

FACTORS AFFECTING ENROLMENT AND
PERFORMANCE IN PHYSICS AMONG SECONDARY
SCHOOL STUDENTS IN GATUNDU DISTRICT, KENYA.

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

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DEDICATION

This work is dedicated to my dear parents Mary Wangui and John Kuria whose constant love, patience and dedication has propelled me this far. And to Grace, my wife and companion for the encouragement that has kept me going, may God bless them.

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Abbreviations and acronyms

AAPT	American Association of Physics Teachers
AAST	Association of American Science Teachers
DQASO	District Quality Assurance and Standard Office
EFA	Education for All
FPE	Free Primary Education
GER	Gross Enrolment Ratio
HOD	Subject Head of Department
KCPE	Kenya Certificate of Primary education: which is the examination done by pupils after eight years of formal education at primary school.
KCSE	Kenya Certificate of Secondary Education: It is an exam done by students after four years of formal education in secondary school.
KICD	Kenya Institute of Curriculum Development
MDG	Millennium Development Goals
MOEST	Ministry of Education Science and Technology
MSS	Mean Standard Score
PI	Peer Instructions
STEM	Science Technology Engineering and Mathematics
TSC	Teachers Service Commission
UNESCO	United Nations Educational Scientific and Cultural Organization

ABSTRACT

This study explores the factors affecting enrolment and performance of students in physics in Gatundu District. The choice of this topic was influenced by the fact that performance and enrolment in physics in Kenya and particularly in Gatundu District has remained low over the years. There are some schools in Gatundu District that do not offer physics at Forms Three and Four levels. This study set out to investigate some of the reasons for this state of affairs. The study was carried out in 12 (twelve) schools sampled from the district, two of which were provincial schools, four district boarding schools and six district day schools. A total of 144 students participated in the study. There were four Form Two students and eight Form Three students from each school. Stratified random sampling was used to come up with the study sample. One physics teacher in Form Three was selected from each school making a total of 12 teachers. The purpose of this study was to identify factors that affect performance and enrolment in physics at secondary school level. The design of the study was descriptive survey. Data was collected using teachers' and students' questionnaires, class observation guide, HODs' interview schedule' and students' achievement tests. These included achievement test scores, students' gender, entry behavior, learners' attitude towards physics, availability and use of teaching/learning resources, teacher characteristics and teaching methodology. The data obtained was analyzed using both descriptive and inferential statistics. Tables and graphs were used to display data. The study found out that availability and proper use of teaching/learning resources improved achievement in physics. There was a significant higher enrolment in schools with enough resources compared with those with inadequate resources. This could probably explain the reason why there was a higher enrolment in physics among provincial schools compared to district schools. Learners who scored good grades in mathematics had a higher achievement in physics. All students who were enrolled in physics had a positive attitude towards the subject and those who performed well had a more positive attitude than those whose performance was low. Boys performed better in physics in District Schools but this was not the case in Provincial Schools where the girls performed better than the boys in the said schools. Students whose lessons were conducted frequently in the laboratory performed better than those who were often taught in their classrooms. The study did not find any relationship between enrolment and performance. The study recommended that teachers should effectively use teaching/learning resources to improve visualization of concepts. Modern teaching methods should also be employed to arouse students' interest and improve their attitude towards physics. Recommendations and suggestion for further research has been made at the end of the study to guide the main stake holders such as teachers, policy makers and trainers in physics.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

Physics is believed to be one of the oldest and probably the most developed of all the sciences (Keith 1996). It addresses the most fundamental questions regarding the nature of the physical universe. It asks questions such as; what is the nature of the universe? What is matter made of? What are the fundamental forces of nature? e.t.c. Because physics is the study of these and other basic questions, it provides the underpinnings for all other physical sciences. 'The ultimate description of all physical systems is based on the laws of physical universe usually referred to as 'the laws of physics' (Nathan et al 1995). Two dominant themes run through the development of physics; (1) matter and energy (2) the search for order and patterns. Secondary school physics is primarily concerned with the study of these two very important themes.

In almost every aspect of life we encounter basic concepts such as matter, heat and pressure. It is therefore not possible to ignore these very important concepts whose knowledge helps to improve peoples' lifestyle. It is unfortunate that our young scientists, especially those in the rural areas, have ignored Physics in favour of Chemistry and Biology (Iraki 1994). The greatest worry is; why are they shying away from this very important subject? What are the consequences of this trend? Is learning the subject is not enjoyable? Is it because they do not understand the concepts and principles taught in physics, or is it because they do not understand the importance and relevance of physics in their future career?

One very important reason why physics form part of the curriculum all over the world is due to its ability to give personal intellectual and physical skills, knowledge and value to the

learner. In learning physics, students acquire process and manipulative skills that enable them to predict accurately the outcome of various events such as the occurrence of the eclipse, effect of gravity and other forces and phases of the moon. A learner with a physics background is able to think both deductively and inductively and approach new situations with a high degree of precision and accuracy. To achieve millennium development goals (MDGs) and realize vision 2030, quality teaching of physics to more young learners has become even more critical. It is with this in mind that central province secondary school heads association came up 'effective 40' program to effectively manage the 40 minutes lesson and hence improve performance in all subjects; physics included.

1.1 Background to the study

Despite the fact that physics has made a significant contribution to life in today's society, a decline in enrolment and performance has been registered over the years (KNEC 2002 to 2011). This trend is more significant especially in schools where the subject has been made optional. Probably there is lack of correlation between what is learnt in class and the real application in everyday life (AAPT 1999). This lack of or little relationship between theoretical physics and application physics may contribute towards the low enrolment and poor performance of physics among secondary school students.

Physics helps the learners to develop critical thinking due to its high reliance on mathematical concepts and logics. The fact that mathematics is not a favorite subject for most low performing students could be a reason why they shy away from physics. Students who perform well in mathematics are likely to enroll and perform better in physics; this could be the reason why the students who enroll in physics have an overall better performance.

The performance of physics like other sciences depends on the spatial ability of the learner (Twoli 1986). Given that boys exhibit higher levels of spatial ability, this may explain the reason why there is a higher enrolment and performance in physics among boys than girls in national exams (KNEC 2010). The socialization of boys among African societies is different from that of the girls. Boys perform more vigorous activities that require activation of the mind as opposed to girls who are subjected to light jobs such as house keeping and cooking. This may explain the reason why boys are likely to develop a more positive attitude towards sciences than girls. According to KNEC (2007-2011), enrolment and performance of physics among girls is always less than that of the boys.

Enrolment of physics in KCSE is always less than that of other science subjects namely chemistry and biology. This trend is even more significant among schools in rural areas than in urban areas (MOEST 2007). Likewise, students in high performing schools are more likely to enroll and perform better in physics than low performing schools. All schools in the district are in the rural setting and enrollment in physics is significantly low as illustrated in Table 1.1

Table 1.1 Students' enrolment in Physics in Gatundu District between 2007 and 2011

Year	Total entry	Physics		Biology		Chemistry	
		Entry	%	Entry	%	Entry	%
2007	3340	870	26.04%	2908	87.06%	3122	93.47%
2008	3634	982	24.96%	3129	86.10%	3364	92.57%
2009	4168	1075	25.79%	3562	85.46%	3904	93.66%
2010	4403	1322	30.02%	3180	72.22%	4226	95.88%
2011	4755	1561	32.82%	3224	67.80%	4520	95.06%

Source; Gatundu District 2007-2011 performance report

As observed in Table 1.1, students' enrolment in physics in the district is quite low. In fact only an average of 25% of the students enrolls for physics. With the assumption that the students who enroll in physics are likely to be the bright ones, the mean score is expected to be very high compared to other sciences. This is however not the case as observed in Table 1.2. There a notable increase in enrolment in both physics and chemistry and a decline in enrolment in biology in 2011 and 2012.

Table 1.2 District mean score for mathematics and sciences from 2007 to 2011

Year	Math	Physics	Biology	Chemistry
2007	2.90	3.82	4.01	3.20
2008	2.72	3.21	3.92	3.04
2009	2.81	4.75	4.39	3.47
2010	2.68	3.47	4.21	3.26
2011	2.47	3.23	3.98	3.08

Source; 2011 Gatundu District performance report

At the district level, performance is tabulated in terms of grades and score as opposed to marks like it is done at the national level. The highest grade that one can attain is an 'A' which is 12 points while the lowest grade is an 'E' with 1 point. It is observed that, though the mean score for all sciences is generally low, the mean score for physics is expected to be much higher given its low enrolment; which is not the case.

Schools with more physics teaching/learning resources and laboratory apparatus are likely to enroll more students in physics and records better performance than those without enough

resources. Enrolment of students in physics over the year has been quite low compared to other sciences (Table 1.1)

At the national level, the percentage enrolment of physics is slightly higher than in Gatundu District as shown in table 1.3. Gatundu District has therefore a lower enrolment compared to the average enrolment for the rest of the country.

Table 1.3 National Percentage enrolments of students in the three sciences from 2002 to 2011

Year	Total Entry	Physics		Chemistry		Biology	
		Entry	%	Entry	%	Entry	%
2002	197140	54180	27.48	187261	94.99	177328	94.79
2003	206489	56497	27.36	198747	96.25	186403	90.27
2004	220951	60082	27.19	214520	97.09	200797	90.88
2005	259331	69424	27.00	253464	97.74	234975	90.61
2006	252053	72499	29.95	236901	97.87	217928	90.03
2007	270629	83273	30.77	236761	97.29	245911	90.87
2008	300794	92648	30.80	296360	98.5	271735	90.33
2009	338834	104188	30.74	328922	97.07	299304	88.33
2010	357488	109072	30.51	347378	97.17	315063	88.13

Source; (2002 to 2011 KCSE Examination Report Books)

It is clear from Table 1.3 that enrolment in physics over the years is way below other science subjects. This trend is a cause of worry to science teachers, educators and the country in general. It was therefore the intention of this study to look into the probable cause of this low enrolment in physics and try to grope for possible solutions to this problem.

Another key concern in students' enrolment is gender disparity. Table 1.4 shows a clear disparity of students' enrolment in physics where female students' enrolment is slightly below a third.

Table 1.4 National Enrolment of physics by gender from 2002 to 2011

Year	Entry	Females		Males	
		Number	%	Number	%
2002	54180	15312	23.26	38868	71.74
2003	56497	16094	28.48	40403	71.52
2004	60082	16966	28.23	43116	71.77
2005	69424	19288	27.78	50136	72.28
2006	72499	21376	29.48	51123	70.52
2007	83273	23767	28.54	59506	71.46
2008	92648	26322	28.41	66326	71.59
2009	104188	29233	28.05	74955	71.95
2010	109072	29964	27.47	79108	72.52

Source (2002 to 2010 KCSE Examination Report Books)

Over the years there were more males than females who enrolled in physics. In fact, the number of boys who enrolled in physics each year was more than double that of the girls. Table 1.4 clearly shows there has been a gender difference in enrolment in physics over the years. This difference will ultimately be reflected in the professions that require physics such as engineering and physics education. This problem is expounded by lack of role models in the subject for the girls therefore strengthening the stereotype that “physics is meant for boys” (Torongey 1986)

Table 1.5 Performances of physics compared by gender from 2002 to 2011

Year	Gender	Math	Physics	Chemistry	Biology
2002	Females	16.44	26.61	22.05	24.58
	Males	22.53	30.89	26.62	28.34
2003	Females	16.05	29.07	24.04	27.23
	Males	22.10	32.28	29.30	31.35
2004	Females	15.39	31.41	25.79	32.91
	Males	21.34	35.25	30.43	37.64
2005	Females	12.97	32.85	24.54	27.24
	Males	18.49	35.99	29.44	30.01
2006	Females	15.75	39.07	22.56	25.00
	Males	21.87	40.42	27.01	29.84
2007	Females	15.74	39.04	22.65	38.99
	Males	23.10	42.23	27.69	44.70
2008	Females	17.71	26.32	20.93	28.49
	Males	24.31	36.95	24.27	32.01
2009	Females	18.11	29.93	17.56	25.15
	Males	23.63	31.88	20.43	29.08
2010	Females	19.71	33.46	22.80	26.99
	Males	25.75	35.76	26.62	31.24

Source; (2002 to 2010 KCSE Examination report)

Performance in physics and biology has improved over the years, but this trend has not been the same for chemistry which has oscillated between 22 and 30 marks (Table 1.3). Performance in physics is generally better than both chemistry and biology except in 2004 and 2007 where biology was performed better than physics. This could be attributed to the low enrolment in physics and the fact that the few students who choose to enroll in physics are the bright ones. However, considered from the fact that enrolment in physics is very low compared to other sciences, performance is expected to be far much better than other sciences, which is not the case.

1.2 Statement of the Problem

A population without a physics background may fail to understand and make use of every day's phenomena such as understanding the causes of wind, solar system, high dams and geothermal energy. This may lead to a low level of technology and therefore a low standard of living among the people.

The fact that a small percentage of students opt to enroll for physics in Form Three despite all the three science subjects being treated as equal in terms of time allocation and mode of assessment, poses a great challenge to the overall qualification of the general work force. Despite the fact that enrolment in physics has been very low, performance has been consistently poor. The fact that selection of a course has a direct relationship with the student's achievement in the subject could be the reason why physics is less appealing to many students especially the weak ones.

Poor performance and low enrolment has adversely affected particularly girls than boys with the trend being that, very few girls opt to pursue physics and the few who enroll generally perform poorer than their male counterparts (KNEC annual report 2002 to 2011). This fact

alone might have contributed to the gender disparity in science and engineering courses among secondary school students. This trend is also reflected in the work place where we have very few female physics teachers, scientists and engineers (Lyons 2005).

Despite a general increase in enrolment in secondary schools due the free primary school education (FPE) and free day secondary school introduced by the government in 2003 and 2008 respectively, enrolment in physics has remained low all over the country and Gatundu district has not been an exception.

In instruction terms, low enrolment at secondary school level is bound to affect the production of physics teachers at higher levels. Indeed, this is the case in many schools across the country (Nderitu 2007).

A few schools that do not have a physics teacher have completely removed the subject from the timetable. In fact, out of the 56 schools that registered for KCSE in 2009 in Gatundu District, 22 schools did not present any candidate for physics. This trend is worrying and should be urgently addressed. This study will therefore look into the factors that are associated with enrolment and performance of physics in Gatundu District which will be assumed to be a replica of many other schools in the rural areas in the country. It is a general expectation that the findings of this study can be used to improve enrolment and performance of physics in the district and possibly throughout the country.

1.3 Objectives of the Study.

The general purpose of this study was to examine the factors affecting students' enrolment and performance in physics at secondary school level. The specific objectives were;

- i. To establish whether students' attitude towards physics affect enrolment and performance.
- ii. To establish the relationship between students' entry behaviour and performance in physics.
- iii. To examine how teachers' characteristics and teaching methodology affect enrolment and performance
- iv. To establish the relationship between learners' mathematical/spatial ability and its effect on performance and enrolment.
- v. To look into what extent the students' gender affect the choice of science subject and performance in physics

1.4 Research Questions

The study sought to answer the following research questions

- i. Does students' attitude towards physics affect performance and enrolment?
- ii. To what extent does students' entry behavior affect enrolment and performance in physics?
- iii. Do the teacher characteristics and teaching methodology influence the choice of science subject by Form Three students and performance in physics?

- iv. To what extent does the students' mathematical/spatial ability affect students' performance and enrollment in physics?
- v. Is there a significant difference in performance and enrolment in physics between girls and boys?

1.5 Purpose of the Study

The purpose of this study was to examine the main factors affecting school enrolment and performance of physics in Gatundu District.

1.6 Significance of the Study

The aim of this study is to contribute towards the improvement of teaching and learning of physics at secondary school level.

The impetus of the study was derived from the fact that, the extent of students' opportunity to learn physics bears a direct relationship to the factors that were considered in this study. The results of this study will provide an insight on the necessity of modifying the said factors to enhance performance and enrolment in physics.

Most of the previous studies were based on limited outcome measures and recommended more research on other areas, subjects, and using different approach (Orodho 1996, Miheso 2002 and Nderitu 2007).

Education stakeholders will find the findings of the study beneficial in the course of developing and improving the curriculum especially at K.I.C.D. On the other hand, M.O.E.S.T in conjunction with TSC will use the findings of the study to improve teacher training and quality of teaching resources.

The curriculum implementers especially the teachers and DQASO, will find the results of this study beneficial since by getting to know the factors that affect performance and enrollment of student in physics, measures can be taken with an intention of improving the same. Since the teacher plays a pivotal role in the course of instruction, well trained teachers will go a long way in improving their teaching methodology and therefore improve enrolment and performance in physics. Most schools in Gatundu district have had a dismal performance in the past physics KCSE examinations and the finding of this study will go a long way in assisting educationists in the district improve enrolment and performance in physics in the district

Teacher trainers will therefore be expected to use the findings of this study to improve the training of teachers.

1.7 Scope and Limitation

The research was carried out in 12 secondary schools of Gatundu District and data collected from H.O.Ds, physics teachers and Forms Two and Three students in March 2012. Due to the limited time that was allocated in researching for the significance of these factors, this study might fail to be exhaustive and could leave out some important variables that could be relevant in this research. The sample selected for the study might fail to be the true representative of the whole population of Gatundu District. Since all the schools in the district are in the rural areas and the terrain is very rough, traveling might be difficult and this may affect the final outcome of the study. Financial constraint is another factor that might adversely affect the depth of this study. With enough resources, this study could be more comprehensive and the sample size increased to improve reliability.

1.8 Assumptions of the study

The sample of schools, students and teachers selected for this study was assumed to be the true representative of the whole population of the said stakeholders in the district. It was also assumed that the participants responded to the research items in all the research instruments accurately and honestly. The research items selected in all the research instruments used was assumed to accurately measure the extent to which the identified factors contribute towards both enrolment and performance of physics. It was also assumed that the time allocated for the study of physics is uniform across all the sampled schools.

1.9 Theoretical Framework

The primary goal of physics education research is to develop pedagogical techniques and strategies that will help the student learn more effectively. Research often focuses on learning more about the common misconceptions that the learners have about the natural world before being subjected to formal learning of the subject. Techniques are then devised to help the learners overcome these misconceptions. A variety of interactive learning methods (also known as active learning methods) and laboratory experiences have been developed with the aim of improving physics performance. The recognition of the value of interactive engagement over more passive lecturing method has been promoted in large measure to minimize learner's misconceptions. According to a committee on undergraduate science education 1992, some of the science misconceptions include;

- preconceived notion
- non-scientific beliefs such as witchcraft and hallucinations
- conceptual misunderstanding

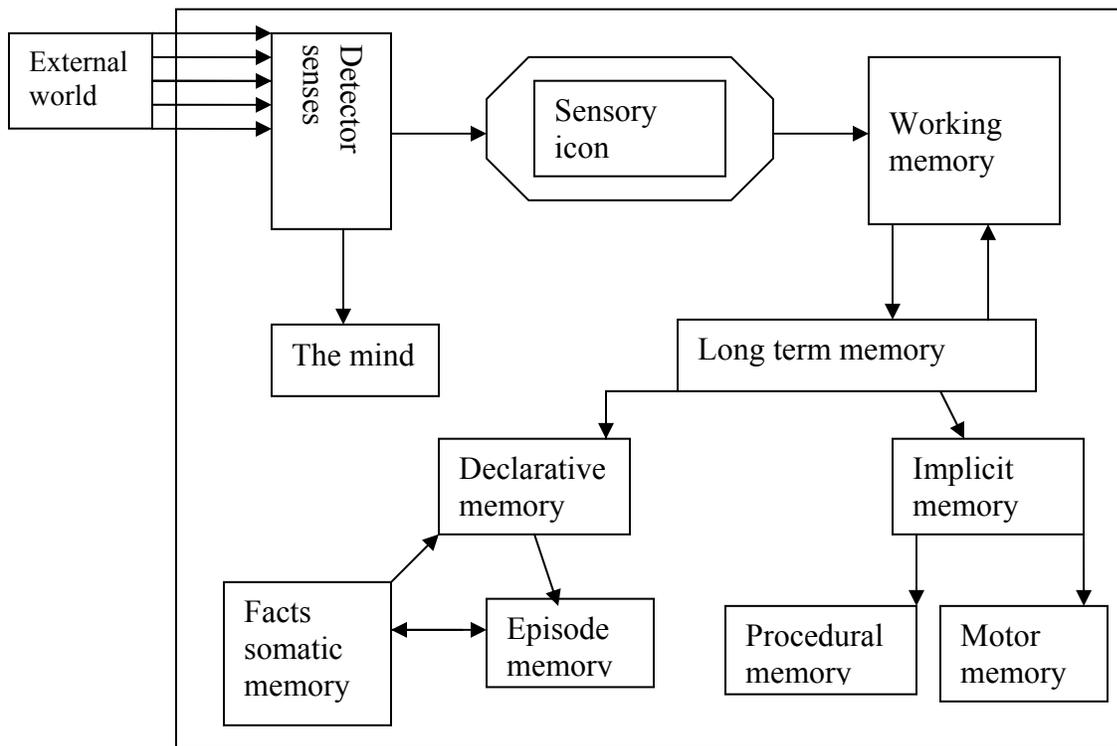
- vernacular misconceptions
- factual misconceptions

This study was guided by Redish E.F (2004) theoretical framework for physics education. Through this framework, three fundamental concepts are inherited from neuroscience; activation, association, and enhancement inhibition. At the cognitive level, analogous structures recognized by cognitive researchers include:

- recall and priming
- linking compilation and spreading activation
- control and executive functions

According to Redish (2004), there is a close relationship between the mind and the external world as conceived by neuroscientists.

Fig 1.1 A map of the structure of the human memory



Source; <http://mazur-www.harvard.edu/research>(2004)

In this model, the human mind is divided into two major parts; the working memory and the long term memory. This model was conceived by neuroscientists with the assumption that all phenomena are describable as arising from fundamental physical objects and the laws that we know.

All cognition takes place as a result of the functioning of the neurons in the individual brains. The neurons connect to each other and send information to each other via pulse trains when they are activated. These neurons may be at various stages of activation and can link to a single neuron. Signals from one or more neurons can result in the activation of linked neurons. Information flows from a set of neurons (e.g. sensory neuron) to processing neuron and back (feedback) learning appears to be associated with a growth of connections (synapses) between neurons. In this model, neuroscientists believe that there is a real world

out there and the learner creates his or her own interpretation of that world based on sensory input. New knowledge is built on the bases of existing one (constructivism)

The memory is fundamentally seen as two distinct components; the working memory and the long term memory the working memory can only hold a small number of data blocks and often lasts for few seconds without specific activities to prolong it. The long term memory contains vast quantities of facts, data and rules for how to use and process the data. The long term memory is highly stable and can store data and information for decades. Getting information from the short term memory to the long term memory requires repetition and active use of the sensory organs. On the other hand, getting information from the long term memory to the working memory may be difficult and time consuming especially if the information is not associated with anything around the environment of the learner. The working memory is basically the part of the brain activated when we are thinking of something. It is fast but can only handle a small chunk of data at a time (Muller M.M. in Redish E.F. 2004). Early experiments showed that the working memory can handle 5 to 9 items at a time. The working memory does not however work independently of the long term memory. The interpretation of and understanding of items in the working memory depends on their presence and association in the long term memory

To understand how learning takes place, we must understand how information is stored and how to get it or part of it from the brain (recall).

1.10 Conceptual Framework

Enrolment and performance in physics is dependent on many variables. Some of these variables will form the bases of investigation in this study. It is common knowledge that

availability and appropriate use of resources greatly enhance enrollment and performance. Some intervening variables such as the school environment and administration will also come into play.

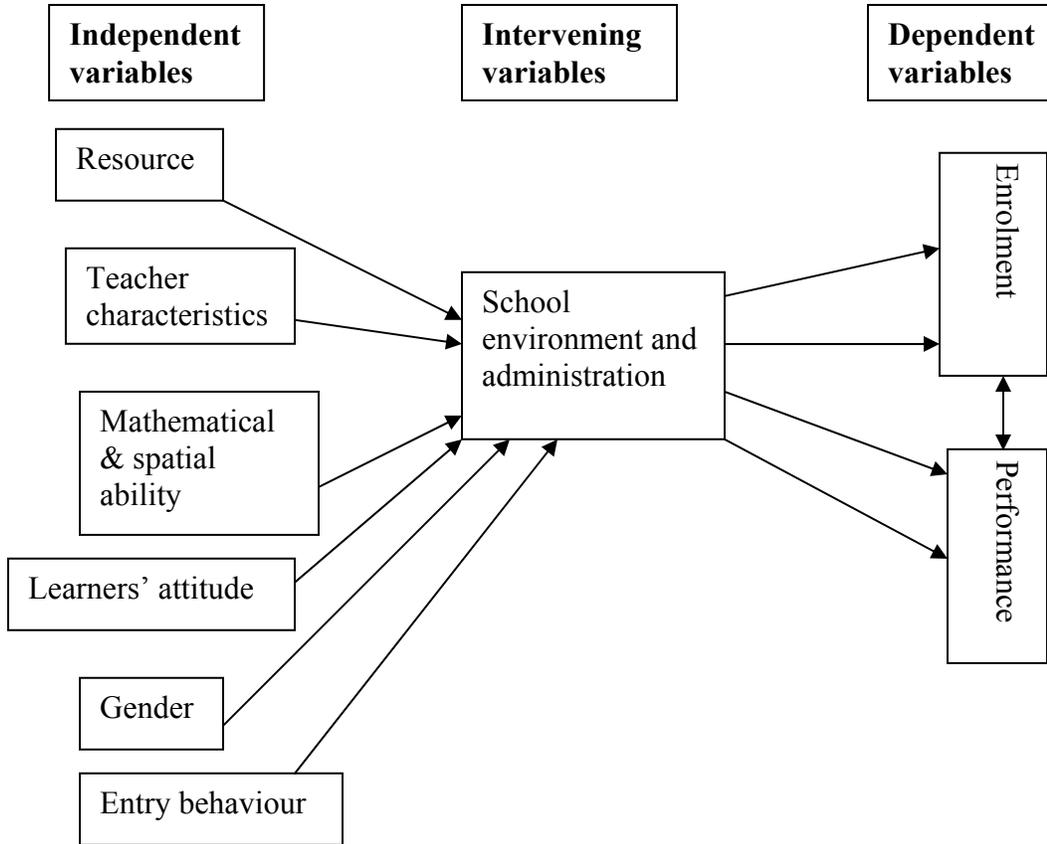


Fig 1.2. The concept model of the study

The teacher forms the link between learners and the material to be learnt, the mode of presentation of these materials is very important and ultimately influence enrolment, performance and learning outcome. The method used to relay information greatly affects reception by the learner. The personality and teacher's teaching style affect the coding of information by the learner (Flanders 1965). Teachers who showed acceptance of students' feelings and praised them were associated with more positive attitude and higher achievement by the pupils.

Most physics concepts and relationship between concepts are stated in mathematical statements (Embeywa 1995). Mathematical ability of a student therefore may affect performance in physics. Students with higher mathematical ability are therefore more likely to enroll and perform better in physics than those with low mathematical ability (Hudson 1989). The study will therefore seek to establish the extent to which mathematical ability affect the choice of science subject selected in Form Three and how he/she performs in the subject.

It is evident from KCSE performance report books that more boys than girls enroll in physics. Performance of physics among the girls is also lower compared to their male counterparts. Research has shown that boys have a higher spatial ability compared to girls (Twoli 1986). This study will seek to establish the extent to which the gender of a student affects his/her choice of science subject and how he/she performs in the subject.

In the current 8-4-4 curriculum, physics in Form One and Two is compulsory. In Form Three, students are allowed to choose at least two sciences. Most of the students opt for Chemistry and Biology.

One significant intervening variable between factors affecting enrollment and performance is the school learning environment which is to a large extent influenced by the school administration. When the school learning environment is conducive, there is a likelihood of higher performance in all subjects, physics included. The school administration influences the quality and kind of learning/teaching resources available in the school and is responsible for teacher's motivation.

1.11 Operational Definition of Terms

- Constructivism** -Knowledge must be constructed on the existing experiences by establishment of new associations, transformations and processes.
- Effective 40** -Central Province Heads Associations' initiative to effectively use the 40 minutes allocated in a lesson.
- Enrolment** -Number of students who choose to pursue physics after completing Form Two.
- Factors** -Determinants that will be identified and assumed to affect enrolment and performance in physics.
- Other sciences** -This will mean Biology and Chemistry.
- Performance** -Used interchangeably with achievement to mean the level of acquisition of knowledge based on KCSE examination and achievement test score.
- Vision 2030** A Kenyan government initiative to improve the living standard of all citizens and eliminate poverty by the year 2030
- Gross Enrolment ratio (GER)** The ratio of total enrolment regardless of age to the population of the age group that officially corresponds to the level of education.
- Teaching style** Teaching strategies, tactics and methods employed during instructions

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter focuses on factors that are perceived to affect students' enrolment and performance in physics. These will include students' attitude, entry behaviour, teaching methodology, mathematical and spatial ability and gender. Since many students perceive physics to be a difficult subject ([http://www. Adelaide now.com/math-science](http://www.AdelaideNow.com/math-science) 2010), scholars in physics education have made quite a deliberate effort to improve the way physics is taught in order to try and eliminate the perception that physics is difficult. This perception is very common not only among secondary school students but also among undergraduate science teachers (Chiappetta et al. 2002). The most common problem confronted by secondary school physics teachers today, is that physics is perceived to be a difficult subject which deters them from opting to study it beyond junior high school level. As a result, students are missing the opportunity to study many interesting and important concepts that could provide them with an insight into the physical world and the universe in which they exist (AAPT Journal 1997). Of those who are sufficiently motivated to study the subject, many find physical concepts abstract and difficult to grasp. Misconceptions about physical phenomena persist among physics students despite the frequent use of experiments to verify the theories (Lyons 2005).

The current emphasis on constructivist approach to learning has brought less conventional strategies such as prediction, observation and explanation (P.O.E.) into the classroom to motivate students to learn and reconstruct concepts using phenomena that have the potential to create cognitive dissonance. Young (2007) contends that the teaching of physics should

shift from demonstration to problem solving in order to promote the construction of physics concepts. The review in this chapter focused on factors that were assumed to affect enrolment and performance in physics among secondary school students.

Much has been written on performance and enrolment in physics in other areas but not in Gatundu District. In view of this, this chapter will deal with the studies and research that have been done by educationists and other researchers in other areas with a view to improve performance and enrolment in physics.

The study will analyze the students', practicing physics teachers' and science HODs' views relating to the problems of poor performance and low enrolment in physics with an aim of searching possible solutions. The objective of this chapter is to give an insight into the conceptual framework of the study. Other possible factors researched by other scholars will also be highlighted

2.1 Modern trends in teaching physics and teacher characteristics

Teaching in general has shifted from the traditional demonstration and showing method to a more hands-on- approach as advocated by the SMASSE project (2003). Physics educators have advocated for the need to use student based activities to enhance retention. Pedagogy should therefore encourage the use of student centered approach to teaching of science subjects. Integration with other methods when teaching sciences should also be encouraged because not all areas in physics can be taught through activities. One such approach is mastery learning approach (MLA) (Wambugu et al 2007). One problem with conventional method of teaching physics lies in the presentation of materials (Mazur et al 2006). Frequently, the materials learned in physics come right from the text books or lesson notes. That the

traditional presentation is nearly always delivered as a monologue in front of a passive audience compounds the problem. Only exceptional teachers are able to hold the students for a long time without actively involving them and even then, the amount of retention is way below average (Flanders 1965). Retention of materials learned is clearly as a result of active participation by the learner and close association with the learning materials. It is also important for the teacher to start with what the students have in their cognitive structure and build on it (constructivism).

Serious teachers should teach with their content in the mind and their students at heart (Bhatt 2007). What all great teachers have in common is the love for their subject and an obvious satisfaction in arousing this love in their student and ability to convince them that what they are being taught is deadly serious.

Today science educators continue to value the importance of laboratory experiences and view the laboratory as an integral part of carefully planned science unit (Singer et al. 2005). The teaching of physics through practical experiments has however been established for a long time to improve students' acquisition of science process and manipulative skills. Practical work forms a key component of teaching physics both at secondary and college level (Iraki 1994, Sneddon et al. 2009). Laboratory work is a unique type of science instruction since it involves first hand experiences; it permits the students to participate in science as a way of thinking and investigating as well as developing better understanding of science concepts, principles and theories (Freedman 1981). Instructions using laboratory work provides concrete authentic experiences that aid students in comprehending phenomena that are under study in the curriculum and discussed in the classroom. It has been accepted since the 19th century that physics cannot be taught without direct practical work either in form of teacher-

led demonstration or class experiment by the pupils. Science laboratory work seems to leave a lasting impression. Many of them enjoy laboratory work and prefer it to other modes of learning (Gardner et al. 1990). However, if laboratory work is to promote productive learning experiences, many important science education goals must be incorporated into the instructions such as the nature of science, science as inquiry and conceptual development of science (Blosser 1991). Huddson (1996) in Sneddon (2009) suggests that the reason behind teaching of physics in a laboratory stems from the fact that teachers want to teach science subjects in an environment that mimics the way science is in ordinary day life.

Through in depth study of simple physical systems and their interactions, students gain direct experience with the process of science starting from their own observations. As observed by McDermott (1991), students develop physical concepts and interpret different forms of scientific explanatory models with predictive capability if this happens during active class participation. Learning involves not just teaching the concepts but also erasing misconceptions learnt earlier (Lillian et al 1996). One of the most recent instructional methods developed by Mazur group is peer instruction (PI) which involves learners sharing with others what they have learned focusing their attention on the underlying concepts (Mazur et al 2006). These modern trends in teaching are likely to determine the mode of instruction employed by teachers and consequently affect enrolment and performance in physics.

2.2 Enrolment in physics

Previous studies have shown that fewer numbers of students are opting to study physics beyond junior high school level (Nderitu 2007). This trend is reflected at the university level where very few students enroll to study physics and engineering related courses (Lyons 2005).

For many students, physics is a subject that is perceived to be difficult and that should be dropped as fast as possible (Lyons 2005, Sperandes et al 2005). Low enrolment is therefore a course of worry not just for physics educators but also for other stakeholders in the economic sector. The number of girls who enroll in physics is significantly lower than that of boys. Gender right activists have however succeeded in enshrining a law to the effect that school subjects should not be stereotyped (MOEST 2007, Torongey 1986). Though this does not completely seal the gap, educators are trying to improve the situation by encouraging the girls to take chemistry and physics (MOEST 2007 in Gender policy in education)

The problem of low enrolment in physics has persisted for decades as was reported by times magazine on 24th may 1993 page 17;

Young Turks of every generation for the past 100 years have proclaimed the imminent end of physics but every advance has only opened new vistas of mysteries. There is no reason to think we even know the right question leave alone ultimate answer. The currency of science is not truth but doubt.

In a study carried out by (Lyons 2005) in Australia, many students regarded junior high school science as irrelevant, uninteresting and difficult leaving them with few intrinsic reasons for enrolling in senior school physics courses. The decline in enrolment in science

subject in general and physics in particular, is promoting question about the future level of scientific literacy and technological expertise (UNESCO 1973).

There is a significant relationship between science enrolment pattern and eclectic range of factors including achievement levels and social economic status (Fullarton et al. 2001 in Lyons 2005). This therefore begs the question; which other factors affect enrolment and performance?

2.3 Performances in physics

Despite the fact that the physics syllabus has constantly been revised with a view to make it more appealing to the students, performance in the subject has not improved (KNEC 2007).

There is a very close relationship between performance and enrolment (Nderitu 2007, Lyons 2005) student's poor performance in a national exam is likely to cause a low enrolment in the preceding classes. Probably this is the reason why there has been a low enrolment in physics.

Over the years, there has been low performance in physics though the mean score for chemistry has been slightly lower than physics; there has been a great disparity in enrolment between the two subjects in favour of chemistry. (KNEC 2002). It may not be clear whether performance in a subject enrolment but perception of difficulty in a subject is also likely to affect enrolment.

2.4 Gender differences

According to KNEC examination report (2002) and the Gender Policy in education report (2007), the overall gross enrolment ratio GER has improved in the past few years (MOEST 2007). This has however not been reflected in physics where the enrolment ratio is 1:3 in

favour of boys as compared to the overall enrolment ratio of 9:10 in favour of boys (MOEST 2007)

The performance of physics among the girls has been quite low compared to that of boys (KCSE performance report 2002 to 2007). This has been a cause of worry for gender activists (Onyango 2003)

Many researchers have investigated the reason for low enrolment and achievement in science among the girls. Some of the reasons given were that; ‘ in developing countries like Kenya, boys were likely to be involved in outdoor activities such as herding animals, fishing and hunting, while the girls’ activities are likely to be domestically oriented involving washing and cooking.’ These activities disadvantage the girls from pursuing science related courses as they do not “tinker” (Twoli 1986). It is with this in mind that Iraki (1994) claimed that the idea of cars for boys and dolls for girls should be discouraged since it placed the girls at a risk of failing to pursue science oriented courses. Girls in most cases opt to take subjects that do not require high order thinking skills such as secretarial, home science and catering. The girls, especially those in day schools are likely to be involved in helping their parents after school and may therefore not have enough time for study. (Onyango 2007). Parents in African societies allocate more house work to their daughters than to their sons (Chege 2001) Girls seem to shy away from physics due to the perception that the subject has many ‘risky’ experiments (Claxton 1991). Perhaps the essential ‘maleness’ of the subject puts the girls off. Girls seem to view physics as a male subject thus opting for biology and chemistry (Nderitu 2007). However, all the sciences require performance of experiments and practical lessons to aid students’ psychomotor and acquisition of science process and manipulative skills.

Enrolment and Performance in physics and other sciences may be affected by among other factors ability or inability to develop psychomotor skills good enough to handle practical examinations (Iraki 1994). When marking KCSE science examination KNEC has a rule that for a student to have a good pass in science, a pass in the practical paper is compulsory. This requirement is likely to cause the girls to perform poorly in sciences; physics included, since they are not adequately prepared to handle practical questions (Nderitu 2007).

Girls especially those in mixed school avoid getting into contact with laboratory apparatus fearing that they will mishandle them. Boys in these schools also play a role in denying the girls an opportunity to handle the apparatus. This could be due to dominance of the boys brought about by the social upbringing. (Iraki1994).

The national gross enrolment ratio (GER) has however improved in the recent past from 44.8% in 2002 to 57.6% in 2006 (Gender Policy in Education 2007). Affirmative action has been used as a corrective measure to curb the gender imbalances. The GER in secondary schools has however remained low at less than 30% throughout 1990s and part of early 2000. It however improved from 2004 to 2006 (MOEST 2007).

Boys tended to perform better in key subjects such as mathematics, science and English but girls performed slightly better in Kiswahili. In a study conducted by Onyango (2003), girls poor performance in key subject especially those in day schools was due to the fact that they had other chores that they perform at home after they leave school thus limiting their study time.

Students perceive physics oriented courses such as engineering and architecture to be masculine while biology is viewed to be feminine. This image is also perpetuated in schools where physics teachers and students are predominantly male (Torongey 1986).

There is higher spatial visualization ability among the boys than among the girls (Alonso 1998). This could explain the reason why boys perform better in sciences than girls. In fact, given a choice, most girls opt to study biology (Clerk 1972)

2.5 Mathematical and spatial abilities

The link between mathematics and physics is a strong one (Hutchings 1973). In fact, there are some topics in physics that appear exactly the way they are in mathematics such as linear motion, trigonometry and vectors. Students who score high in mathematics are likely to enroll and perform better in physics than those who do not perform well (Lyons 2005). The most distinctive feature of modern physics is its use of mathematics and experiments, in fact its joint use of them. The business of mathematics in physics has to do with construction of subsequent analysis of concepts that are applicable to any practical or theoretical situation (Hudson 1989).

Spatial visualization ability is the ability to mentally manipulate three dimensional figures (Alonso 1998). The theoretical aspect of mathematics calls for spatial visualization ability which is a significant contributing factor to science achievement (Twoli 1986).

Generally, boys have higher spatial visualization ability than girls according to standard achievement tests done by Alonso (1998). He also noted that spatial visualization ability tended to be higher among young adults than the older adults. Embeywa (1995) argues that, since mathematical formulas are expressions of formal relations among constructs, by appealing to a set formula, the physicist is able to undertake both extensive and intensive investigation of various logical relations among constructs without the burden of each time looking at individual events from which the constructs were abstracted. The use of

mathematical formulae according to Embeywa (1985) constitutes a saving of mental energy. It provides for an economical use of mental effort. Physics students tend to treat mathematical relations as symmetrical entities by distinguishing dependent from independent variables.

Physics, like mathematics should be taught with all efforts being made to ensure that mathematical expressions introduced by physics teachers are not ambiguous and provide a direct relation with the physical world and direct environment of the learner (Lerner 1989).

Galileo noted that, mathematics is the language in which nature expresses its laws. Most experimental results in physics are numerical measurements. Theories in physics use mathematics to give numerical values to match these measurements. Physics relies upon mathematics to provide the logical framework in which physical laws may be precisely formulated and predictions quantified. (<http://en.org/wiki/physics> 2009).

2.6 Attitude towards sciences

Pupils feelings are very important when teaching and have a strong effect upon the amount of work, the effort put towards and the learning that is acquired (Callahan 1971). This means that positive attitude plays a significant role in learning physics since it determines the amount of time and effort dedicated to the subject and this is likely to be reflected in performance (Nderitu 2007).

The bureau of education research of Kenyatta University, reporting Aiken et al (1987), noted that “there is a modest positive relationship between attitude and achievement in elementally schools; it would be interesting to find out what happens at secondary school level.”

Students' attitude towards a subject may also be defined by the teacher characteristics. Students who were taught science by female teachers had a more positive attitude towards science than those taught by male teachers. Female teachers were found to have a more positive attitude towards teaching science and more receptive to change than their male counterparts. While male teachers had a higher academic achievement, students perceived them to be more difficult (Wasanga 1996)

Low academic achievement is likely to lead to low enrolment due to the learner's low attitude in the subject. Although there is a relationship between attitude and academic achievement, one cannot be certain whether negative attitude causes low performance or whether performance causes low attitude (Twoli 1986). It is however possible that consistent low academic achievement may lead to discouragement and consequently negative attitude. Past performances may have an impact on how learners perceive a subject (Orodho 1996, reporting Okpala et al 1988). Some may believe that since they never performed well in the past they may as well fail in the future and vice versa.

The attitude of students towards sciences, their grades and their career expectations, have been identified as possible contributing factor to achievement in science. (The) few students who reported that they liked physics very much tended to perform better than those who did not like it (Orodho 1996).

To feel positive towards a subject, one has to actualize one's ability through achievement. In other words, it is primarily the acquisition of proficiency in a subject that leads to positive attitude in that subject. (Aiken et al 1987). It follows therefore that students who have been known to do better in physics will hold a more positive attitude in the subject since good performance in the subject area reinforces the attitude towards that subject. Persistent low

performance in a subject may lead to a low attitude in the subject hence lowering the academic learning time in that subject and a consequent lower performance. A study carried out in Australia in August 2010 noted that high school students perceived mathematics, science, engineering and technology as too hard, boring and irrelevant. (<http://w.w.w.Adelaide.now.com/math-science> 2010)

2.7 Entry behavior

These are the specific skills the students are supposed to have prior to the beginning of instruction. Entry behavior for the purpose of this study will mean marks obtained in science at KCPE and the previous grade attained by the student before coming to the current class. Entry behavior is determined to a large extent by the amount of quality time a student spends studying that subject. Performance and enrolment in a subject may be defined by the learners' entry behavior and previous exposure to the content of that subject (Orodho 1996, Nderitu 2007). The quality of grades in the KCPE science paper is likely to a certain extent influence the performance of physics, chemistry and biology. There is a strong correlation between mathematics grades and achievement in physics (Hudson et al 2006)

2.8 Resources

Various definitions for instructional resources have been put across. Romiszowski (1986) defines instructional resources as "teaching aid". He states:

A teaching aid must as the name suggests aid in teaching of a topic. This implies two things; it does not do the whole job, part of the job is done by other methods usually the human teacher. The aid is controlled by the teacher. (Pages 142)

This basically means that an instructional resource is an aid and helps in learning and therefore should not be treated as anything more than that. The teaching aid should not and must not replace the teacher.

Resources provide an activity hands on approach to learning science and to engage students in a genuine pursuit of science. The activities provide a meaningful interaction between students and their world in a manner that encourage sound scientific reasoning (Herr 1994)

There are several types of instructional materials available for use in schools. These include printed materials such as books, newspapers and charts. There are also audio-visual aids such as radio broadcast, television and magnetic tapes. Laboratory apparatus also play a crucial role in teaching and learning of science.

Proper utilization of teaching/learning resources plays an important role in students' acquisition of knowledge. Though it is obvious that teaching/learning materials can improve performance, appropriate utilization of the same can significantly improve performance in a subject. There are several factors that influence the type of resources to be used key among them is their availability (Romiszowski 1986). Lack of science learning facilities was associated with poor performance and low enrolment in sciences among primary school pupils (Wasanga 1996). The use of instructional resources is even more critical when teaching girls to cater for their low spatial ability (Mbirianjau 2009).

2.9 Summary

As has been expressed in this literature review, most research on performance has been done in mathematics (Eshiwani 1992, Hutchings 1973, Miheso 2002, Kungania 2006, and Onyango 2003). It is however clear that most of the factors affecting performance in mathematics are likely to do the same to physics. In other research done in physics (Nderitu 2007), a limited number of research instruments were employed, however, in this study, a total of five research instruments were used which significantly improved the overall reliability of the study. Orodho (1996) looked into the factors determining achievement in science (chemistry and biology) but left out physics. Though none of these studies have been conducted in Gatundu District, various researchers have recommended this study in other areas of the country to compare the outcome (Nderitu 2007, Miheso 2002)

CHAPTER THREE

METHODOLOGY

3.0 Introduction

In this chapter, the methodology and the research design that was used in the data collection and analysis will be discussed. The chapter will also describe the location where the study was carried out, population, sample and sample selection. The research instruments that were used and how they were administered will also be discussed. An attempt will also be made to describe how both piloting and actual data collection was done

3.1 Research design and process

The research was designed as a descriptive survey to look in to the factors that influence enrolment and performance of physics at secondary school level. The researcher started by piloting the research instruments in two schools to test their validity, relevant changes were then made on the instruments and improvements made to increase reliability. A stratified random sampling of the schools in Gatundu district was done to come up with the schools that were involved in the study. The reason for using stratified survey was to allow the researcher to include different categories of schools. At least one practicing physics teacher in the selected schools participated in the study by filling in a questionnaire. Only six teachers were observed in a physics lesson due to some constraints. Science HODs participated through an interview. The collected data was then analysed, discussed and then presented in form of graphs, charts and tables. A summary, conclusion and recommendations were then drawn from the study (Fig 3.1)

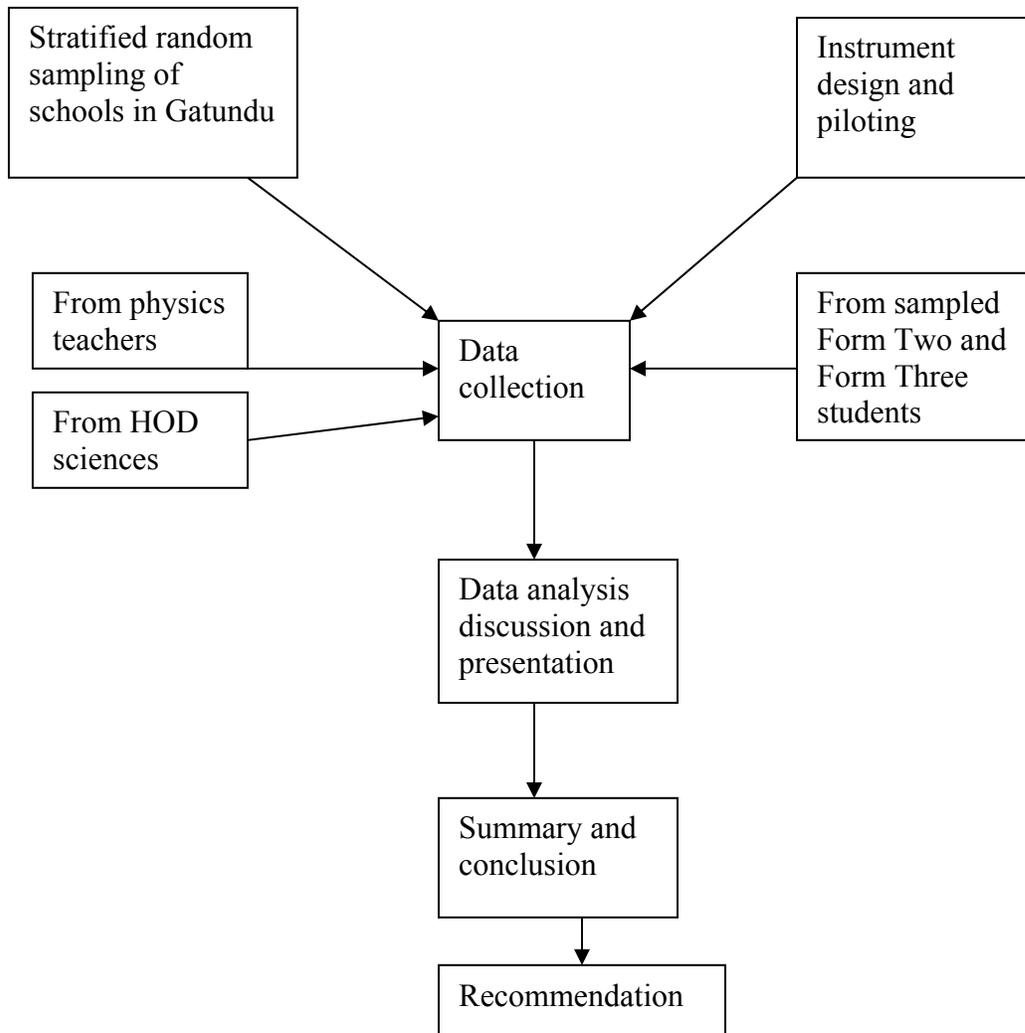


Fig 3.1 A Concept Map of the Research Design and Process

3.2 Location of the study

As stated earlier, the study was carried out in Gatundu District of Central Province about 50 KM from Nairobi. The district comprises two newly created districts; Gatundu North and Gatundu South. Both districts have common cultural and economic back ground. The main economic activities are tea, coffee and dairy farming. The reason for selecting Gatundu District is due to its accessibility to the researcher and the fact that most of the schools in the district have a low enrolment in physics and the performance in the subject has been poor over the years. All the schools in this district are in the rural areas. Out of the 56 schools in the district, only two are provincial schools all the others are either district day or district boarding

Most of these schools have had a dismal performance in the past physics KCSE examinations and the finding of this study will go a long way in assisting educationists in the district improve enrolment and performance in physics in the district

3.3 Target population

The subject of the survey comprised samples that were drawn from the population of trained practicing teachers and their students. The selected sample was considered to be a representative of the population in the whole district. A total of 12 (21.4%) schools out of the 56 schools in the district were sampled for the purpose of this study. The respondents included heads of departments, physics teachers and students so as to make the study diverse and representative. Actual data collection took place in March 2012 and the previous exam results was taken as the end of year exam result for 2011

3.4 Sample and sampling procedure

As has been stated earlier, the study involved all practicing physics teachers in the sampled secondary schools, all science HODs and randomly sampled students from Forms Two and Three. Four Form Two students were selected on the basis of the fact that all of them take physics while in Form Three eight of those taking physics were sampled.

The researcher used stratified random sampling since both day and boarding schools participated in the study. A sample size of 10% to 20% is acceptable in a descriptive survey (Geneserth et al 1987). This study used 21.4% of the total population of the schools in the district. It was then assumed that the sample collected was representative of the whole population in the district. The justification of using stratified random sampling was to ensure clear variation of independent variables in order to find out whether the said factors affect performance and enrolment in physics in the same way for the different kind of schools.

Table 3.1. Population sampling grid

Type of school	Total no of schools	No of schools sampled	Form Two students	Form Three students	Physics teachers	Science HODs
Provincial school (girls)	1	1	4	8	1	1
Provincial school (boys)	1	1	4	8	1	1
District boarding schools	19	4	16	32	4	2
District day schools	35	6	24	48	6	4
Total	56	12	48	96	12	8

The population of teachers sampled dropped from 24 to 20 because some of the physics teachers were also HODs who participated in both the interview and responded to the questionnaire.

3.5 Research instruments

The research instruments comprised questionnaires for teachers and students, class observation schedule, students' achievement test and HOD's interview schedule. The interview guide was administered to HOD sciences while the observation guides collected information on teacher's characteristics and teaching methodology and how it influences enrolment and performance in physics. Use of multiple instruments was necessary to limit the bias that would have resulted from using data obtained from using one type of instrument.

3.5.1 Students' questionnaire.

The students' questionnaire was administered to Form Two and Form Three physics students and was used to collect data on students' gender, attitude towards physics, their entry behaviour and their opinion on teacher characteristics and teaching methodology. This instrument also collected data on students' performance in the previous examination (app A Item 13) the answer to this question and the results of the achievement test formed the basis for performance.

3.5.2 Teachers' questionnaire.

This instrument sought information on students' and teachers' attitude, characteristics, teaching methodology and availability of teaching/learning resources in the school. The instrument also collected data on the extent of gender disparity in physics classes and an opinion sought on improving the same.

3.5.3 Physics lesson observation schedule.

Through this instrument, information on teacher characteristic and resource utilization in class was sought. The researcher, through this instrument collected data on how well teachers were prepared to teach physics. Mastery of content and how well the lesson was delivered to the students were also sought. This instrument collected information on teacher's teaching style, teaching approach and methodology.

3.5.4 Science HOD Interview schedule.

This instrument collected information on students' entry behaviour, teachers' and students' attitude towards physics, and teacher characteristics. The HOD gave information pertaining to the school administration and how it affected enrolment and performance. End of term departmental results on science and mathematics was provided by the HOD and was compared with enrolment and performance in physics in that school.

3.5.5 Students' assessment test.

Students' assessment test was used to collect information on students' mathematical and spatial ability. The results for this test were used as the basis for performance in all the

schools sampled. It also tested on students' basic knowledge in physics. The results of this test was also compared with their entry behaviour to find out to what extent this affected enrolment and performance.

The use of multiple instruments was found necessary in order to limit the bias that would have resulted from using a single instrument. It also improved the reliability of the data collected.

3.6 Pilot study.

Two schools were selected for the pilot study. One of the schools was a boarding school while the other was a mixed day school. The pilot study involved 20 students; 10 from each school and 2 physics teachers; 1 from each school. The sample consisted of 4 Form Two students and 6 from Form Three students from both schools. One of the teachers selected was a science HOD and the other one was a practicing physics teacher. The main objective of the pilot study was to determine the reliability of the research instruments, time required to answer the questions in the research items and to understand the type of responses that will be received from the respondents. The pilot study was also required to check on the clarity or ambiguity of the items in the research instruments with an intention to improving the same. It also checked on the suitability and levels of language used for the various respondents and improvements done accordingly. This then determined the final form in which the items were phrased for the actual study.

After the piloting, the results were analysed and the reliability coefficient (consistency) α of the instruments calculated using Spearman Brown formula (Gibson et al 1987).

$$r = \frac{\Sigma xy}{\sqrt{(\Sigma x^2 \Sigma y^2)}}$$

r is calculated using spearman product moment formula

$$\alpha = \frac{2r}{1-r}$$

x stands for the mean scale score of a half the group and y stands for the other half of the group.

3.7 Data collection procedure

The researcher visited the schools selected to participate in the study and arranged with the administration of the school on when it was most appropriate to collect data from the school. As for the questionnaire, the researcher took them personally to the respective schools. The researcher sought assistance from the physics teachers to administer the questionnaires to the students to help reduce the Hawthorne effect. The teacher introduced the researcher to the student to reduce impressionistic factor. The researcher then explained to the students what was expected of them in filling the questionnaire. The questionnaire for the teachers was left to be collected on an agreed date or filled and collected on the spot.

As for the interview schedule, the researcher arranged with the science HOD on the most appropriate date and time to conduct the interview. However, only five teachers were available for the interview and class observation was done only in four schools. In some schools teachers were not very enthusiastic on the observation and preferred to fill in the questionnaire only.

3.8 Data and data analysis

Most factors identified were tested using the chi-square (χ^2) technique to establish their level of significance. The data was then presented in form of tables in means, percentages and frequencies. The teacher respondents were categorised as male or female and with their level of academic qualification. The students were also categorised as male or female.

The set research questions were also tested using χ^2 and the outcome for each test discussed. Tables, charts and graphs were used where possible and appropriate to make the results clearer.

3.9 Logical and ethical considerations.

3.9.1 Logical considerations.

The choice of Gatundu district as the location of the study was necessitated by the researcher's proximity to the area. This reduced on travelling cost and saved on time that was required to collect the data. The researcher obtained a permit from National Council for Science and Technology in the ministry of higher education to enable him legally collect data in Kenyan schools. Advance prior arrangements were made to make the actual collection of data relatively easy.

3.9.2 Ethical considerations.

The respondents were not required to fill in their names and the information given was treated with confidentiality and will not be used for any other purpose other than for the findings of this study. This was clearly shown on the research instruments that were distributed to the respondents. None of the respondents was forced or coerced to give information. Prior arrangements were done through the administration of the schools to be involved in the study in order not to adversely interfere with the school programs.

CHAPTER FOUR

RESEARCH FINDINGS, PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

4.0 Introduction

This study was concerned with finding out the factors affecting enrolment and performance in physics in Gatundu District. This chapter examines and explains how certain factors such as teaching methodology, learner's attitude, mathematical and spatial ability, gender, and entry behavior affect enrolment and performance in physics. As was expected, the study found out that there was a high correlation between the identified factors with enrolment and performance. The specific objectives of this study were;

- i. To establish whether student's attitude towards physics affect enrolment and performance.
- ii. To establish the relationship between student's entry behavior and performance in physics.
- iii. To examine how teaching methodology affect enrolment and performance.
- iv. To establish the relationship between learner's mathematical/spatial ability and its effect on enrolment and performance.
- v. To find out to what extent the students' gender affects the choice of science subject and performance in physics.

To gather this information, the following research instruments were used;

- i. Students' questionnaire.
- ii. Students' achievement test.
- iii. Teachers' questionnaire.

- iv. Physics lesson observation schedule.
- v. HOD interview guide

The data is presented using tables on percentage, frequency and means. The findings have also been presented in graphs and pie charts. Chi-square values for the responses were taken to establish the level of significance for various variables.

4.1 Enrolment in physics.

Students in Form Three have an opportunity to choose two science subjects or pursue the three of them. Most students however opt for two science subjects. Enrolment will therefore mean the number of students who choose to take physics and another subject or all the three sciences namely Physics, Chemistry and Biology.

Enrollment of students in physics in Form Three was a major objective in this study. The information revealed was analyzed from the teacher's questionnaire and HOD's interview guide. There was a higher percentage of enrolment in physics in provincial schools than other categories of schools namely district boarding and district day as shown in Table 4.1 The total number of Form Three students from the sampled schools was 943 out of which only 259 had enrolled in physics which is 27.46% of the total population of Form Threes from the sampled schools.

Table 4.1. Physics students' enrolment in Form Three and the sampled population.

No of schools	Type of school	Students population in Form Three	Students' enrolment in physics in Form Three	% enrolment in physics in Form Three	Frequency of physics students sampled	% of physics students sampled
1	Provincial school (girls)	118	34	28.81	8	23.53
1	Provincial school (boys)	123	43	34.96	8	18.60
2	District boarding schools(girls)	194	42	21.65	16	38.10
2	District boarding schools(boys)	206	57	27.67	16	28.07
6	District day schools(mixed)	302	83	27.48	48	57.83
12	Total	943	259	27.46	96	37.06

It is observed from Table 4.1 that physics students' enrolment is higher in provincial schools than in other categories. Enrolment is also lower in girls' schools than in boys' schools. The percentage of sampled Form Three student was 37.06%. Eight Form Three students and four Form Two students participated from each school. The physics teacher was given the

prerogative to select the students to participate the study. Enrollment in physics is higher provincial schools than in both district day schools and district boarding schools.

The enrolment of students in physics was not greatly influenced by the category of school as shown in the chi-square values in Table 4.2. Category of school in this case will mean whether the school is provincial or district, day or boarding, mixed or single gender and boys or girls

Table 4.2 Chi- square values for enrolment and school category

School type	Observed frequency	Expected frequency	O-E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
PS(Girls)	118	119.25	-1.25	1.5625	0.01324
	34	32.75	-7.23	52.2729	0.42498
PS(Boys)	123	130.23	8.85	78.3225	0.40372
	43	35.77	0.33	0.1085	0.00052
DBS(Girls)	194	185.15	-0.04	0.0016	0.00000
	42	50.85	1.25	1.5625	0.04595
DBS(Boys)	206	206.33	7.23	52.2729	1.2156
	57	56.67	-8.85	78.3225	1.8648
DDS (mixed)	302	302.04	0.37	0.1369	0.0024
	83	82.96	0.04	0.0016	0.00000
Total	1202	1202		$\sum \frac{(O-E)^2}{E}$	3.97121

Key

PBS (Girls): Provincial girls' boarding school

PBS (Boys): Provincial boys' boarding school

DBS (Girls): District girls' boarding schools

DBS (Boys): District boys' boarding school

DDS (mixed): District mixed day school

$$\sum \frac{(O-E)^2}{E} = 3.97121$$

With the assumption that there is no significant difference between enrolment of physics and school categories, the computed values of the χ^2 is 3.97121. This is much smaller than the critical chi-square value at 2 degrees of freedom and with a probability of less than 5%. χ^2 is therefore not significant at this level. This means that the school category does not influence enrolment in Form Three. This study has shown that there is low enrolment in physics in Gatundu District. Indeed, there is low enrolment in high school physics in many districts in Kenya (Nderitu 2007). The decline in enrolment and graduation rate in physics in all levels has been the case in many countries including the USA, UK and Netherlands (Tobias et al 1999, Osborne et al 2003 and Ankibi 1983)

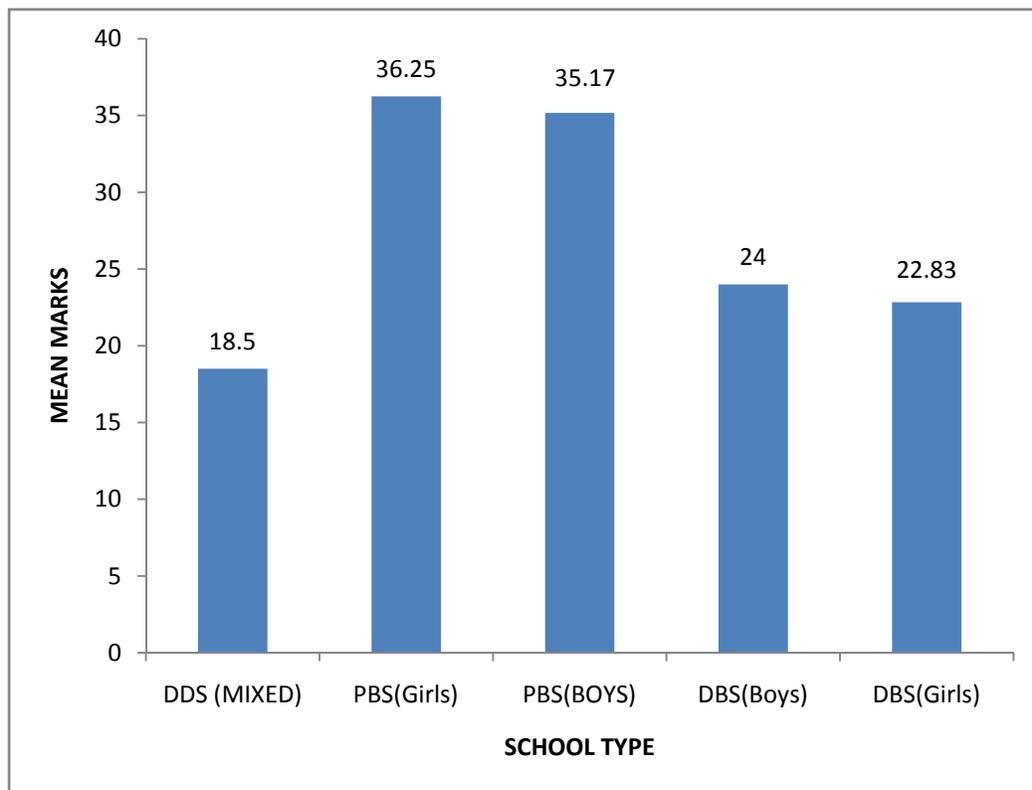
4.2 Enrolment and performance in physics.

This study sought to establish the relationship between enrolment and performance. This was done using students' achievements test score and teachers questionnaire items 9(i) and (ii). The performance (mean score for achievement test) is shown in the in fig 4.3. performance was rated from grade A to E with A being the highest and E being the lowest.

Table 4.3 Mean score and mean grade for physics achievement test for various school categories

	A	B	C	D	E	MSS	TOTAL
PBS(girls)	6	4	1	1	0	9.8333	12
PBS(boys)	4	3	5	0	0	8.7500	12
DBS(Girls)	2	5	5	7	5	5.5000	24
DBS(Boys)	1	7	7	9	0	6.3750	24
DDS (mixed)	3	11	14	25	19	4.7638	72
Total	16	30	32	42	24	5.8750	144

Fig 4.1 Mean mark for achievement test



A *t*-test was also carried out to compare the girls and boys performance in the achievement test.

Table 4.4 *t*-test values for performance across the gender

	Boys' mean score	Girls' mean score	<i>d</i>	<i>d</i> ²
Provincial schools	35.17	36.25	-1.08	1.1664
District boarding school	24.0	22.83	1.17	1.3689
District day school	22.5	15.6	6.9	47.61
	$X_1 = 27.223$	$X_2 = 24.89$	$\sum d = 6.99$	$\sum d^2 = 50.1453$

N=144

Df =2

$$t = \frac{\sum d}{\sqrt{\frac{N \sum d^2 - (\sum d)^2}{N-1}}}$$

The *t*-test value was found to be 0.9870 which is below the critical value of 4.3 with $p < 0.05$. This shows that the school category cross tabulated with gender did not have a significant effect on performance.

It is clear from Table 4.4 and fig 4.1 that provincial schools performed much better than did both district boarding and district day schools. Girls in the provincial category performed much better than their male counterparts in the same category. This is contrary to the assumption that boys perform better than girls in physics. This is however not the case for district schools where boys performed better than girls. The high performance in provincial schools could be explained by the obvious high entry behaviour and better teaching resources compared to the district schools. District day schools performed significantly lower than both district boarding and provincial schools.

4.3 Resources, enrolment and performance

This study sought to investigate the effect of availability and use of teaching/learning resources on enrolment and performance in physics in various school categories. Availability and use of resources was determined using students' questionnaire items 14, 19, and 25. It is also determined using the interview guide item 21 and physics lesson observation guide. Asked whether there were enough laboratory apparatus in their school, most students (76%) indicated that they had enough. All the sampled students in the provincial schools agreed that there were enough laboratory apparatus. Physics lessons were almost always conducted in the laboratory in the provincial schools as opposed to district schools where students went to the laboratory only when there was a double lesson.

During the class observation guide, it was noted that most teachers hardly use audio-visual aid in their lessons. This was the case in all schools visited.

Table 4.5 Cross tabulation for resources and performance in physics

School type	Are resources adequate?	Performance in physics					
		A	B	C	D	E	Total
PS (Girls) Provincial schools (girls)	No			10%	10.5%		20.5%
	Yes	15.8%	37.4%	10.5%	15.8%		79.5%
Provincial school (boys)	No	5%	5%	15%	15%		40%
	Yes	10%	25%	12.5%	12.5%		60%
District boarding school (girls)	No	5.9%	11.8%	11.8%	17.6%		47.1%
	Yes		5.9%	23.5%	23.5%		52.9%

District boarding school (Boys)	No			12.5%	18.8%		31.3%
	Yes		25.0%	6.3%	25.0%	12.5%	68.7%
District day Schools (mixed)	No			7.7%	15.4%	15.4%	38.5%
	Yes			7.7%	23.1%	30.8%	61.5%

As observed from Table 4.5, adequacy of resources had a direct relationship with performance. Of the 79.5 % of the students in provincial girls who believe that resources are adequate 53.2% had Grade A or B. This trend is however contradicted by District Day Schools where 61% of the students believe that the resources are enough yet 38.8% of them got a grade E.

In the teacher's questionnaire item 17 (The school administration is not keen on providing physics laboratory equipments) none of the 12 teachers said that laboratory apparatus were not enough. From the teachers, questionnaire it can be concluded that all the schools had enough physics laboratory apparatus and therefore their adequacy did not have a significant effect on performance. From students' questionnaire item14 (how often do you perform experiments in the laboratory?) 78% of the students in day schools said weekly and 83% of the students in the provincial school said weekly. Laboratory experiments are performed more often in boarding schools than in day schools. All the HODs who responded to the interview in item 21 of the interview guide (Do you consider physics equipments and apparatus enough?) said that the school had enough laboratory apparatus. In provincial schools all science lessons were conducted in the laboratory which provided the students with an opportunity to handle science apparatus confidently.

Students' hand on activities significantly improve conceptualization of science and this leads to higher achievement (SMASSE 2005). Availability and proper use of resources play an important role in teaching and learning (Wasanga 1996). Using practical approach to teaching science improve retention especially among the girls (Twoli 1986). Students should therefore be given an opportunity to perform experiments on their own to enhance retention of concepts and processes. The students should also learn to form patterns from the results of the analyzed data from the experiment carried out in the laboratory (Iraki 1994)

Availability and proper use of resources significantly improves learners' visualization of concepts (Romiszowski 1986). Girls are supposed to be exposed to more practical lessons to cater for their purported low spatial ability

If students have to learn meaningful science, we must give them an opportunity to make observation and deductions from their own experiments rather than taking the pronouncement of the text book (Lerner 2005). This will be possible if the students are allowed to explore in performing experiments and making deductions by themselves rather than the teachers demonstrating and explaining the observation. Due to the fact that girls have been found to possess a lower spatial ability they are likely to be disadvantaged by lack of experiments in science lesson. Iraki (1994) suggests that girls are supposed to be exposed to more practical lessons to arouse interest in science and improve visualization ability.

The high performance in provincial girls' school in this study could be explained by the fact that there are more teaching resources in the school and that all the lessons are conducted in the science laboratory. This is unlike district day schools where science lessons are taken in the laboratory only during double lessons. In a study carried out to investigate utilization of science resources, it was found that materials and equipments used in physics laboratory

were often not enough or out of order (Singer et al. 2005). This limits the frequency of class experiments resulting to other modes of instructions other than laboratory work which is likely to lower achievement in sciences.

4.4 Teaching methodology and performance.

Instructional methodology plays a significant role in delivery and acquisition of knowledge. One objective of this study was to find out whether teaching methodology and teacher characteristics affects enrolment and performance. The data on teaching methodology was collected using students' questionnaire items 11, 14, 15, 20, and 21. Most of the information on teaching methodology and teacher characteristic was collected from all items in the lesson observation guide. Teaching methodology is closely related to teacher characteristics. Out of the 12 teachers sampled for this study only three were female, this could probably explain the reason why only 27% of the students taking physics in the sampled schools are girls. Most likely, the girls lacked the role models in physics and therefore developed a low attitude towards the subject.

All the 7 lessons observed were single 40 minutes lessons. There was no written lesson plan in all the lessons observed though schemes of work were available in 6 of the lessons observed, however only two teachers had their schemes of work coinciding with the lesson that was being taught. The topics observed were refraction of light and linear motion in Form Three. Out of the 7 teachers observed 5 were graduates while the rest were diploma holders. All the teachers observed had an outstanding mastery of content and were able to deliver it well to the learners. All the lessons were well executed; however, time management was a problem in most of the lesson. Most teachers took some time before going to the classroom

and none of the lessons observed lasted the 40 minutes hence students' valuable time was apparently wasted. All teachers introduced the lessons by referring to the previous lesson. In most of the lessons learners' interest was aroused by making reference to every day's experience. The language used in the delivery of the lesson was appropriate to the level of learners and teachers defined and explained difficult terms. In most cases familiar examples were used to illustrate concepts. Learners were involved through question and answer method however student centered activities were not common in most lessons. There were signs of student motivation by the teacher in a few cases after the student answered the questions correctly. Conclusion of the lesson was not clear and in most cases was haphazardly made after the lesson was over indicating poor lesson preparation. Learners were rarely involved in evaluation of the lesson.

From the students' questionnaire item 10 and 34, only 13% of the students had gone for a physics field trip once. Only 8.4% had gone more than once, 37.9% had not gone for any physics field trip while the rest did not respond to this question. From item 14, most of the students indicated that they performed physics experiments in the laboratory more than once in a week, however students did not differentiate between class experiment and teacher demonstration since most students answered question 14 the same as question 15. Most students agree from item 20 of the students' questionnaire that their teacher allows them to actively participate in physics lessons but most disagree that they often work in groups.

Most teachers preferred to teach physics as opposed to their other subject. Of the 12 teachers who responded to the teachers' questionnaire, 8 were teaching physics and mathematics while 4 were teaching physics and chemistry. Only three of them had attended an in service course in physics other than SMASSE project in the last two years. Those who had attended

claimed it had assisted them improve in their teaching of physics. One of those who had not attended recommended that the ministry should organize more in-service courses for teachers at the district level.

None of the teachers was able to complete the Form One syllabus during the first year of study; however the teachers did not have a problem in completing the Form Two syllabus. Most teachers agreed that completion of the syllabus had a strong effect on the way students selected science subjects in Form Three. They therefore suggested that in order to improve enrolment of students in physics teachers should endeavour to complete the Form One and Two syllabi in time. Most teachers preferred to teach using class experiment but claimed that this was time consuming. The finding of this study is in agreement with Iraki (1994) that students taught frequently through practical work acquired manipulative and process skills faster. Meaningful learning takes place when the learners are exposed to more hands on activities than demonstration and lecture methods (Snelddon et al 2009). The study also found out that students investigation and predictive capability was improved when students were given an opportunity to make independent observations. This is in agreement with Lillian et al (1996) that students develop physical concepts and interpret different forms of scientific explanatory models with predictive capability through practical lessons.

4.5 Learners' attitude on enrolment and performance.

Students' attitude was tested in the students' questionnaire using items 2(a), (b), 3(a), (b) 4, 5, 6(i) (ii) and 12. Most students in Form Three had a positive attitude towards physics, in fact 76 students (79.6%) listed physics as their most preferred subject. Most of these students associated their liking for physics to its applicability in life and their future career

expectations. This was however not the case in Form Two where only 13 students (27.08%) listed physics as their most preferred subject. None of the students in Form Three had physics as their least liked subject and also none of them regretted having enrolled in physics. The percentage number of students in Form Two who were likely to take physics in Form Three was 39.58% (19 students). This shows that there is a modest relationship between students' attitude towards physics and their intention to enroll in the subject. Out of those taking physics in Form Three, only four students (4.16%) believe that physics is a difficult subject. This number is much higher in Form Two where 15 students (31.25%) believe that physics is difficult. this can be attributed to the fact that the Form Two students had not reached subject specialization stage.

A five scale Likert's items were used to gauge students' attitude towards physics in students' questionnaire items 16, 17, 19 and 23. A value of 1 and 2 was taken to represent negative attitude while the value of 4 and 5 were taken to represent positive attitude.

Some responses were considered in the cohorts using the statement "I look forward to a physics lesson"

Table 4.6; Attitude cross tabulated with performance.

I look forward to a physics lesson		Performance using mean grades obtained in the achievement test					
School type	Attitude	A	B	C	D	E	TOTAL
PBS (Girls)	5 & 4 (positive)	5	3	1			9
	3	1	1		1		3
	2 & 1 (Negative)	-	-	-	-	-	-
	TOTAL	6	4	1	1	-	12
PBS (Boys)	5 & 4 (positive)	4	3	4	-	-	11

	3	-	-	1	-	-	1
	2 & 1 (Negative)	-	-	-	-	-	-
	TOTAL	4	3	5	-	-	12
DBS (Girls)	5 & 4 (positive)	2	4	2	4	3	15
	3	-	1	2	2	1	6
	2 & 1 (Negative)	-	-	1	1	-	2
	TOTAL	2	5	5	7	5	24
DBS (Boys)	5 & 4 (positive)	1	6	5	6	-	18
	3			1	1		2
	2 & 1 (Negative)	-	1	1	2	-	4
	TOTAL	1	7	7	9		24
DDS (Mixed)	5 & 4 (positive)	3	9	10	18	10	50
	3	-	2	2	3	4	11
	2 & 1 (Negative)	-	-	2	4	25	11
	TOTAL	3	11	14	25	19	72
TOTAL		16	30	32	42	24	144

Most students who performed well especially in Form Three had a positive attitude towards physics and looked forward to a physics lesson. Students who did not look forward to a physics lesson all came from Form Two. This shows that all the students who had already enrolled in physics have a positive attitude towards the subject. Students' performance in a subject affects their attitude towards the subject. Pupils' feeling are very important when

teaching and have a strong effect upon the amount of work, the effort put towards and the learning that is acquired (Callahan (1971), Orodho (1996),).

This study found out that there is a modest positive relationship between altitude and achievement which is in agreement with the Bureau of Educational Research of Kenyatta University reporting Aiken et al (1987). The study is also in agreement with Aiken et al (1987) who noted that acquisition and proficiency of skills in a subject leads to positive attitude in that subject. Students who performed better in the achievement test held a more positive attitude towards physics. This shows that good performance in subject area reinforces attitude towards the subject. Most students whose performance was low reported a negative attitude towards physics. Positive attitude towards a subject also determines the amount of time and effort dedicated in a subject and this is likely to affect performance (Nderitu 2007).

4.6 Mathematical/spatial ability on enrolment and performance.

This was tested using students' achievement test items 4(b), 5(ii), 8, 9, 10, 12(a) 14 and 15(b) Appendix (E). It was also tested using students' questionnaire item 22 and teachers' questionnaire item 16. Most students who performed well in the achievement test scored high in the questions that required mathematical calculation. Ninety two percent (92%) of the students who responded to item 22 in the students' questionnaire either agreed or strongly agreed that students who perform well in mathematics also perform well in physics. All teachers who responded to item 16 either agreed or strongly agreed that students who perform well in mathematics are likely to enroll and perform well in physics. Table 4.6.1

shows a cross tabulation of the frequency of students per grade from last end of term examinations

Table 4.7; A cross tabulation of the frequency of students per grade from previous end of term exams from students' questionnaire item 13

School category	Subject	A	B	C	D	E	TOTAL
PBS (GIRLS)	Physics	6	2	2	0	0	10
	Mathematics	5	3	1	1	0	10
PBS (BOYS)	Physics	7	4	1	0	0	12
	Mathematics	6	3	2	0	0	11
DBS (GIRLS)	Physics	1	9	10	2	0	22
	Mathematics	2	8	11	1	1	23
DBS (BOYS)	Physics	4	6	5	5	0	20
	Mathematics	5	7	6	1	0	19
DDS (MIXED)	Physics	5	11	20	19	4	59
	Mathematics	3	6	26	24	3	62
TOTAL		44	49	84	53	8	217

**Some students did not respond to the question*

It is observed from table 4.6.1 that, students who performed well in mathematics also performed well in physics. Let us look at the chi-square values for each school category

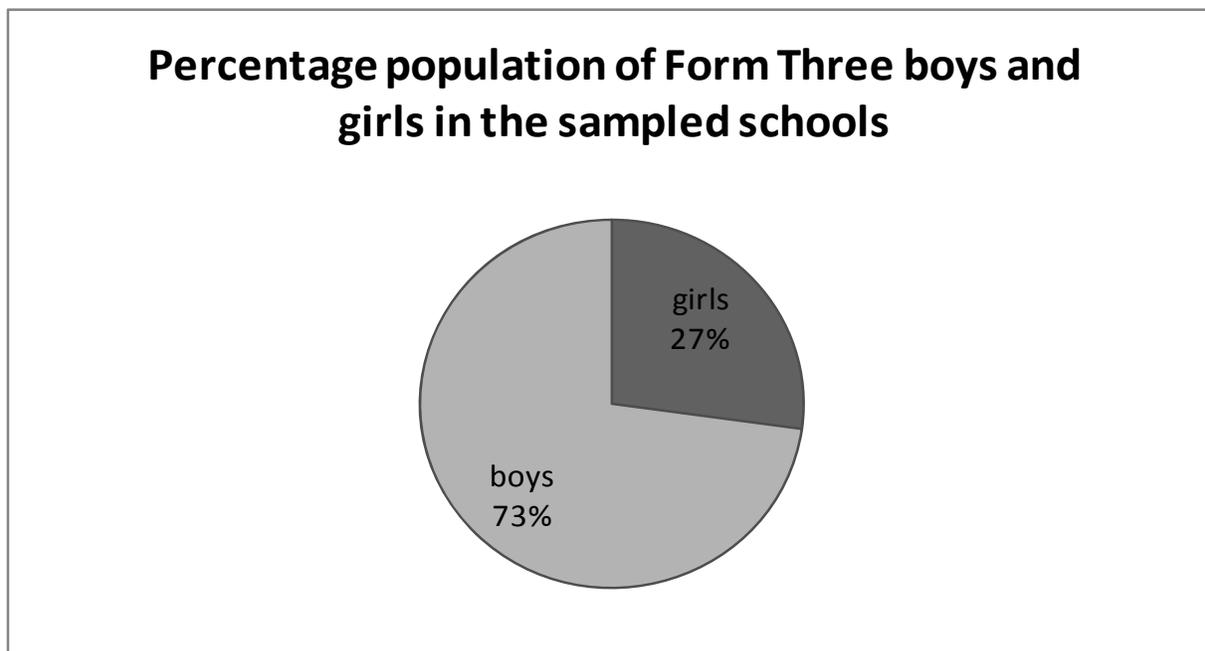
Mathematical and spatial visualization has been found to contribute towards achievement in science (Twoli 1986). Spatial visualization ability was also found to be higher among the boys than among the girls (Lyons 2005). It has also been found that the link between mathematics and physics is a strong one (Hutchings 1973). Though this study did not

exhaustively cover the relationship between spatial ability and performance in mathematics, students who performed well in mathematics scored high in physics. Mathematical ability did contribute towards achievement in physics. As observed by Embeywa (1985) the use of mathematical formulae in physics provided an economical use of mental effort. As noted by Alonso (1998) boys did portray higher spatial visualization ability than the girls. This trend affected District Day Schools more than Provincial Schools. It is therefore recommended that teachers teaching physics should have a high proficiency in mathematics and should be able to accurately relate physics concepts to mathematical interpretations.

4.7 Gender, enrolment and performance.

This study sought to find out if the students gender affect enrolment and performance in physics. Students' questionnaire and achievement test was categorized as male or female. Students' gender on performance was observed using students' questionnaire items 13, 18 and students' achievements test scores while students' gender and enrolment was observed using students' questionnaire items 6(i) (ii) and teachers' questionnaire item 9(i) and (ii). The total population of girls in Form Three from the sampled schools was 259 (27%) and that of boys was 694 (73%)

Figure 4.2; Percentage population of Form Three students by gender



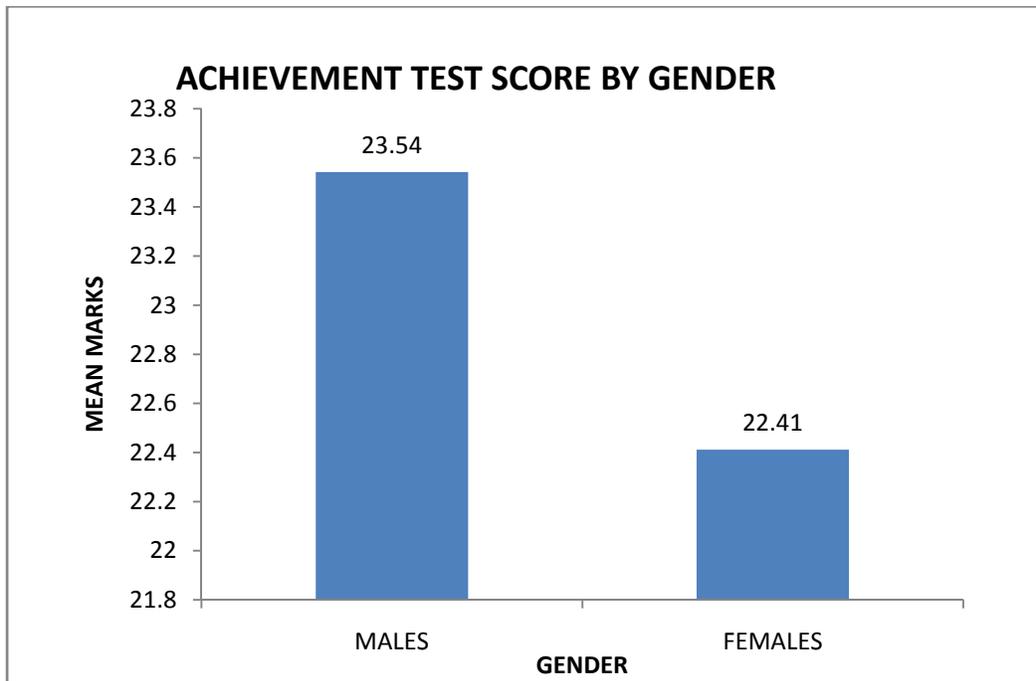
A total of 62 girls were involved in the study out of which 36 (58.06%) were sampled from three Girls' only schools and 26 (41.94%) came from six mixed schools. A total of 82 boys participated in the study out of which 36 (43.9%) were from three Boys' only schools and 46 (56.1%) were sampled from 6 mixed schools. As observed from the findings of this study that majority of students who enrolled for physics in Form Three in mixed schools were boys. In fact in one of the mixed school visited, only two girls had enrolled for physics out of the 25 students in the class. In the said school, the girls sampled in Form Two did not intend to enroll for physics in Form Three. Asked why they did not intend to enroll in physics, one student said that "physics is meant for boys"

Only 13 (20.96%) of these girls believed that boys perform better in physics than girls, 31(50%) didn't agree while 12 (19.35%) neither agreed nor disagreed and 4(6.45%) remained non committal. Most boys (58.5%) believed that boys perform better in physics

than girls. In the students' achievements test, girls scored better in questions that required comprehension than those that required numerical solutions. This is in agreement with (Twoli (1986) that indeed boys seem to have a higher mathematical and spatial visualization ability than girls.

Even though girls in the provincial category had the highest mean score in the achievement test, the mean score of all the girls from the sampled schools was relatively lower at 22.41 compared to that of boys at 23.54 as indicated in fig 4. This difference has been attributed to socialization Theory (Semala 2008). On average men perform better than women in college and high school physics. Studies of elementary and secondary education suggest that these disparities originate when students are in junior high school (Mazur et al 2006). Some studies have shown that women perform better in science classes that are taught cooperatively than rather than cooperatively and benefit from classes that challenge every student to think about and respond to questions asked during class (Tobias et al 1999, Osborne et al 2003 and Mazur et al 2006). The findings of this study is in agreement with Orodho (1996) that in deed there is sex difference in science achievement and particularly in physics at secondary school level in Kenya.

Figure 4.3; A bar graph of achievement test score by gender.



The achievement test was marked out of 50. Boys in all the schools managed to score a mean of 23.54 while the girls had a mean score 22.41. Even though the girls in girls' only schools performed relatively well their counterparts in mixed schools scored very low in the achievement test. On average, men perform better than women in college and high school physics. Studies of elementary and secondary education suggest that these disparities originate when students are in junior high school (Mazur et al 2006) some studies have shown that women perform better in science classes that are taught cooperatively rather than competitively and benefit from classes that challenge every student to think and respond to questions asked during instructions. The findings of this study are in agreement with Orodho (1996) that indeed there are sex differences in science achievement and particularly in physics at secondary school level in Kenya.

4.8 Entry behaviour, enrolment and performance.

Entry behaviour is the specific skills that students have prior to the beginning of instructions. This is what is assessed for admission in a subject area. However, admission should not be strictly regulated by entry behaviour. Entry behaviour for the purpose of this study will mean the science grade attained in KCPE science and the grade attained in physics in the previous class. This was tested using the students' questionnaire items 7(a) (b) and 13. Let us consider the entry behaviour (KCPE science grades) cross tabulated with achievement test result analysis for various school categories

Table 4.8; Comparison of achievement test score to K.C.P.E Grade

SCHOOL CATEGORY	EXAM	Frequency of students in various grades					TOTAL
		A	B	C	D	E	
PS (Girls) Provincial schools (girls)	KCPE	12	0	0	0	0	12
	ACHIEVEMENT TEST	4	3	5	0	0	12
Provincial school (boys)	KCPE	11	1	0	0	0	12
	ACHIEVEMENT TEST	6	4	1	1	0	12
District boarding school (girls)	KCPE	5	9	8	2	0	24
	ACHIEVEMENT TEST	1	7	7	9	0	24
District boarding school (Boys)	KCPE	6	8	9	1		24
	ACHIEVEMENT TEST	2	5	5	7	5	24
District day Schools (mixed)	KCPE	2	15	30	24	3	72
	ACHIEVEMENT TEST	3	11	14	25	19	72

All the students from provincial girls' school had grade A in KCPE science but 8 dropped to grade B and C in the achievement test. It is however clear from Table 4.8 that there is a close relationship between the entry behavior and achievement test score.

It is crucial to assess entry behaviour and to set appropriate prerequisite to understand the level of the students' capabilities before instructions. Failing to adequately assess entry behaviour and prior knowledge may be detrimental to the learners and result to teachers' failure to achieve the goals and objectives set for instructions. Equally important is to ensure diversity of background as it may be a great asset to instructions by contributing a breath of opinions and fostering critical thinking. Lorna et al (1988) contends that to a large extent cognitive entry behaviour affects achievement in any subject. Knowledge of students' cognitive entry behaviour helps the teacher to design instructional materials to the level the learner.

4.9 school administration enrolment and performance.

The school administration plays a pivotal role in both enrolment and performance. This study placed it as an intervening variable and sought to find out how the school administration affects enrolment and performance. Information on the effect of school administration on enrolment and performance was sought using teachers' questionnaire item 17 and HODs' interview. Most teachers were of the view that the school administration is keen on providing physics teaching/learning resources and physics laboratory equipments.

Students' response to questionnaire item 17; The school administration is not keen in providing physics teaching/learning resources and physics laboratory equipments, was tabulated in Table 4.9

Table 4.9; Rating of school administration on provision of laboratory equipments by physics teachers.

Rating	Frequency	Percentage
Strongly agree	0	0
Agree	1	8.3333
Neither agree nor disagree	2	16.6667
Disagree	4	33.3333
Strongly disagree	5	41.6667

of the teachers rated the school administration very high in providing learning resources and physics laboratory equipments. However, most HODs were of the opinion that the school administration did not adequately motivate the physics teacher. "More in-service courses should be organized for teachers to improve the quality of their teaching" said one HOD. The school administration should be student centered. Any that occurs in the school should revolve around what is good for the learner. If it is not good for the learner, then there is no reason why it should continue or even begin in the first place. The school administration should create a society of learners where students are constantly challenged by teachers as well as their peers to keep improving. The administration should motivate the learners to enable them to become facilitators of learning rather than dispensers of content. Teachers should also be given an opportunity to experience meaningful personal growth. School

administration acts as the link between the school and the surrounding community. This will help in tapping the community resources that may be utilized to promote growth throughout the school. The administration promotes growth among all members which include the principal, teaching and non-teaching staff, students, parents and all other stakeholders.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS.

5.0 Introduction

In this chapter, the summary, conclusion and recommendations of the study findings will be made. The fundamental purpose of educational research is to develop new knowledge about educational phenomena and develop our confidence regarding particular knowledge while confirming whether it is true or false. (<http://www.physics.educ/havard> 2010). The purpose of this study was to identify and examine the identified factors affecting enrolment and performance in physics among secondary school students. Having collected and analyzed data, a summary of findings, conclusion and recommendations are outlined in this chapter.

5.1 Summary of the main findings.

The study was anchored on six factors that include; entry behaviour, attitude, teacher characteristics, teaching methodology, mathematical/spatial ability and gender differences. These factors were assumed to affect enrolment and performance in physics among secondary school students in Gatundu District. Five research questions guided the study and they form the following outline in the summary.

5.1.1 Resources for physics instruction.

Schools were found to have several teaching and learning resources. The teachers made use of several of them. It was however noted that these resources were mostly used during class experiments in the laboratory. There was no notable use of charts, overhead projectors or even power point presentations. In most cases, the text books were used during the lesson to discuss diagrams and flow charts. Wall charts which would have been very convenient were

rarely used. The study found out that the text books were over used in spite of the fact that the teacher's guide had suggestions on the various resources that the teacher could employ in teaching particular topics. There was no evidence of the use of class projects in the process of teaching. This was restricted to presentations made during annual congress on science and technology by the few students who attend. It is worth noting that projects play a vital role in the students' understanding of physics concepts. Teachers are therefore advised to incorporate projects in the process of teaching. Generally, the use of resources in the classroom elicits a marked show of interest in the topics of discussion.

5.1.2 Teaching methods for physics and teacher characteristics.

The method of presentation of materials to the learners is key to acquisition and retention of the content learnt. Despite this fact, teachers did not show a great attempt to vary their style of teaching. In spite of the fact that most teachers had an outstanding mastery of content, this was not very well presented to the learners as in most cases teachers used question and answer method. Little time was spared for student centered activities as advocated by SMASSE project. As have been stated earlier, pedagogy should encourage the use of student centered approach to teaching of sciences. Materials learnt in physics should not always come from the text books neither should lessons be delivered as a monologue in front of passive audience. Learners should be given an opportunity to perform class experiments in the laboratory on their own. This is particularly useful when teaching the girls. Teaching through activities improves the spatial visualization ability of the girls. Retention of materials

learnt is clearly as a result of active participation by the learner and close association with learning materials.

5.1.3 Mathematical and spatial abilities

Spatial visualization ability is the ability of a learner to cognitively “see” operations in space. This ability is closely associated with mathematical ability. Physics and mathematics at secondary level are requirements for all students intending to pursue Science and Technology related courses. This is because the said professions require high precision and spatial visualization ability. Though this research did not exhaustively study spatial visualization ability due to its complexity, it found out that students who performed well in mathematics were likely to enroll and perform well in physics. Boys performed better and this is likely to give them an advantage over the girls.

5.1.4 Attitude towards sciences

The attitude of student towards a particular science subject was found to significantly affect the choice of subject in Form Three. All the students who had enrolled in physics had positive attitude towards the subject. The attitude was even higher among the students who performed well. Student attitude determines the amount of time and effort dedicated to the subject and this ultimately improves enrolment and performance in the subject. Acquisition of proficiency in a subject may lead to a positive attitude in the subject. Teachers should therefore work towards improving students’ achievement in the subject in order to inculcate positive attitude to the learners.

5.1.5 Entry behaviour and learning physics

Entry behavior was taken to mean the marks obtained by the students in science at KCPE and also the grade obtained in the previous class. The study found a positive relationship between entry behaviour and performance. This was particularly true for provincial schools that had very good grades at KCPE and also obtained good grades in the achievement test. The students who scored high in the previous class also performed well in the assessment test. This indicated that previous performance had an effect on future performance of a student; however, other factors such as student's previous exposure to relevant content in the subject may affect performance.

5.1.6. Gender and learning Physics

The study found a great disparity in enrollment across the gender. In all the mixed schools sampled, there were more boys than girls enrolling in physics. Performance was also better among boys in mixed school than their female counterparts. However, girls in provincial schools performed better than the boys. The girls in the provincial school had however a higher entry behavior than the boys in the same category. Teachers should therefore make a deliberate effort encourage the girls in mixed schools and employ teaching methods that are girl friendly. Inclusion of guidance counseling during selection of subjects at Form Two is highly recommended. This will go a long way in helping the students choose subjects that will assist them in their future career.

5.2 Conclusion

To a certain extent, the identified factors were found to affect enrolment and performance. However, contrary to what was indicated in the concept model, enrolment did not affect performance neither did performance affect enrolment. The school environment played a major role in improving students attitude towards learning which leads to improved performance and higher enrolment. Provincial schools had a higher enrolment than District schools yet the former had a better performance. As was found out in the study, an attempt has been made in the recent past to try and synchronize primary science and high school science to try and bridge the gap between the two levels both in content and instructional methods. However, primary science teachers have not adopted a practical/inquiry instructional strategy leading to confusion after transition to high school. Teachers at primary school should therefore be encouraged to use appropriate methods of instructions to develop in learners an exploratory, investigative and intuitive mind at an early age in educational ladder. Girls were found to perform lower than boys in areas that required spatial and mathematical ability. This poor performance was partly due to the fact that in mixed schools, boys denied the girls an opportunity to handle apparatus which contributed to their poor manipulative skills. Teachers in these schools should therefore adopt more cooperative than competitive methods in the process of instructions. Single gender schools performed better than mixed schools. They had however higher entry behaviour and this study could therefore not establish the relationship between performance and the school's gender composition. Contrary to what was indicated in the concept model, enrolment did not have a significant effect on performance but schools with better performance in the previous years had a higher

enrolment in physics. This was the case in provincial schools where there was a greater percentage physics enrolment and better performance in the previous years.

5.3 Contribution of the study to the body of knowledge

This thesis was intended to find out and analyze the factors affecting enrolment and performance in physics. It was the intention of the researcher that the findings of this study will go a long way in improving enrolment and performance in physics at secondary school level. Teachers will also tap from the findings of this study on the modern and effective methods of teaching physics. Spatial visualization ability is key to the study of science and engineering courses. This study therefore intends to have the teachers encourage the students with high spatial visualization ability to pursue science and engineering courses and use instructional methods that encourage the use of spatial ability among the learners. Proper utilization of teaching/learning resources plays a pivotal role in the process of instruction. It is therefore the intention of this study to encourage the teachers to adequately prepare learning materials prior instructional period to effectively utilize them.

5.4 Recommendations for action.

The following recommendations for action were made based on the findings of this study.

- a) Teachers are advised to use effective modern teaching methods to improve absorption and retention of learnt materials by the learner. The use of field trips and laboratory work in particular should be encouraged to give the students direct experience with their surrounding and appreciate the importance of physics to the environment.
- b) Resources assist in visualization and conceptualization of concepts more so in physics. The school administration should therefore prioritize provision of physics laboratory equipment to improve the quality of class experiments. Teachers should

also make use of locally available materials so that learners can associate the subject with the surrounding environment and compliment on convectional resources.

- c) The study found out that girls learning physics without the boys were more confident and consequently performed better than their counterparts in mixed schools. There is need therefore for the government to minimize the number of mixed schools and increase the number of boys' only and girls' only schools. Teachers teaching the girls are also encouraged to use more practical approach to improve their mastery of concept and cater for their low spatial ability.
- d) School administration can add value to the learning environment in schools. This can be done by provision of enough teaching/learning resources and strengthening the guidance and counseling team to guide the students on careers related to physics. This is likely to improve enrolment and performance in physics.
- e) Positive attitude of students towards physics was found to greatly improve performance. It is therefore the responsibility of the physics teachers to make the subject more appealing to the learners since this will consequently lead to a more positive attitude towards the subject. As has been stated earlier, students' feelings are very important and have strong effect upon the amount of work and the effort put towards learning. It is the teachers' responsibility to foster students' positive attitude towards a subject. Teachers' and parents attitudes affect the way a student views a subject, they should therefore themselves cultivate a positive attitude on order to foster the same to the learners.

5.5 Recommendation for further research

- a. This study was set up in location where people have similar culture and economic background. It is therefore recommended that a similar study should be carried out in other districts in the country to investigate whether or not the findings of this study apply to other areas of different cultural and economic backgrounds
- b. There are other factors which affect enrolment performance in physics but were not considered. The factors that were not considered in this study include class size, students' literacy level, subject's difficulty index, students' cultural back ground and type of curriculum offered; further research should therefore be carried out to look into the extent to which these factors affect enrolment and performance.
- c. The study focused on physics at secondary school level. Another study should also be considered in other science subject areas to establish the extent to which these factors affect enrolment and performance in those subjects
- d. Since the cost of implementation was not carried out in this study, a survey should be conducted to investigate the cost of implementation of physics curriculum at secondary school level and its effect on enrolment performance.
- e. That there is a gender difference in physics achievement and enrolment is not in dispute, a further research should therefore be carried out to find out the major causes of the disparity and recommend action to bridge the gap. Such a study should identify social, cultural, ecological, economic, physiological and political factors that tend to influence gender differences in physics achievement and enrolment.

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APPENDIX A
STUDENTS' QUESTIONNAIRE

INSTRUCTIONS

- ✓ Do not write your name on this paper
- ✓ Please answer all the questions
- ✓ Do not spend so much time on one question, write N/A if the question does not concern you
- ✓ Where choices are provided, choose the most appropriate in your view by ticking (✓) in the corresponding box

General information

School.....

Class.....

Sex: male
 Female

- 1) Which science subjects are you taking?
- i. Physics and chemistry
 - ii. Physics and biology
 - iii. Chemistry and biology
 - iv. all the sciences
- 2) (a) List the three subjects you like most in order of preference
- i)
 - ii)
 - ii)
- (b) Give one reason why you like them

- 3) (a) Which science subject do you like least?

(b) Give one reason for your answer in 3 (a) above.

- 4) If you have chosen physics in (1), give the reason why you chose it.

- 5) So far, do you regret having chosen physics if you are in Form Three?

- 6) (i) If you are in Form Two, will you take physics in Form Three?

Yes

No

- (ii) Give your reasons in 6 (i) above

7) How many types of physics text and reference books are there in your school

8) Is there a careers master in your school?

Yes

No

9) If yes in 8 above, do you consult him/her when making career decisions?

10) Do you go for field trips for the purpose of learning physics lessons?

Yes

No

11) If yes, how many times have you gone and where?

12) (a) Do you believe physics is a difficult subject?

Yes

No

(b). Give reasons for your answer.

13) What grade did you get in the last end of term exam in the following subject?

a) Physics _____

b) Biology _____

c) Chemistry _____

d) Mathematics _____

Please check only one item in questions 14 to 25 below

14) How often do you perform physics experiments in the laboratory with your teacher?

a) Twice a week

b) Weekly

c) After two weeks

d) Once a month

e) Once a term

f) Never

15) How often does the teacher demonstrate what she/he is teaching during a physics lesson

a) Always

b) Quite often

c) Occasionally

d) Never

16) I look forward to a physics lesson

a) Strongly agree

b) Agree

c) Neither agree nor disagree

d) Disagree

e) Strongly disagree

- 17) I rarely finish all my physics assignments
- a) Strongly agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly disagree
- 18) Boys perform better in physics than girls
- a) Strongly agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly disagree
- 19) I love doing physics experiments because they are interesting.
- a) Strongly agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly disagree
- 20) Our physics teacher allows us to actively participate in physics lessons.
- a) Strongly agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly disagree
- 21) We often work in groups during physics lessons.
- a) Strongly agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly disagree
- 22) There are hardly enough physics text book in the class.
- a) Strongly agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly disagree
- 23) If there were no physics practical examinations, I would pass better in physics.
- a) Strongly agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly disagree
- 24) Our physics teacher patiently takes us through difficult problems.
- a) Strongly agree
 - b) Agree
 - c) Neither agree nor disagree

- d) Disagree
 - e) Strongly disagree
- 25) There are enough physics apparatus in our school laboratory.
- a) Strongly agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly disagree

Thank you

APPENDIX B
Teachers' Questionnaire

The researcher interested in finding out the factors that affect enrolment and performance of physics among secondary schools in Gatundu district. Please give accurate information that will assist the study come up with credible and valid results. The information given will be treated with confidentiality and will not be used for any other purpose other than for this study

General information

Name of the school _____

Teaching subjects; Major _____, Minor _____

Highest academic qualification _____

Sex

Male Female

Teaching experience in years _____

Please answer all the questions below.

1. Besides physics, what other subjects do you teach?

2. In your own opinion, were you adequately prepared at college level to teach the subjects you are now teaching?

Yes

No

3. If yes, in what way has this improved your teaching of physics?

4. If no, in what way has this improved your teaching of physics?

5. (a) To what extent do you cover the physics syllabus?

Very adequately

Adequately

Fairly adequately

Not adequately

(b) Explain your answer in (a) above

6. (a) Do you always complete the Form One and Two syllabus

Yes

No

(b) If no, how many topics are left uncovered?

Form One _____

Form Two _____

(c) Does completion of syllabus in form two affect the way the students choose physics in form three? _____

7. Which is your preferred method of teaching physics?

Lecture method

Question and answer

Demonstration

Group work/discussion

Class experiment

8. What is the number of boys and girls taking physics in Form Three class in your school?

Girls _____

Boys _____

9. Give the reason for disparity in (8) above if any.
-

10. In your opinion, what can be done to lower the disparity?
-

Please check only one choice in questions 11 to 20.

11. I enjoy teaching physics.

- a. Strongly agree
b. Agree
c. Neither agree nor disagree
d. Disagree
e. Strongly disagree

12. Most students bring their assignments for marking in time.

- a. Strongly agree
b. Agree
c. Neither agree nor disagree
d. Disagree
e. Strongly disagree

13. My students always score low marks in physics.

- a. Strongly agree
b. Agree
c. Neither agree nor disagree
d. Disagree
e. Strongly disagree

14. The students I teach in Form Three were forced to take physics.

- a. Strongly agree
b. Agree
c. Neither agree nor disagree
d. Disagree
e. Strongly disagree

15. Most topics in physics are challenging to teach.

- a. Strongly agree
b. Agree
c. Neither agree nor disagree
d. Disagree
e. Strongly disagree

16. The school administration is not keen on providing physics teaching/ learning resources and physics laboratory equipments.

- a. Strongly agree

- b. Agree
 - c. Neither agree nor disagree
 - d. Disagree
 - e. Strongly disagree
17. The physics syllabus is too broad for secondary school students.
- a. Strongly agree
 - b. Agree
 - c. Neither agree nor disagree
 - d. Disagree
 - e. Strongly disagree
18. Girls often perform better than boys in physics.
- a. Strongly agree
 - b. Agree
 - c. Neither agree nor disagree
 - d. Disagree
 - e. Strongly disagree
19. I would rather teach my other subject as opposed to physics.
- a. Strongly agree
 - b. Agree
 - c. Neither agree nor disagree
 - d. Disagree
 - e. Strongly disagree
20. Few students choose physics because there are very few careers related to the subject.
- a. Strongly agree
 - b. Agree
 - c. Neither agree nor disagree
 - d. Disagree
 - e. Strongly disagree

Thank you

(ii)	Geared to the level of learners				
(iii)	Gender sensitive				
(iv)	Language appropriate to the level of learners				
(v)	Teacher defines and e explains difficult terms				
(vi)	Used appropriate and familiar examples to illustrate concepts				
(vii)	Level of students involvement in the lesson				
(viii)	Motivation of the learners by the teacher				
(ix)	Stimulating/ captivating lesson				
3 Conclusion					
(i)	Attempted to make a conclusion				
(ii)	Lesson evaluation				
(iii)	Involvement of the learners in the lesson evaluation				
(iv)	Executed lesson as planned				

9) Effective use of teaching aids by the teacher.

- a. Outstanding
- b. Above average
- c. Average
- d. Below average
- e. Did not use

10) Events which indicated effective or ineffective use of instructional materials.

11) Assignment given to students after the lesson.

- (i) Adequate
- (ii) Inadequate
- (iii) Not available

12) Any signs of teacher motivating the students in the class.

13) Inclusion of humour to arouse interest and keep the class lively.

14) Teacher's rate of interaction with students.

- a. Outstanding
- b. Above average
- c. Average
- d. Below average
- e. Poor

15) Did the teacher relate the lesson with everyday's experience?

Yes
No

APPENDIX D
Interview Guide for Science Heads of Department

School _____

Number of year in teaching _____

Teaching subjects _____

- 1) How do you rate your students' entry behaviour?
- 2) Do you stream your students according to ability or do you do random streaming?
- 3) Is the choice of physics by students in Form Three random or according to ability?
- 4) Are learners given adequate illustrations and examples in relation to the experiences and the environment which they know?
- 5) a) According to you, is there a positive or negative attitude towards physics in the school? By;
 - i. Physics teachers _____
 - ii. Other teachers _____
 - iii. Administration _____
 - iv. Students _____
- b) (*If negative*) what is done by the teachers/ school administration to improve the attitude?
- 6) Are physics students encouraged to take a keen interest in mathematics and other sciences?
- 7) Are students aware of the job opportunities available when they pursue physics?
- 8) How often do you check teachers' schemes of work and lesson plans?
- 9) How often do you assess students in science department?
- 10) Which teaching approach/method is often employed by teachers in your department?
- 11) How does the teacher find out whether the students have learned what was intended?
- 12) How often do teachers check students' exercise books?
- 13) Do you choose those to take various sciences in Form Three or are they given a chance to choose?
- 14) In which way are science teachers motivated to do their work?
- 15) How do you ascertain that physics teachers remain motivated?
- 16) Are physics students taken out for academic trips?
- 17) Do Quality Assurance and Standard Education Officials make surprise visit or do they always announce their coming?
- 18) Do you inspect teaching in your department?
- 19) In your opinion, what do you think should be done to improve the performance of physics in your school?
- 20) How is the enrolment of physics in Forms Three compared to other sciences?

Appendix E
Students' Physics Achievement Test for Form Two and Three
Term One 2012

Name.....
 Class.....

Instructions

- ✓ This paper consists of 2 sections: Section I and II.
- ✓ Section I can be answered by both Form Two and Three students.
- ✓ Section II can be answered by Form Three students only.
- ✓ Each section consists of 25 marks.
- ✓ Form Two students should attempt section I only while Form Three students should attempt both sections.
- ✓ Marks may be awarded for correct working even if the answer is wrong.
- ✓ Scientific calculators and mathematical tables may be used.
- ✓ Show all working in the spaces provided

For examiner's use only

Section	Maximum score	Score attained
Section I	25	
Section II	25	
Totals	50	

SECTION I

1. When a small stone and a big one fall from the top of a building, which one will reach the ground first given negligible air resistance? (1marks)

2. A heavy axe is more effective in chopping firewood than a sharp knife. Explain. (2mark)

3. Describe a method you would use to estimate the thickness of a coin using a ruler. (2marks)

4. (a) Describe the concept of the mercury barometer (2 marks)

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(b) A mercury barometer reads 720mmHg at a certain altitude. How much pressure is this in N/m^2 (take the density of mercury to be 13.6 g/cm^3 and $g=10\text{N/kg}$) (3 marks)
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.....

5. In an experiment to determine the thickness of an oil molecule, a drop of oil was allowed to spread on clean water surface sprinkled with lycopodium powder. The oil spread to form a circular patch.

(i) State the function of the lycopodium powder. (1marks)
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.....

(ii) In such an experiment, a drop of oil of volume 0.012 cm^3 spread into a patch of diameter 28cm. Determine the thickness of the patch in M. Express your answer in standard form. (3marks)
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.....

(iii) What does this thickness represent? (1marks)
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.....

(iv) State one assumption made in this experiment.(1marks)
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6. (a) State two reasons why mercury is used as a thermometric liquid. (2 marks)
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(b) Why is it not advisable to sterilize a clinical thermometer by boiling it? (1marks)
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(c) How can a mercury thermometer be modified to become more;

(i) Sensitive. (1marks)
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.....

(ii) Accurate. (1marks)
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.....

7. (a) A fixed mass of pure water was cooled from 20°C to 0°C . Sketch a graph of volume against temperature for the cooling water. (2 marks)
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.....

(b) What name do we give to this phenomenon? (2marks).
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.....

SECTION II

- 8) A student gently placed a steel needle on water which floated making a small depression on the surface. After a small amount of detergent was poured next to the needle, it sunk. Explain this observation. (2marks)

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- 9) Water flows through a pipe that has two sections. Section A has an area of 0.5m^2 and section B has an area of 0.2m^2 . the velocity of the water in section A is 0.6m/s . Determine the velocity of water in section B. (3marks)

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- 10) An echo sounder in ship produces a sound pulse and an echo is received from the sea bed after 0.4 second. Given that the speed of sound in sea water is 1500m/s , calculate the depth of the sea. (3 marks)

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- 11) Use a diagram to show the formation of images by a concave mirror. (2 marks)

- 12) The diagram below shows how the displacement of a particle varies with time as a wave passes a fixed point.

- (a) Determine the periodic time and hence the frequency of the wave. (3 marks)

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.....
(b) On the same axis sketch a displacement – time graph with twice the frequency and half the amplitude (2 marks)

13. Two steel pins were attracted by a magnet as shown in the figure below. When a south pole was brought in between the two pins, they moved further away.

(i) Explain this observation. (2marks)

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.....

(ii) Label the poles A and B. (1marks)

14. The diagram below shows a uniform plank of wood 10m long balanced at its centre

Determine the weight of W in Newton. (3 marks)

15. (a) State Hooke's law. (1marks)

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(b) Three identical springs with negligible weight are arranged as shown in the figure below.

Given that the spring constant of each spring is 2N/cm , calculate the total extension due to 30N . (3marks)

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-End-

Appendix F
List of schools that participated in the study

S/N	School	Category
1	St Francis Girls	Provincial Girls
2	Kairi Boys	Provincial Boys
3	Gatunguru Boys	District Boarding Boys
4	Makwa Boys	District Boarding Boys
5	Gakoe Girls	District Boarding Girls
6	Kiriko Girls	District Boarding Girls
7	Ndekei	District day school (mixed)
8	Nyamthumbi	District day school (mixed)
9	St. Joseph The Worker	District day school (mixed)
10	Igegania	District day school (mixed)
11	Kairi Rumwe	District day school (mixed)
12	Kanjuku	District day school (mixed)

Appendix G
Copy of Research authorisation Permit

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Research Permit No. NCST/RCD/14/012/1088

THIS IS TO CERTIFY THAT:
Prof./Dr./Mr./Mrs./Miss/Institution
Simon Munene Kuria
of (Address) Kenyatta University
P.O.Box 43844-00100, Eldoret.
has been permitted to conduct research in

Location Gatundu	District Central
Province Central	

on the topic: Factors affecting enrolment and performance in physics among secondary school students in Gatundu District, Kenya.

for a period ending: 31st December, 2012.


Applicant's Signature
Secretary
National Council for Science & Technology