

**CONTRIBUTION OF SMASSE IN-SERVICE PROJECT ON
STUDENTS' PERFORMANCE IN MATHEMATICS IN KCSE
EXAMINATION IN NKUENE DIVISION, MERU COUNTY, KENYA.**

BY

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DECLARATION

This is my original work and has not been submitted to any other institution for any other program.

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DEDICATION

This research project is dedicated to the creator the Almighty God, who has granted me the physical and mental strength to undertake and accomplish this project in the prescribed period of time.

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The preparation of the research project called for co-operative efforts from several key individuals and institutions. However, while it might be impractical to mention all of them, some minimum crediting is inevitable.

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ABBREVIATIONS AND ACRONYMS

ASEI	-	Activity, Student-centered Experiment and Improvisation
BER	-	Bureau of Educational Research
DDC	-	Developing Commonwealth Countries
EFA	-	Education For All
INSET	-	In-Service Education and Training
JICA	-	Japan International Cooperation Agency
KCSE	-	Kenya Certificate of Secondary Education
KEMI	-	Kenya Education Management Institute
KIE	-	Kenya Institute of Education
KSTC	-	Kenya Science Teachers College
MOEST	-	Ministry of Education Science and Technology

- PDSI - Plan Do See and Improve
- SESEMAT - Secondary Science and Mathematics Teachers Project
- SMASE - Strengthening Mathematics and Science Education
- SMASSE - Strengthening Mathematics and Science in Secondary
Education
- SMASTE - Strengthening Mathematics Science and Technology Education

ABSTRACT

Strengthening Mathematics and Sciences in Secondary Education (SMASSE) Project as an educational innovation is an initiative of the Government of Kenya with support of the Japanese International Corporation Agency (JICA). SMASSE project was launched in 1998 as a measure to raise performance in mathematics and sciences in Kenya Certificate of Secondary Education Examination (KCSE). Despite the critical role mathematics education plays in promoting scientific and technological development, students' performance in the subject is quite poor. To this end the purpose of this study was to find out if SMASSE project had made an impact on students' performance in mathematics in KCSE Examinations in Nkuene Division, Meru County. The study was guided by Jean Piaget's (a constructivist and interactionist) theory of intellectual development which posts that knowledge is a construct of heredity and environmental factors. As the child develops and constantly interacts with the world around him or her, knowledge is invented and reinvented. The study adopted survey research design, a method of collecting information by administering questionnaires and by interviewing a sample of individuals. To obtain the study samples, proportionate stratified random sampling technique was used to select samples from boarding or day schools or boys, girls and mixed schools. Target population consisted of head teachers, mathematics teachers and form three students. From the sampled schools (nine out of eighteen), nine out of eighteen head teachers (50 %), thirty three out of seventy five (44 %) mathematics teachers and one hundred and eighty out of one thousand and eighty (17 %) form three students were sampled. Data was collected using questionnaire for students, mathematics teachers and head teachers, and an oral interview schedule for a SMASSE trainer. Questionnaires for teachers accessed the impact of SMASSE project on students' performance in mathematics in KCSE examinations. Questionnaires for student established whether teachers were applying the ASEI/PDSI approaches in teaching mathematics. Interview schedule for a SMASSE inset trainer in charge of mathematics came up with strengths, weaknesses and challenges in the implementation of SMASSE project. Document analysis revealed the teaching methods applied and the resources used in teaching/learning mathematics. Piloting was carried out in two purposively selected schools. From the two schools, the two head teachers filled the head teachers' questionnaire, four mathematics teachers' filled the mathematics teachers' questionnaire and twenty form three students filled the students' questionnaire so as to test the reliability of the research instruments. Data collected was analyzed using both descriptive and inferential statistics. The findings were that SMASSE project has contributed to improved performance in mathematics in KCSE examinations in Nkuene Division. Teaching methodologies that are learner centered have been adopted since the introduction of SMASSE project. This has greatly influenced students' attitude towards mathematics which has led to improved performance in KCSE examinations. This study has established the contribution of SMASSE project on students' performance in mathematics and the fact that there are no enough teaching/learning resources in the Kenyan schools. The study recommends that the ministry of education incorporate SMASSE training curriculum in the teacher training institutions involve teachers in planning of SMASSE programmes and emphasize more on ICT training. The ministry

should motivate teachers who have successfully undergone all the SMASSE insets through proper remuneration and promotion.

CHAPTER ONE

1.1 Introduction

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

1.2 Background to the Study

1.2.1 General Content of Strengthening Mathematics and Sciences in Secondary Education (SMASSE)

Shiundu and Omulando (1992) observe that in-service teacher education is a scheme of training in which participant teacher trainees attend an institution for training either as full time or as part time, during the professional life of the teacher. In-service education may consist of a carefully planned, sustained work over a lengthy period leading to further qualification in the form of an advanced certificate, diploma or higher degree. It may equally be a casual study, pursued irregularly in the evenings or during school vacations and in no sense leading to measurable recognition for purpose of salary or promotion. In the latter case, in-service education helps the practicing teacher to get informed with the latest innovations in the curriculum of his or her subject area. In this way, the teacher is most able to cope with new demands in his or her area of specialization as well as new approaches and methodology intended to enhance teaching and learning. This is the essence of Strengthening Mathematics and Sciences in Secondary Education (SMASSE) in-service project.

In-service training is important because of the explosion in knowledge and the need to have teachers keep abreast of new developments in knowledge. No teacher can claim to be fully equipped in knowledge sufficient to last him or her through his or her teaching career. Teacher in-service in Kenya is done through seminars and workshops for teachers organized by bodies such as Kenya Education Management Institute (KEMI), Kenya National Examinations Council (KNEC), Teacher Advisory Centres among others. SMASSE project was introduced in Kenya in 1998 by Japan International Corporation Agency to in-service Science and Mathematics teachers.

Before introduction of SMASSE project, performance in Kenya Certificate of Secondary Education (KCSE) examination in Mathematics had been dropping significantly and this became a major national concern. If Kenya was to become an industrialized nation by the year 2030, emphasis had to be put in the learning of Science and Mathematics. Japan International Corporation Agency (JICA) started SMASSE project in Philippines in 1994 and ended in 1997 after the four cycles. The Philippine's Government was left to carry on with the project and it has been quite effective up to date.

Japan International Cooperation Agency (2004) outlines that in Philippines the constructivists learning design is the major mode of teaching. In the constructivist design, the teacher designs the activities for learning rather than teaching, organizes what the student will do rather than what the teacher will do and assumes that the students construct their own knowledge on the basis of interaction with their environment. The constructivists assume that knowledge is a physical construct by learners who are

involved in active learning, knowledge is symbolically constructed by learners who convey its meaning to others and is theoretically constructed by learners who try to explain things they do not completely understand.

The primary message is that learners learn by being actively involved in the teaching/learning process. Learners create their own knowledge from situations in the environment. In this system, teaching is set to involve practical work. Practical work approach to the teaching and learning enables learners to get more interested in the subject matter. This is because they either see or perform by themselves and their interest in learning the subject is enhanced.

Secondary schools in Kenya have been performing poorly in KCSE creating worries among the parents, students and teachers. Due to this poor performance the Ministry of Education Science and Technology entered into joint venture with Japan International Cooperation Agency (JICA) to improve the performance in Mathematics, Biology, Chemistry and Physics, hence started a project which goes by the name 'Strengthening Mathematics and Sciences in Secondary Education' (SMASSE).

According to SMASSE INSET- Fact Finding Report (2004) Strengthening Mathematics and Sciences in Secondary Education in-service project, a Kenya government initiative in collaboration with the government of Japan through Japan International Co-operation Agency (JICA) started operating on a pilot basis in July 1998 in nine (9) districts namely Kisii, Kajiando, Maragua, Gucha, Makeni, Butere-Mumias, Kakamega, Murang'a and Lugari. In October 2000 its scope was extended under an in-country Training Program to

include an additional six (6) districts namely Meru South, Taita-Taveta, Kiambu, Kilifi, Baringo and Garissa.

In 2001 the project was expanded to other districts in the country. The project was introduced in Nkuene Division in 2004, which was then in Meru Central District but now in the Imenti South District. The SMASSE project was to be covered in four cycles. Cycle 1 emphasized on attaining a positive attitude change towards Mathematics and Science education among the stakeholders especially the teachers and the learners.

Cycle 2 was based on hands-on activities that were designed to address specific areas that were considered difficult and hence not adequately handled by the teacher. This provided opportunity to put into practice the principles of Activity Student-Centered Experiment and Improvisation (ASEI) movement and Plan Do See and Improve (PDSI) concepts.

1.2.2 Rationale behind Student-Centered Experiment and Improvisation (ASEI)

According to Oyaya (2000), Student-Centered Experiment and Improvisation (ASEI) Approach considers quality of classroom activities as critical to achieving effective teaching and learning and hence good performance in Mathematics. It therefore, religiously extols the virtues of teaching/learning that is first and foremost activity focused. These are meaningful hands-on (manipulation), minds-on (intellectual thinking, reasoning) mouths-on (discussions), heart-on (those that stir up the learners' interest/feeling about the subject) activities.

These activities should be student-centered designed to involve the participation of the learner as much as possible. The student centered teaching/learning activities involve

performing experiments. The rationale is the established fact that human beings are more likely to remember what they see more than what they are told. Apart from training the learners on how to handle apparatus/equipments, experiments also enhance learning by promoting curiosity and interest. While performing the experiments, the movement advocates for improvisation where conventional equipments/apparatus or chemicals/materials are not available. Improvisation may also be adopted. This is a case of more effective utilization of locally available materials in the learners' environment to improve learning.

1.2.3 PDSI Approach

To achieve the ASEI condition, SMASSE project came up with the Plan Do See and Improve (PDSI) approach to teaching.

-Plan

Apart from schemes of work and lesson plans, the teacher carefully plans and tries out the teaching/learning activities materials and examples before the lesson. Emphasis is on how instructional activities will enable the learner to;

- Understand individual concepts and connections among them
- Get rational/value for the lesson
- Get rid of the learning difficulties and misconceptions
- Have more interest in the lesson

-Do

The teacher carries out the planned lesson/activity as planned. Teachers are encouraged to;

- Be innovative in lesson presentation
- Present lessons in varied and interesting ways to arouse learners interest for example through role play, storytelling among others
- Ensure active learner participation
- Be a facilitator to the teaching/learning
- Deal with students questions and misconceptions
- Reinforce learning at each step

During INSETs, teachers carryout peer teaching on the ASEI lessons and later actualize in schools.

-See

The teacher evaluates the teaching and learning process during and after lesson using various techniques and feedback from students. Teachers also allow their colleagues to observe their lessons and offer feedback. It enables the teacher to

- See the good practices in the lesson and improve on the mistakes made in the earlier one
- Avoid earlier mistakes in future lessons

In the process, the teacher becomes more open to evaluation by fellow teachers, school administrators, quality and standards assurance officers and students.

-Improve

Reflect on the performance evaluation report and effectiveness in achieving the lesson objectives. This enables the teacher to;

- See the good practices in lesson and strengthen them
- See mistakes made in earlier lesson
- Avoid earlier mistakes in future lessons

The teacher makes use of such information in planning the next lesson to enhance performance and student learning.

It is an established fact that we are more likely to remember or internalize what we do than what we see or are told. According to Wafula and Njore (2005), the degree of retention increases with increase in use of senses.

The SMASSE project aimed at assisting to improve performance in Science and Mathematics through;

- 1) Motivating teachers and learners to change their negative attitude towards science and mathematics
- 2) In-servicing teachers through provision of new instructional methodologies for Mathematics and Sciences
- 3) Provide Science and Mathematics equipments, facilities and other teaching resources for common use

Since the introduction of 8-4-4 system of education in 1985, schools in Nkuene division have been performing poorly in Mathematics and Sciences in general. Poor performance is generally attributed to:

- i. Negative attitude towards Mathematics by the students

- ii. Large number of students per class
- iii. Minimum use of teaching aids
- iv. Wrong advice to students by the art based teachers (encourage students to concentrate on those subjects they are performing well at the expense of Mathematics)
- v. Poor methodologies and approaches to Mathematical concepts for example lecture method for teaching
- vi. Poor morale for teachers which is caused by poor performance by the students in the national exams
- vii. Students' failure to accept the fact that Mathematics is an important subject in technological advancement

However after the introduction of SMASSE project, it was expected that there would be marked improvement in performance in Mathematics.

Reasons for this include:

- a) Improved positive attitude among students towards Mathematics
- b) New methodologies and approaches towards teaching and learning Mathematics. These include symposiums for students, setting of form three mock exams and a common exam for form one and two at the end of the year
- c) Use of the "Hands on minds on" activities in lesson development which would make Mathematics more real, practical, and interesting as facts and principles taught could be verified

- d) Appreciate the fact that Mathematics is a vital subject in technological advancement

Cycle 3 majored on actualization of hands-on activities in cycle 2 inside the classroom situation. Cycle 4 emphasized on enhancing ASEI/PDSI practices in the classroom.

It is becoming widely accepted among educators that pre-service training is only but an induction into teaching profession. The researcher will find out the contribution of SMASSE project in improving Mathematics performance in KCSE in Nkuene Division by comparing the period before SMASSE project and the period after introduction of SMASSE project.

1.3 Statement of the Problem

In the Kenya education system, Mathematics is a core subject up to secondary school level of education, meaning that every student has to take Mathematics as one of the subjects of study. This is because Mathematics is a foundation for other fields such as medicine, engineering, architecture, agriculture and commerce. The attainment of vision 2030 requires that science and technology be at the core of learning. However, performance in Mathematics has been poor in Nkuene Division and the whole country at large resulting to a national outcry by all education stakeholders. This study sought to find out the contribution of SMASSE in-service project on students' performance in KCSE examinations, in Nkuene Division, Meru County. The Kenya government through the Ministry of Education in conjunction with the government of Japan came up with SMASSE In-service Education and Training (INSET) as a remedy to the problem.

Science and Mathematics teachers in Nkuene division had the opportunity to access the SMASSE inset. The researcher carried out the study to find out whether teachers are using resources to promote teaching/learning Mathematics, identify the main teaching methods used by teachers who have attended SMASSE in-sets and evaluate the students' attitude towards mathematics since the implementation of SMASSE project. Use of resources and proper teaching methods by teachers plus a positive attitude towards learning mathematics among students leads to good performance in examinations.

1.4 Purpose of the Study

The purpose of the study was to assess the contribution of SMASSE project on performance in Mathematics in KCSE examinations in Nkuene Division, Meru County. Nui and Wahome (2006) observe that the purpose of SMASSE is to upgrade the performance of young Kenyans in Science and Mathematics. SMASSE being an innovation, follow-up is necessary to assess its contribution towards performance in mathematics in KCSE examinations.

1.5 Objectives of the Study

The objectives of the study were:

1. To examine the role played by SMASSE project towards learning and good performance in mathematics in national examinations
2. To find out whether SMASSE project has enhanced teachers use of available resources to promote teaching and learning mathematics

3. To assess the contribution of SMASSE project towards students' positive attitude towards learning mathematics
4. To find out the main teaching methods advocated by SMASSE project to teach mathematics

1.6 Research Questions

1. What role has SMASSE project played towards learning and good performance in mathematics in national examination?
2. Has SMASSE project enhanced teachers' use of available resources to promote teaching and learning mathematics?
3. What is the contribution of SMASSE project towards students' changed attitude towards learning mathematics
4. Which are the main teaching methods advocated by SMASSE project to teach mathematics

1.7 Significance of the Study

The findings of the study will be important in establishing the effectiveness of SMASSE project in improving performance in Mathematics in KCSE exams. Results of the study will help establish the extent to which resources promote teaching and learning Mathematics. This will encourage the stakeholders particularly the art based head teachers to support Science and Mathematics teachers in the provision of teaching/learning resources. The government of Kenya and Japan will realize that its effort to promote learning and performance in Science and Mathematics is not in vain.

Finally, curriculum developers will see the need to incorporate SMASSE training in teacher training institutions so that all science and mathematics teacher trainees will undergo SMASSE training.

1.8 Assumptions of the Study

The study was guided by the following assumptions:

That the information that was given by the respondents was true.

That all Science and Mathematics teachers in secondary schools in Nkuene Division had undergone the four SMASSE project insets.

That resources in the SMASSE project centers are easily accessible for all teachers in Nkuene Division.

That schools can readily supply teachers with materials for improvisation.

That all students in Nkuene Division have their Science and Mathematics syllabus covered before they sit for their KCSE exam.

1.9 Limitations of the Study

The study was carried out in Nkuene Division in Imenti South District, Meru County although SMASSE project had been conducted in the whole country.

1.10 Delimitation of the Study

Research was conducted in selected secondary schools in Nkuene Division. The selected schools formed a representative of the total number of schools found in Nkuene Division.

In the selected schools, form 3 students filled the students' questionnaire, Mathematics

teachers filled the teachers' questionnaire, head teachers filled the head teachers' questionnaire and one SMASSE trainer was interviewed. The researcher used KCSE examination results for the years 2002 – 2003 (period before SMASSE project) and 2005-2006(period after introduction SMASSE project) for comparison.

1.11 Theoretical Framework

The study was based on Jean Piaget's Theory of Learning which posts that knowledge is a construct of interaction between heredity and environmental factors. A first principle drawn from Piaget's theory is that learning is an active process. Knowledge is a construction from interaction between the learner and the environment. As the child develops and constantly interacts with the world around him or her, knowledge is invented and reinvented. As far as education is concerned, the chief outcome of the theory of intellectual development is a plea that children be allowed to do their own learning. One cannot further understanding in a child by simply talking to him or her. Golby, Greenwald and West (1983) note that good pedagogy must involve presenting the child with situations in which he himself experiments, in the broadest term- trying things out to see what happens, manipulating symbols, posing questions and seeking his own answers, reconciling what he finds one time with what he finds at another, comparing his findings with those of others children. In this intellectual argument, scientific and mathematical abilities are stressed. These abilities include abstract and logical reasoning, generation of hypothesis and organizing mental activities into more complex structures. In Piaget's theory knowledge is assumed to have a specific role or purpose that is to aid a person in adapting to the environment. Piaget's central thesis is that the individual is

active, curious and inventive throughout the life cycle. Piaget discovered that children think and reason differently at different periods in their lives. He believed that everyone passed through an invariant sequence of four qualitatively distinct stages. Invariant means that a person cannot skip stages or reorder them.

The four stages are:-

Sensorimotor- birth to 2 years

Preoperational -2 years to 7 years

Concrete operational -7 years to 11 years

Formal operational -12 years and above

In the sensorimotor stage, the mental structures are mainly concerned with mastery of concrete objects. The mastery of symbols takes place in the preoperational stage. In the concrete operational stage, children learn mastery of classes, relations and numbers and how to reason. The last stage deals with mastery of thought. A central component of Piaget's theory of learning and thinking is that both involve the participation of the learner. Knowledge is not merely transmitted verbally but must be constructed and reconstructed by the learner. Piaget asserted that for a child to know and construct knowledge of the world the child must act on objects and it is this action which provides knowledge of those objects. The mind organizes reality and acts upon it. The learner must be active: he is not a vessel to be filled with facts.

A Piagetian- inspired curricula emphasizes a learner centered educational philosophy. Piaget espoused active discovery learning environments in our schools. Intelligence

grows through the twin process of assimilation and accommodation. Assimilation involves the incorporation of new events into pre-existing cognitive structures. Accommodation means existing structures change to accommodate the new information. Children need to explore, to manipulate, to experiment, to question and to search out for answers for themselves which are the components of ASEI-PDSI Approach. Instruction should be individualized as much as possible and children should have the opportunity to communicate with one another, to argue and debate issues.

Piaget saw teachers as facilitators of knowledge that is they are to guide and stimulate the students. Children are allowed to make mistakes and learn from them. Learning is more meaningful if the child is allowed to experiment on his own rather than listening to the teacher lecture. The teacher should present students with materials, situations and occasions that allow them to discover new learning. Virtual reality has the potential to move education from its reliance on books to experiential learning in naturalistic settings. This is the essence of SMASSE.

Mathematics provides opportunities to promote;

Spiritual development: Through helping pupils obtain an insight to the infinite and through explaining the underlying Mathematics principles behind some of the beautiful natural forms and patterns in the world around us.

Moral development: Helping pupils recognize how logical resources can be used to determine the consequences of particular decisions and choices and helping them learn the values of Mathematics truth.

Social development: Through helping pupils work together productively on complex Mathematical tasks and helping them to see that the result is often better than any of them could achieve separately.

Cultural development: Through helping pupils appreciate that Mathematical thought contributes to the development of our culture and is becoming increasingly central to our highly technological future and through recognizing Mathematics from many cultures have contributed to the development of modern day mathematics.

SMASSE project is an innovation and an innovation is about change. Innovation is one type of change in which something new is added to an existing phenomenon. Shiundu and Omulando (1992) observe that an innovation is an idea or practice which is perceived as new but at the same time, it can mean the process of initiating something new and spreading it through the system. Robbins and DeCenzo (2008) contend change as an alteration of an organization's environment, structure, technology or people. Change in an organization is a reality. Change is brought about by external and internal forces. Technology is an external force while composition of an organization's workforce changes in terms of age, education and gender.

SMASSE project is about change.

- Change from the old teacher-centered learning approach to the new learner-centered learning approaches.
- Change from the old theoretical way of learning to the new ASEI/PDSI Approach.

All the above opportunities enhanced and the teacher transmits to the learners a comprehensive mastery of the skills, chances will be high that the learner will be able to adopt the skills and apply them hence earning high grades. This exhibits the SMASSE inset.

1.12 Conceptual Framework

Before implementation of SMASSE project Mathematics performance in KCSE in the country was very poor. SMASSE project came into intervene. The project was geared towards application of new orientation in terms of approaches and methodologies and also in terms of priorities and policies. Attitude has a far -reaching influence in almost every aspect of a person's mode of operation. It influences perspectives and hence decisions and actions. Attitude is the primary force that determines whether we succeed or fail.

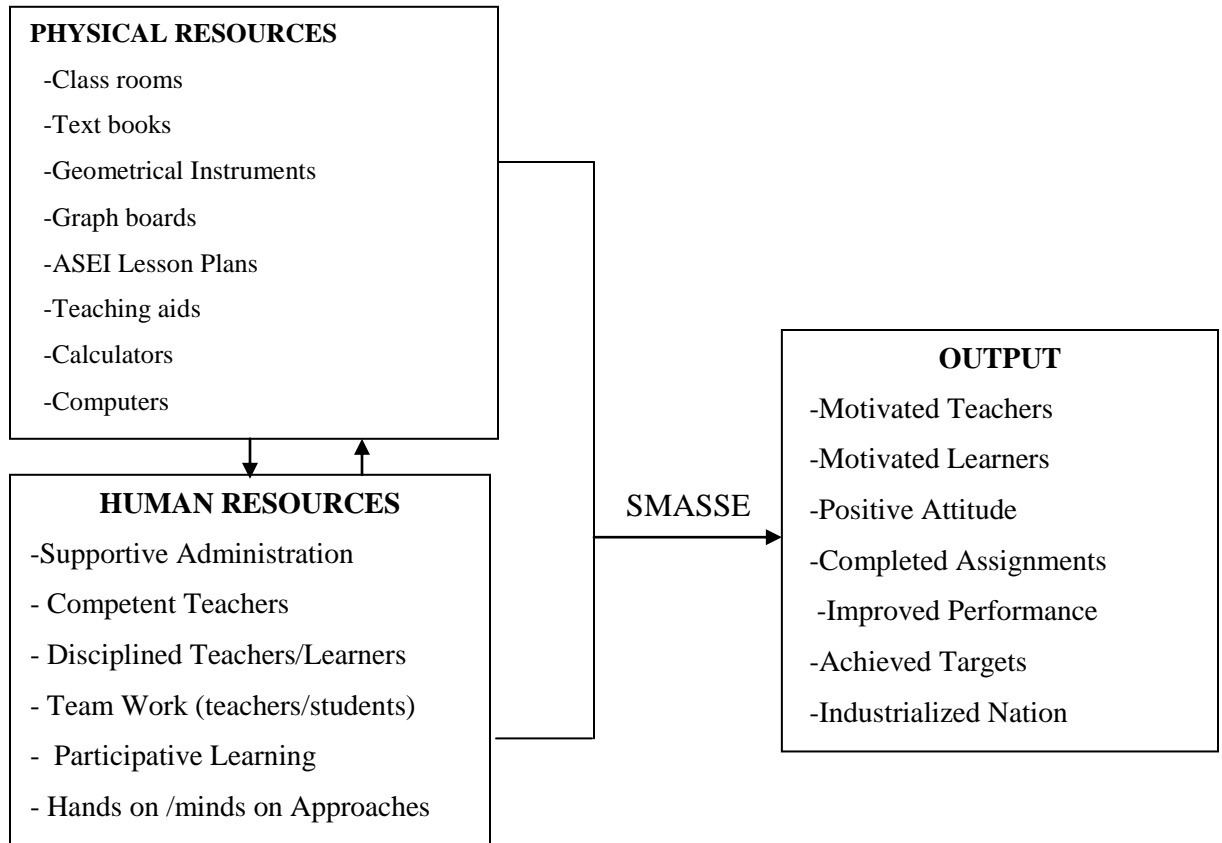


Fig 1.1:SMASSE Project expected output.

Source: Adopted from Orodho (2009: 120)

In figure 1.1 Interaction between physical resources and human resources produce the desired output of good performance. Availability of classrooms, textbooks, geometrical instruments, graph boards together with use of ASEI lesson plans, teaching aids and calculators provide the essential tools for a successful lesson delivery. However, without supportive administration, competent teachers, teamwork and disciplined teachers and learners, it would be difficult to have a lesson well taught. Proper interaction between physical and human resources yield motivated teachers and learners, positive attitude, improved performance and achieved targets. SMASSE project was the vehicle used to deliver by way of in-servicing teachers which was intended to improve performance in Science and Mathematics hence the achievement of vision 2030.

1.13 Operational Definition of Central Terms

Approach	-	Way of thinking or dealing with a situation
Attitude	-	Having inclined interest and emotion towards Mathematics
Inset	-	Workshop
Pedagogy	-	Study or theory of methods and principles of teaching
Performance	-	Ability to score grade C and above in Mathematics
Project	-	An organized programme of instruction
Resource	-	Is any physical or virtual entity of limited availability that needs to be consumed or used to obtain the desired output or response.
Stakeholders-		Persons or institutions with interest in education matters of a country

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter reviews literature on conceptual issues in Mathematics, importance of learning and good performance in Mathematics, use of resources and how they affect learning and performance in mathematics and students' attitude towards Mathematics and how it affects performance in KCSE exams.

2.2 Conceptual Issues.

The current reform efforts in Mathematics and Science education recognize the crucial role that teachers play and thus target them as curriculum innovators and implementers through In-Service Education and Training (INSET). There is a growing consensus that improving students' performance depends on the teaching force with appropriate beliefs and attitudes towards teaching/learning. While initial teacher training nurtures these characteristics, it is insufficient to prepare teachers for greater challenges of everyday teaching where time constraints and pressure from summative assessments overwhelm both the newly qualified and experienced teachers. Whereas in-service teacher education compliments initial teacher training, there is lack of adequate and appropriate opportunities for most practicing teachers to enhance their skills and align their practice to the reform visions in education.

Background to the SMASSE projects in Africa, is the Jomtien declaration of Education For All (EFA) in 1990 that marked a shift of Japan's focus from "hardware" type of

projects for example supply of school equipment and construction of school buildings to “software” areas in basic education. In addition, at the General Conference of the United Nations Conference on Trade and Development (UNCTAD) in 1996, Japan expressed her interest in supporting education development in Africa. In a paper presented during the 7th SMASSE-WECSA (West, East, Central and South Africa) annual conference held in Lusaka Zambia, JICA recognized the need for assistance for improving the quality of education, teacher training, school administration and management.

Japan has a history of in-service teacher training, that is experience of linking Mathematics and Science education to industrial applicability and enhanced employability, a unique approach to reforming industrial practices through lesson study. Within this background, the initiatives in Africa in which Japan plays a significant role, seek to strengthen mathematics and science education and enhance learners’ ability through improved teachers’ mastery of content and pedagogical skills.

Ho Stein (2005) notes that initiatives include Strengthening of Mathematics and Science in Secondary Education (SMASSE-Kenya, SMASSE-Niger, SMASSE-Malawi and the proposed SMASSE-Rwanda), Strengthening of Mathematics and Science Education-Nigeria (SMASE-Nigeria), Secondary Science and Mathematics Teachers Project-Uganda (SESEMAT-Uganda) and Strengthening of Mathematics, Science and Technology-Zambia (SMASTE-Zambia). These projects are best suited for most African counties and developing countries which face severe resource constraints since they focus on strengthening education within the existing structures, emphasize the need for

mobilization of resources and recognize the value for building consensus on educational issues. Other visions include science and mathematics teachers' with opportunities for continuous professional development, facilitating collegiality and collaborating teachers of specific disciplines and incorporating change process in professional development.

Ministry of Education Science and Technology (2005) notes that issues of reform in education require informed policies that recognize the need for change to appreciate possible challenges and set guidelines for effecting the changes in Mathematics education. The Kenya Education Support Program (KESSP) recognizes the need for professional development with constrained resources and outlines other policy measures regarding funding for various education initiatives.

Center for Mathematics, Science and Technology Education in Africa was established in Kenya in 2006 to offer in-service education in mathematics and science. Hitherto, it is housed as a department of Kenya Science Teachers College (KSTC) in terms of financial management and has a quasi-autonomous administrative structure that is running its programs. The project has grown from being a department under KSTC to a full-pledged INSET centre in CEMASTEKA-Karen in Nairobi. Nui and Wahome (2006) observe that CEMASTEKA was granted legal identity through a legal notice No 96 published in Kenya Gazette Supplement No 45 and released on 23rd June 2006. This is an indicator of the Kenyan Government support towards development of Mathematics and Science education in Kenya and Africa. The overall goals of SMASSE project were upgrading the capability of the young Kenyans in mathematics and science education. The project's

purpose was to strengthen the quality of mathematics and science education at secondary schools through training teachers. The following were the main outputs of the project.

- i) A system of training for the district trainers in the pilot districts in Mathematics and Science was established at KSTC
- ii) A system of inset in Mathematics and Science was to be established in pilot districts
- iii) The role of KSTC and district inset centers was to be strengthened

FINANCING

SMASSE project had three main sources of finances

a) JICA

This source of fund catered for the following activities in the project

- 1) Kenya counterparts training in Japan
- 2) Secondment of long term and short term Japanese experts
- 3) Provision of training materials and equipment at national and district insets
- 4) Local expenses for Japanese experts

b) MOEST

The Ministry of Education Science and Technology provided funds that enabled the following activities to be undertaken

- 1) Salaries to Kenyan counterparts attached to the project
- 2) Travel and subsistence for Kenyan counterparts outside Nairobi

- 3) Training materials for INSETS
- 4) Accommodation and meals for national INSET
- 5) Assistance for the SMASSE account
- 6) Provision of the office to the national INSET unit

c) District Head teachers Association

The heads association through the District Education Board (DEBs) authority had to raise funds towards the project's activities. These funds were directed towards

- i. Accommodation for trainers and participants in the district level
- ii. Travel allowances for participant to national and district levels
- iii. Facilitation allowances to trainers at district level
- iv. Provision of basic materials at district level
- v. INSETS organizational costs within districts
- vi. Repair and maintenance of provided equipment

In-service education and training in Mathematics and Sciences began in 1998 with the launch of SMASSE project. The project was a joint technical cooperation between the Government of Kenya through Ministry of Education and Government of Japan through JICA. SMASSE came into being when consistently poor performance in Mathematics and Sciences (Biology, Physics and Chemistry) became a serious matter of concern. Broad curriculum, lack of facilities and inadequate staffing were always cited as the major cause of the problem. Although poor performance in these subjects had almost been accepted as a norm in some schools, the Ministry of Education Science and

Technology (MOEST) and other stakeholders felt that an intervention was inevitable, hence the launch of SMASSE.CEMASTEAs has brought primary education on board and is laying strategies and developing lessons on Information Communication Technology (ICT) integration in learning mathematics and sciences.

2.3 Importance of Learning and Good Performance in Mathematics

Life is about Mathematics and Mathematics is about life. National Council of Teachers of Mathematics (2003) notes that Mathematics is important for life and therefore good performance in the subject is vital. Knowing Mathematics can be personally satisfying and empowering. The under- pinnings of everyday life are increasingly mathematical and technological for example making purchasing decisions, choosing insurance or health plans and voting knowledgeably all call for quantitative sophistication. Mathematics is part of cultural heritage. It is one of the greatest cultural and intellectual achievements of human kind. Citizens should develop an appreciation and understanding of that achievement including its aesthetic and recreational aspect.

Mathematics is important at the work place. Just as the level of Mathematics needed for intelligent citizenship has increased dramatically so too has the level of mathematical thinking and problem solving needed in the work place in professional areas ranging from health care to graphic design.

Good performance in Mathematics is essential for scientific and technological advancement. Although all careers have foundation of mathematical knowledge some are

Mathematics intensive. More students must pursue an educational path that will prepare them for lifelong work as mathematicians, statisticians, engineers and scientists. In this changing world those who understand and can perform well in mathematics will have significantly enhanced opportunities and options for shaping their future. Mathematical competence keeps doors to productive future open. All students should have the opportunity and the support necessary to learn significant Mathematics with depth and understanding.

Gates (2003) points out that mathematics promotes pupils spiritual, moral, social and cultural development. Spiritually pupils obtain insight on the principles behind patterns in the world around us. Morally students develop logical reasoning in making decisions and choices. Socially Mathematics helps pupils develop the spirit of working together. Cultural development is through pupils appreciating that mathematics is a culture.

Mathematics is important for its utilitarian value, hence learners should put extra effort to ensure that they perform well in the subject. Mutunga and Breakell (1992) say that it is difficult to transact the normal business of the day without some mathematics. Mathematics provides a highly effective means of conveying information in a concise and precise form. Mathematics helps to develop powers of logical thinking. Some students will find delight in mathematical puzzles which helps them grasp and understand relationships.

There is a general feeling that every child should study mathematics at school. Mondoh (2005) observes that mathematics provides a means of communication which is powerful, concise and unambiguous. Accordingly, she outlines that:-

Mathematics is fundamental to the study of physical sciences and engineering. Mathematics is increasingly being used in Medicine and Biological Sciences, in Geography and Economics, Business and Management Studies and operation of Industry and Commerce.

Mathematics helps to develop powers of logical thinking, accuracy and spatial awareness. Mathematics provides an inherent interest and appeal to most children and adults and teaching it will lead to increased mathematical understanding.

Mathematics holds some instrumental importance and competence in it could become a ticket to opportunity, careers and lifestyle. This may lead to status and power.

Good performance in mathematics has economic benefits. A numerate population is necessary for future prosperity.

The Commonwealth Secretariat Report (2002) contends that the future depends on a popular understanding and application of science. Hence, human resource development in science and mathematics is crucial to build a critical mass of skilled people. The report further says that Africa needs scientifically literate citizens who can promote development by:

- Better decision making about science and technology which impacts on everyday life thus promoting an improved quality of life in a participating democracy.
- Providing the workforce with appropriate skills for delivery of quality products for national and international markets, thereby promoting economic growth and social development.

- Producing scientists and technologists to solve local problems and create innovations that can be put into commercial use at national and international level.

Orton and Wain (1996) note that we live in a society that is increasingly dependent upon mathematics as a way of representing, communicating and predicting events, information and future trends. Employment is subject to radical changes through the use or introduction of Mathematics into specific situations or processes. Aeroplanes are a twentieth – century invention and a mathematical theory of aerodynamics is required to help design them reliably. Outside physics, environmental workers had become great users of methods of statistical design and inference especially in biology and then came the World War II. Griffiths (1974) states that during World War II, science of operational research and the related ‘systems analysis’ was established using particularly the techniques of linear algebra and inequalities as well as statistical methods.

It is appropriate to analyze the usefulness of mathematics education provided in most of the Developing Commonwealth Countries (DCC) for employment and other aspects of national life. Most of the inherited colonial education and traditional school leavers have only been interested in white collar jobs.

Mathematics Education in the Commonwealth (1982) indicates that educationists and curriculum development bodies in the Developing Commonwealth Countries have shown genuine concern for the relevance of school mathematics to employment. The syllabus was recast to provide commercial mathematics and technical Mathematics in addition to general Mathematics.

2.4 Use of Resources in Teaching and Learning Mathematics

A resource is any physical or virtual entity of limited availability that needs to be used to obtain a desired output or response. Resources offer very powerful image for representing and understanding number operations which children are able to internalize and subsequently use for mental calculation. Resources includes good mathematics textbooks, drawing instruments, measuring instruments, geometric models, materials for numeration and computation for example calculators, items for demonstrating probability, equipments for demonstrating weight among others. SMASSE project emphasize that teachers design, use locally available resources and students' real life situations to improvise teaching/learning materials that enhance learner participation and scientific skills all geared towards students' improved performance in national examinations.

Gates (2003) notes that there is no Mathematics in a resource. The Mathematics is brought to the resource by those who interact with it or is developed by them as they use it to support their thinking. Resources enable teachers to follow and interact with children thinking more directly and they make relationships between numbers more apparent. Resources have strong visual and tactile appeal that relates well to how children learn and enable children to explore the properties of numbers independently of the teacher.

Mondoh (2005) acknowledges that active experimentation in which a child handles concrete objects and observes what happens precedes the formal operation stage in learning mathematical ideas. Each time a model is used in the classroom, it should play a positive role in providing deeper student understanding of Mathematics. Models illustrate

a specific concept, provide a basis for development or are used as a vehicle for student discovery.

Visual aids used should incorporate the basic ideas of the topic under consideration and should be exploited extensively over a long period of time so that the structure it offers can be assimilated. As far as possible they should be available as large model for class demonstration and small model for individual pupil to use.

Teachers no longer rely upon chalkboard, blackboard and textbooks. There are commercially available resources, resources prepared by the teacher and students and resources available within the community. Bell (1978) states that teaching and learning resources are used to improve students' interest in Mathematics, to motivate, drill and practice of skills, to illustrate and clarify mathematical concepts and principles and to provide remedial work for slow learners and supplemental activities for faster or highly motivated students.

Children may arrive at a concept partly as a result of logical reasoning and partly because of their experiences with manipulating objects. Mutunga and Breakell (1992) note that a teacher must create an environment wherever the desire to learn is stimulated and where children are free to make mistakes, manipulate objects in order to discover mathematical concepts.

Models are very useful to modern man because they help him to clarify his thoughts and problems. Models are devices which can help pupils to solve their problems, discover or

create new ideas, systems, relationships, generalizations, express ideas and facilitate creative thinking. Model making is also a useful and meaningful activity for slow learners. Wilkins (1976) asserts that teaching aids are resources that the teacher employs when teaching to supplement oral explanations and descriptions. Teaching aids can be visual (to look at and handle) or audio (to listen to). Teaching aids may be part of the school equipment or the teacher may make them him or herself. SMASSE project emphasizes on improvisation of locally available materials to aid in teaching.

Features of well-designed visual aids comprise of

- Purpose; The information in the aid must help the pupils in learning, must be relevant to the lesson

- Simplicity; Must be understood by the pupils, unnecessary details are excluded

- Accuracy; No mistakes of facts or spelling, no misinformation

- Clarity; All details on the aid can be easily seen and read by the pupils furthest away from it

- Attractive; The pupils like looking at it, it holds their interest.

2.5 Students' Attitude towards Learning Mathematics

According to Newstrom and Davis (2002), attitudes are feelings and beliefs that largely determine how one perceives their environment, commit themselves to the intended actions and intimately behave. For one to perform well in a certain task, he or she should be positively motivated. Positive attitude motivates one to work and the end result is good performance. Positive attitude towards Mathematics leads to good performance. Ndimbirwe (1975) notes that lack of interest, motivation and confidence makes students

view Mathematics as a hard subject. Further he points out that there is a belief that mathematics is a God given gift for a few only. Mediocre expectations by parents, teachers and society that males should do better than females in Mathematics discourage the girls from doing well. According to Lenga (2001), in everything we do, success is determined by the attitude with which we appreciate it, and in most cases, we become what we think. If students are to do well in Mathematics then they should change their attitude towards the subject and parents at home should make a contribution by telling the children the importance of Mathematics, check on children's work, buy them the necessary learning materials and let them attend extra classes.

Mouly (1973) says that if the teacher is pleasant, enthusiastic about his subject and sensitive to the needs of his students, the latter may develop favorable attitudes towards the teacher and the subject. If the teacher is punitive, the child will tend to develop negative attitudes towards the teacher and towards the subject. This will prevent the child from doing well and will serve to reinforce his or her dislike for the subject.

Pupils learn attitudes as well as mathematical content from their classroom experiences. Orton and Wain (1996) note that the solution to overcoming the negative reaction of pupils to open problems is never to allow such attitudes to develop. This can only be achieved by pupils experiencing problems and investigations from the moment they enter the reception class or the first standard or grade. If the approach is continued through subsequent classes, standards or grades, pupils' perceptions of Mathematics will be quite different from what is found to be the case at the present time.

Orton (1991) drew attention to the possibility that a liking for Mathematics stemmed from preferred style of study. Mathematics does not involve the learners in revealing emotions or opinions to others and hardly involves any communication with others the fact that mathematics provide 'a beautiful safe haven from the fears and anxieties of life' is attractive to some. He also showed that pupils often perceive the Mathematics classroom as being a place for competition which is attractive to some and not to others. A competitive atmosphere can act as an incentive for successful pupils and for less successful pupils a negative attitude to Mathematics is the outcome. Attitudes particularly like and dislike, attractions and aversion, interests and antagonisms are traceable to strong emotional experience or to incidents or associations of a definitely pleasant or unpleasant nature. They are also built up by means of many different forms of experiences. Such experiences include what one is told, see or read. The information may be true, distortion of the true or it may be wholly false. Performance in mathematics may be influenced by the student's attitude towards the subject. Those who do well in the subject have positive attitude towards it and those who do poorly have negative attitude towards the subject.

Students who believe Mathematics is difficult attend Mathematics classes unwillingly and simply do not put a lot of effort since they already believe they will never do well. Some of these students end up joining the teaching profession, carrying with them the fear of Mathematics. Consciously or unconsciously, they make pupils believe that Mathematics is difficult and that it is suitable for the gifted few. That it is possible to shift attitudes of pupils in a desired direction by means of suitable instructional material has

been shown by some studies for example musical interest may be increased by suitable musical training. The same leaf can be borrowed for Mathematics. Teachers should direct their efforts towards attitude development as well as academic growth. A teacher's own attitude is also very important. A teacher is not likely to succeed in training others to enjoy what he himself does not appreciate. Therefore Mathematics teachers should avoid comments such as 'Mathematics is difficult' in presence of their students and also teachers teaching other subjects.

In summary, teachers who received SMASSE training expressed the view that SMASSE in-service training was practically useful. Due to the success of SMASSE project, students participate in lessons more actively by encouraging teachers to use their ingenuity. Moreover, students' willingness to learn increases and the number who choose science and mathematics is increasing. Performance in mathematics has been increasing over the years.

2.6 Teaching Methods

Teaching methods comprises the principals and methods used for instruction. The choice of an appropriate teaching method depends largely on the information or skill that is being taught and it may also be influenced by the aptitude and enthusiasm of the students. In addition, it is common in a class to have a variety of teaching methods in any particular subject. Teachers need to use different teaching methods in order to reach all students effectively. A variety of teaching strategies, knowledge of students' levels, and an evaluation of which strategies are best for particular students can help teachers to

know which teaching methods will be most effective for their class. SMASSE in-set addresses pedagogy and content mastery by teachers. Learner-centred approaches through the Activity-Student-Experiment-Improvisation (ASEI) pedagogic paradigm and the Plan-Do-See-Improve (PDSI) approach are the focus of SMASSE in-set all of which are geared towards promoting good performance in national examinations. Teachers design, use locally available resources and students' real life situations to improvise teaching/learning materials that enhance learner participation and scientific skills. In Kenya all lessons used to be teacher centered with the teacher writing on the blackboard and explaining everything to the students. Mathematics and Science lessons were no exception. It was difficult to engage students with this style of lesson. One of the main objectives in starting SMASSE project was to change the teacher centered lessons to student centered lessons and hence improved performance in Science and Mathematics.

Direct Instruction- Direct instruction is the most common form of instruction. This is the lecturing method of teaching. Many teachers use this teaching method almost exclusively, as it is considered the simplest and the teacher can cover large amounts of work in a short period of time. However, this is not the most effective teaching method to reach all students especially the low achievers and the young ones, who often need a more engaging hands-on strategy in order to learn effectively hence not advocated by SMASSE movement.

Inquiry-Based Learning- This is a method which is rapidly gaining popularity. Based on the scientific methods, this teaching method can be used for virtually all subjects. Using inquiry-based method, learning takes a lot of time, energy and planning but it is often very effective. Students practice problem solving and critical thinking skills to

arrive at a conclusion. This teaching method is extremely student-centred and student-directed and can be modified for students at any level. The method is highly used in teaching/learning mathematics and is particularly used by teachers who have undergone SMASSE training.

Cooperative Learning- In cooperative learning, students are put in small groups to work together. Students are usually not grouped by ability, but put in a group with children at a variety of levels. The students are then given tasks to accomplish together. Teachers may need to monitor these groups carefully to make sure they are staying on task and that all students are participating.

Demonstration- Demonstration is the process of teaching through examples or experiments. For example a science teacher may teach an idea by performing an experiment for students. A demonstration may be used to prove a fact through a combination of visual evidence and associated reasoning. Demonstrations are similar to written storytelling and examples in that they allow students to personally relate to the presented information. Demonstrations help to raise students' interest and reinforce memory retention because they provide connections between facts and the real world application of those facts. Demonstration method is commonly used in mathematics lessons particularly by teachers who have attended SMASSE in-sets in handling topics such as surface area of solids using models.

If the teacher finds the best teaching method for a particular group of students, the students are likely to learn more quickly and be more engaged. In addition, using a variety of teaching methods will keep children from being bored, and help them encounter the information in new and exciting ways.

2.7 Summary of Literature Review

The main challenge addressed by SMASSE in-service programme is the quality of teaching which needs to be strengthened and made effective for quality performance in national examinations. Good performance in mathematics as a subject is very important in the changing society. Mathematics promotes spiritual, moral, social and cultural developments. Mathematics is essential for scientific and cultural community. Teaching and learning Mathematics is promoted by use of resources. Gates (2003) points out that using physical apparatus helps make learning easier. He notes that using something tangible and visible helps pupils draw connections more easily and makes the learning experience more memorable by relating different sensory areas. Encouraging a child manipulate some physical resource can help to make an otherwise more abstract idea more concrete.

Poor performance in KCSE is attributed to attitude. Attitudes are carried by both students and teachers. A student who has lost hope in doing well in the subject will not put extra effort and is bound not to do well. A teacher whose attitude is negative will not make an extra effort to assist the students.

There is a great deal of pressure on the high school students to do well in Mathematics. Experts recommend building strong foundation in the principles of mathematics in order to reduce challenges students encounter both in classroom and beyond. To ensure that children receive quality education in Mathematics, their progress need to be monitored and the important role Mathematics will play in life emphasized. Whether or not a student plans on pursuing a technical career, chances are that he/she will have to work

with numbers or with people who work with numbers. To minimize children's potential and increase their odds of succeeding in a competitive and increasingly numerical world, children who are in high school should possess the following mathematical skills:-

- i. They should employ a high level of abstract, symbolic thinking
- ii. They should perceive relationships and be able to make translations among fractions, decimals and percentages
- iii. They should deal easily with a wide array of equations, formulas and proofs
- iv. They should be able to explain and illustrate mathematical formulae rather than simply apply them
- v. They should know how to plan and self-monitor during multi-step problem solving
- vi. They should feel comfortable using calculators and computers

SMASSE in-service training came up in the 21st century. The role of science was emphasized hence the training was timely. Establishing the effects of SMASSE in-set on students' performance would provide monitoring and evaluation information. It avails stakeholders with useful and timely information to manage and guide resources and interventions. Kusek&Rist (2004) observe that the feedback would help incorporate lessons learned in decision making process hence secure the highest possible quality of education provision. Evaluation information can raise the need for re-examination of the presumed cause of a problem and what alternative counter measures might be needed. Similarly, SMASSE training may fail to show any consequences to the performance of

students due to poor implementation or that the real problem was not addressed hence need for re-examination.

Innovations typically are assimilated into an organization through a series of steps. Likewise, SMASSE in-set was supposed to go through steps for purposes of successful implementation. Introduction of SMASSE was geared towards emphasizing the importance of Mathematics in the changing world, contribution of resources in teaching and learning Mathematics and changing the attitude of teachers and learners to promote learning and uplift performance in national examinations.

CHAPTER THREE

RESEARCH METHODOLOGY AND DESIGN

3.1 Introduction

This chapter deals with research design, locale of the study, target population, sampling, research instruments, and data collection technique and analysis.

3.2 Research Design

The study adopted survey research design, a method of collecting information by administering questionnaires and by interviewing a sample of individuals. Questionnaires for teachers assessed the impact of SMASSE project on students' performance in KCSE examinations. Questionnaire for students established whether teachers were applying the ASEI/PDSI approaches in teaching Mathematics. Questionnaire for head teachers assessed the provision of teaching/learning resources in mathematics whereas the interview schedule for a SMASSE in-set trainer in charge of Mathematics came up with strengths, weaknesses and challenges in the implementation of SMASSE project. Information gathered helped assess the contribution of SMASSE project students' performance in national examinations.

3.3 Locale of Study

The study was carried out in Nkuene Division in Imenti South District, Meru County. Over the years, performance in mathematics in KCSE examinations had improved significantly and therefore the researcher sought to investigate the contribution of SMASSE project towards this improved performance since its inception. Nkuene Division covers an area

of 131.45 Square Kilometers. It extends over a cool and wet climate on the western part where tea is grown and warm and wet climate on the eastern part where coffee is grown. The area under study is mainly rural since only two schools are located in the urban Nkubu town which is the divisional headquarter. From Nkubu to Meru town is a distance of fourteen kilometers. A majority of the schools are served by murram roads making them accessible throughout the year. The division is on the south-western direction of Meru town.

3.4 Target Population

Out of a total of eighteen secondary schools in Nkuene Division, there are four boys' schools, four girls' schools and ten mixed day schools. The target population constituted eighteen (18) headteachers, seventy five (75) teachers of Mathematics and one thousand and eighty (1080) Form 3 students yielding a total population of one thousand, one hundred and seventy three (1173). Head teachers gave an insight on the provision and availability of teaching/learning resources. Mathematics teachers provided information on the teaching methods used to teach mathematics and the extent of their use of resources to promote learning. Form 3 students helped acquire information about changed attitude towards learning mathematics and the importance of good performance in mathematics.

3.5 Sampling Procedure

Proportionate Stratified random sampling was used. Orodho (2009) notes that in many education and social science studies, the sample should be selected in such a way that you

are assured that certain sub-groups in the population will be represented in the sample in proportion to their numbers in the population itself. Such sub-samples are usually referred to as stratified samples. Respondents were 9 head teachers (50%), 33 mathematics teachers (44%) and 158 form three students (14.63%) of the total population. The study consisted of three strata namely boys' boarding schools, girls' boarding schools and mixed day schools. Form 3 class was purposively selected based on the following criteria.

- i. They had learnt mathematics for the previous two years
- ii. They had covered over half of the syllabus content
- iii. They were the incoming candidates

Two schools were purposively selected for piloting purposes. Figure 3.1 shows population and samples that were used by the researcher.

Table 3.1 Population and Samples

Type of Subject	Population	Sample	Percentage
Head Teachers	18	9	50.0
Maths Teachers	75	33	44.0
Form 3 Students	1080	180	16.7
Total	1173	222	

3.6 Research Instruments

Research instruments that were employed included questionnaires and interview schedule.

3.6.1 Questionnaires

Questionnaires were appropriate in enabling the researcher gather a large amount of data from many subjects economically.

Sets of questionnaires were prepared to help in data collection. These included

- a) One set of the questionnaires for head teachers which obtained information about their opinion about SMASSE project that is the impact of the project on performance in KCSE.
- b) The second set of questionnaires was for Mathematics teachers to establish whether SMASSE project had in any way influenced teaching, learning and performance in Mathematics.
- c) The last set of the questionnaires was for students to establish whether teachers were applying the ASEI-PDSI Approaches in teaching Mathematics and if the approaches simplified learning the mathematics.

3.6.2 Interview Schedule

Interviewing method for the SMASSE Trainer allowed the researcher to investigate and prompt things that could not be observed for example attitude of students could not be observed. The method probed the interviewee's thoughts, values, prejudices, perceptions, views, feelings and perspectives about the SMASSE project.

3.6.3 Observation Guide

The researcher used an observation guide to analyze whether the schools had an operating libraries and the availability of teaching/learning resources. This also helped the researcher determine whether teachers were using the available teaching/learning resources and the teaching methodologies employed by teachers in the classrooms. In addition, the researcher examined instructional documents such as syllabi, schemes of work, records of work, teachers' notes and course evaluation results. Quantitative data was collected from KCSE results booklets.

3.7 Piloting

Piloting was carried out in two purposively selected schools to ensure the research instruments were of acceptable validity and reliability.

3.7.1 Validity of the Research Instruments

Validity refers to the degree to which an instrument measures what it is supposed to measure. Validity was determined by using a panel of persons who judged how well the measuring instrument met the standards. Validity was tested by discussing the instruments with supervisors and other specialists in the department of Educational Management, Policy and Curriculum Studies, Kenyatta University.

3.7.2 Reliability of the Research Instruments

Reliability is the measure of degree to which research instruments yields consistent results or data after repeated trials. To test reliability, a pilot study was carried out in two

purposively selected schools. The head teachers, mathematics teachers' and form three students were used to test the reliability of the instruments. Split half method of assessing reliability was used. According to Orodho (2009), split half method is a technique of assessing reliability that requires only one testing session. This method involved dividing the test into two halves to calculate the extent of correspondence or reliability between the halves. If the test is reliable, the scores on the two halves will have a high positive association. An individual scoring high in one half would tend to score high on the other half. A reliability coefficient was computed to indicate how reliable the instrument was.

A correlation coefficient (r) of 0.85 was considered high enough to judge the reliability of the research instruments.

3.8 Data Collection Technique

Data collection started after acquisition of a research permit from Government Research Control Office in Nairobi with the help of School of Graduate Studies, Kenyatta University. The researcher acquired an introductory letter from the District Education Office. The researcher personally delivered the questionnaires to the schools selected for study. With the help of head teachers, the concerned respondents were able to fill in the questionnaires within the same day which resulted to independent responses and a high rate of return. An observation guide was used to find out the teaching methodologies and availability of teaching /learning resources. The researcher conducted an oral interview schedule to a SMASSE in-set trainer in charge of Mathematics. The researcher experienced problems in accessing the schools which were far from each other and poor

road networks. Time was also a challenge since the researcher could visit only one school in a day.

3.9 Data Analysis

Data analysis refers to examining raw information that has been collected from the field and making deductions and inferences. It involves uncovering underlying structures, extracting important variables, detecting any anomalies and testing any underlying assumptions. Orodho (2009) asserts that data analysis is the lifeline of a research and that the method of analysis is the backbone and conduct wire. The researcher did data editing, coding, classification and tabulation. After data collection, the researcher also scrutinized the instruments for completeness, accuracy and uniformity. Data collected was analyzed using both descriptive and inferential statistics. Descriptive statistics involved tabulating data. Data collected was coded and entered in the computer for analysis using the Statistical Package for Social Scientists (S.P.S.S) to generate tables and compute percentages. Findings were reported by use of frequency tables and percentages. Inferential statistics was used to draw conclusions and generalizations for the whole of Nkuene Division using information taken from a representative of nine schools. The researcher attempted to determine the relationship between the dependent and independent variables. Not only did the researcher find out if a relationship existed, but also its direction. KCSE mathematics mean scores for the years 2002-2003 (period before SMASSE project) and 2005-2006 (period after SMASSE project) were computed for comparison.

CHAPTER FOUR

RESEARCH

FINDINGS, INTERPRETATION AND DISCUSSION

4.1 Introduction

This chapter details the data analysis, presentation of study findings, interpretation and discussion. The data was analyzed and organized regarding general information (including gender, level of education, position held and type of school). The researcher established the impact of SMASSE project in improving Mathematics performance in KCSE in Nkuene Division by comparing the period before SMASSE project and the period after introduction of SMASSE project. The respondents' opinion and suggestions formed basis of what can be done to improve the situation at hand. The analysis was based on the four research questions formulated from the objectives. The responses were obtained from principals, teachers, students, SMASSE trainer and observation by the researcher in schools in Nkuene Division. Table 4.1 presents the questionnaires rate of return.

Table 4.1 Questionnaires Rate of Return

Items	Delivered	Returned	Percentage
Head Teachers	9	9	100
Maths Teachers	33	33	100
Form 3 Students	180	158	88

All the nine principals responded and returned their questionnaires and all the thirty three teachers responded and returned their questionnaires. On the side of students one hundred and fifty eight returned their questionnaires. This was made possible by the fact that the researcher delivered the questionnaires personally and waited for the respondents to respond on the questionnaires. However, a small percentage of the students withheld their questionnaires and others returned them blank.

4.2 Demographic Data

Demographic data is the characteristics of the sampled respondents in this study. The study questionnaires were administered to the principals, teachers, students, and an interview schedule for the SMASSE trainer and an observation guide by the researcher from the sampled nine secondary schools of Nkuene Division.

4.2.1 Respondents Gender for Students

An item was included in the students' questionnaire, which sought information on the gender of the respondents. The study targeted both male and female respondents from public secondary schools in Nkuene Division. The students who returned their questionnaires were 158. Table 4.2 presents the number of respondents by gender for students.

Table 4. 2 Numbers of Respondents by Gender for students

Gender	Frequency	Percentage
Male	96	60.8
Female	62	39.2
Total	158	100

Figure 4.2 shows that a majority of the respondents were male and this was due to the fact that from mixed day schools, most of the form three students were male. This was attributed to the fact that there was a high rate of girls' dropouts due to unwanted pregnancies in form two and lack of school fees and demand for child labour. MaendeleoyaWanawake (1999) notes that some of the causes of school dropout in Kenya include early marriage, pregnancy, low self-esteem, lack of school fees, harassment by male teachers and fellow students and low value placed on the education of girls by their parents and society in general. In social economic context, Eshiwani (1993) notes that in areas where there is demand for child labour or where there are employment detractors, school quality is adversely affected.

4.2.2. Level of Education for Principals and Teachers of Mathematics

The study sought to establish the academic qualification of the principals and the teachers who were sampled and the results are reflected on the Table 4.3.

Table 4. 3 Principals and Teachers Academic Qualification

Academic Qualification	Principals	Percentage	Teachers	Percentage
Masters & Above	1	11.1	1	3
BEd	8	88.9	24	72.7
BA/BSC with PGDE	0	0	1	3
BA/BSC without PGDE	0	0	2	6.1
Diploma	0	0	1	3
Others	0	0	4	12.1
Total	9	100	33	100

On academic qualification for principals, majority had a degree in education where 11.1% of principals' respondents were masters degree holders. On the other hand, almost three quarters of the teachers had a degree in education. From the remaining group of teachers, majority comprised of university students on long vacation who had been engaged by schools' Board of Governors to assist in teaching. Academic qualification of teachers directly affects teaching and learning mathematics in the sense that teachers who have had professional training are able to use the right teaching methods to teach mathematics. This agrees with Sessional Paper No 4 of 2005 which notes that the current Government programmes for teacher education aim at providing qualified teachers and are therefore central to ensuring the provision of quality education. Majority of secondary school teachers are trained at public universities and diploma colleges and are required to specialize in two teaching subjects upon graduation. Trained teachers are those who have been awarded a teacher's certificate by the ministry of education. Teachers' colleges give

courses in preparation for the certificate examination. There are two kinds of courses, pre-service and in-service. Eshiwani (1993) observes that the pre-service is a full time residential course while the in-service course consists of residential sessions in the college during school holidays and radio and correspondence lessons during the term. The objectives of teacher education programmes aim at developing communication skills, professional attitudes and values that equip a teacher with the knowledge and ability to identify and develop the educational needs of the child. These teachers also know the importance of using resources in learning. Guidance and counseling sessions enable teachers to emphasize the importance of learning and good performance in Mathematics. Above all, most of these teachers have had SMASSE training.

4.3 Importance of Good Performance in Mathematics

Some items were included in the students' questionnaire, which sought information on their thinking about the importance of learning and good performance in mathematics, and the results reflected on the following table.

Tables 4.4 Students Opinion on Performance in Mathematics

Students opinion on Maths	Frequency		%	
	Yes	No		
Mathematics as favourite subject	121	37	76.6	23.4
Have personal study time table	153	5	96.8	3.2
Target career demand you pass Maths	142	16	89.9	10.1
Mathematics remain compulsory	130	28	82.3	17.7

From Table 4.4 majority of the students said that their target career demand that they do well in mathematics and that mathematics should remain a compulsory subject in the school curriculum. Mutunga and Breakell (1992) are of similar opinion and note that mathematics is important for its utilitarian value and that it is difficult to transact the normal business of the day without some mathematics. Better still, three quarters of the students agreed that Mathematics was among their favourite subjects. National Council of Teachers of Mathematics (2003) concurs by noting that knowing Mathematics can be personally satisfying and empowering.

4.3.1 Students' Personal Time Table on Performance in Mathematics

An item sought information on Math's preference in the time table. Results reflected on the Table 4.5

Table 4.5 Frequency of Mathematics in the Students' Personal Study Time Table.

Times	Frequency	Percentage
None	5	3.2
Once a Day	75	47.5
Twice a Day	36	22.8
Once a Week	12	7.6
Twice a Week	30	19.0
Total	158	100

From table 4.5 majority of the students agreed to be practicing Mathematics while for a negligible percentage, Mathematics did not appear in their timetables at all. Frequency of

Mathematics in the student's personal study time table shows how often the student practices Mathematics. Eshiwani (1993) notes that in any lesson, the work of the pupils is far more important than the work of the teacher. In Mathematics, lessons will usually start with explanations and demonstrations mixed with questions by and to the teacher followed by practice e.g. exercises during which the teacher discovers and corrects common errors and gives extra attention to the pupils with learning difficulties. Students who practice Mathematics often have a positive attitude towards the subject. Lenga (2001) is of the same opinion and notes that in everything we do, success is determined by attitude with which we appreciate it and we become what we think. Students wish is to perform well in Mathematics and that is why they have accorded it ample time for practice. This implies that students regard Mathematics as an important subject in their careers.

4.3.2 Students Personal Study Time Table and Discipline in its use

An item was included in the questionnaire, which sought information on the way students follow their time table, and the results reflected on the Table 4.6.

Table 4.6 Students' Personal Time Table Adherence.

Follow Time Table Strictly	Frequency	Percentage
Yes	79	50
No	78	49.4
N/A	1	0.6
Total	158	100

For students, preparing a personal study timetable is one thing and adhering to it, is another. Table 4.6 shows that only half of the students are keen to follow their time table strictly. This can be tied together with students' attitude towards mathematics which is generally negative and hence poor performance in exams. Eshiwani (1993) observes that in preparing a timetable, lessons with similar kinds of learning should not immediately follow each other but instead there should be regular rest periods and lessons requiring the most physical and mental activity should be timetabled early in the day. Quite often, student's study timetable reads mathematics early in the day but students end up reading other subjects which they perform well in. Good performance in mathematics is enhanced by regular practice and the fact that half of the students do not follow the timetable strictly implies lack of practice in the subject.

In summary, Mathematics is a subject all children take in school. Some children love mathematics while others struggle. Many careers require strong mathematical foundation. Engineers, scientists, mathematicians, accountants and doctors all require exceptional math skills. Strong math skills are not just for the aforementioned careers. Small business owners, construction workers, librarians and even homemakers all use math to some degree. The problem solving processes used in mathematics classes develop logic skills. Taking time to work through math problems and arrive at the correct answer teaches children persistence and perseverance. Outside the school, students engage in activities such as crafts, tinkering with electronics or cookery which all indirectly relate to the problem solving abilities learned in school. The Commonwealth Secretariat Report (2002) contends that the future depends on a popular understanding and application of

science. Hence, human resource development in science and mathematics is crucial to build a critical mass of science oriented people. From the study findings it is clear that the students in Nkuene Division understand the importance of learning and good performance mathematics.

4.4 Teaching/Learning Resources in Mathematics

An item was included in the questionnaire, which sought information on the teaching/learning resources in the school, and the results reflected on the Table 4.7.

Table 4.7 Principals’ Opinion on Provision of Resources

Resource type	Frequency		Percentage	
	Yes	No	Yes	No
Adequate teachers	1	8	11.1	88.9
Teachers seminars	9	0	100	0
Teaching resources	8	1	88.9	11.1
School library	5	4	55.4	44.4
Motivational speakers	9	0	100	0

Resources comprised of both human and physical. From Table 4.7 all principals said they sponsor their teachers for seminars and invite motivational speakers. This helps improve attitude of both the teachers and students. A majority of the principals said they provide teaching resources but don’t have adequate teachers of Mathematics which is a

contributing factor to poor performance in mathematics. Due to shortage of Mathematics teachers, classrooms are overcrowded and this makes it impossible for the teacher to give special attention particularly to the low achievers. Teachers are overwhelmed with high workloads making them rush over the syllabuses. Eshiwani (1993) notes that the harmful effects of unsatisfactory teaching in mathematics and science are made worse by the grave shortage of textbooks, science apparatus and teaching materials and by large classes found in many schools. Barely half of the principals said their schools have libraries. Availability of reference books enhances students practice in mathematics. SMASSE project emphasizes on the importance of availability and use of resources in promoting teaching and learning of mathematical concepts. Bruce (2005) observes that teaching aids are an essential part of learning process. He notes that it is important for pupils to have a variety of learning experiences. If teachers provide materials that add interest to the lesson, this can help to reinforce learning.

4.4.1 Materials Prepared by Teachers of Mathematics

An item was included in the observation guide, which sought information on the teaching/learning resources prepared by the teachers, and the results reflected on Table 4.8.

Table 4.8 Instructional Materials Prepared by Teachers of Mathematics

Instructional materials	Frequency		Percentage	
	Yes	No	Yes	No
Lesson Notes	9	0	100	0
Schemes of Work	9	0	100	0
ASEI Lesson Plans	4	5	44	56
Record of Work	6	3	67	33
Performance Record	9	0	100	0

From the results in Table 4.8, teachers from the nine sampled schools were preparing lesson notes, schemes of work, performance records but one third of the respondents were not preparing record of work while slightly more than half were not preparing ASEI lesson plans. Teachers who take time to prepare instructional materials go to class well prepared and deliver the content better than those who do not prepare. Scheme of work enables the teacher to plan for the available time and is able to finish the syllabus on time making it possible for the teacher to spare time for revision before students sit for exams. Performance record enables the teacher to keep track of students' performance and hence plan on how to assist the low performers. ASEI lesson plan which is highly advocated by SMASSE project enables the teacher to effectively deliver in a lesson by setting the lesson objectives of which the teachers is able to tell whether he or she has been able to achieve by the end of the lesson.

4.4.2 Mathematical Instruments and Models

An item was included in the observation guide, which sought information on the teaching/learning resources available in the schools and the results reflected on table 4.11

Table 4.9 Mathematical Instruments and Models

Are there teaching aid materials like:	Frequency		percentage	
	Yes	No	Yes	No
Cube	9	0	100	0
Cuboids	9	0	100	0
Sphere	9	0	100	0
Cone	9	0	100	0
Frustrum of a cone	7	2	87.5	12.5
Pyramids	9	0	100	0
Frustrum of a pyramid	7	2	77.8	22.2
Prisms	9	0	100	0
Meter rule	9	0	100	0
Protractor	9	0	100	0
Set squares	9	0	100	0
Pair of compasses	9	0	100	0
Clinometers	0	9	0	100
Playing cards	1	8	11.1	88.9
Dice	0	9	0	100
Mathematical sets	9	0	100	0
Calculators	9	0	100	0
Measuring tape	9	0	100	0
Mathematical tables	9	0	100	0

From the results reflected on table 4.9, all the schools have the required mathematics instruments apart from a few instruments like dice and clinometers where all the

respondents said they don't use. Majority of the school had frustrum of a pyramid and cone while a small fraction of the schools was using playing cards. Availability and use of mathematical instruments and models enables the teacher to create curiosity and capture interest of the learners. Models illustrate a specific concept, provide a basis for development or are used as a vehicle for student discovery. SMASSE project advocates for use of teaching aids as a vehicle to deliver concepts that students find difficult to perceive and to make abstract ideas appear real.

4.4.3 Library Materials

An item was included in the students questionnaire, which sought information on whether their schools had a library and the results reflected on table 4.12.

Table 4.10 Students' Response on Availability of a School Library.

Have a library	Frequency	Percentage
Yes	109	69
No	49	31
Total	158	100

Table 4.10 shows that slightly more than two thirds of the students said that their schools had libraries.

4.4.4 Availability of Library Reference Materials

An item was included in the students questionnaire, which sought information on whether their school had a library and if the reference materials were readily available and the results reflected on table 4.13.

Table 4.11 Availability of the Reference Materials from the Library

Availability	Frequency	Percentage
Yes	74	46.8
No	84	53.2
Total	158	100

Table 4.11 indicates that less than half of the libraries had adequate reference materials. Availability of reference materials gives students a wide field for revision. Exposure of students to concepts explained by different writers enables students to grasp concepts and retain them too. This gives students confidence when it comes to sitting examinations.

4.4.5 Students' Opinion on the Relevance of the Library Materials

An item was included in the students questionnaire, which sought information on whether the library reference materials are relevant and the results reflected on table 4.14.

Table 4.12 Students' Opinion on the Relevance of the Reference Materials

Relevance Level	Frequency	Percentage
Very Relevant	45	28.5
Relevant	49	31.0
Irrelevant	10	6.3
Not Available	54	34.2
Total	158	100

Table 4.12 shows that in one third of the schools, reference materials were not available and in a few others the materials were irrelevant. However, in slightly more than half of the schools reference materials were relevant. Relevant materials comprised of books that were in use before the syllabus was revised. Very relevant materials were revision books, bound past examination papers and few class texts. Relevant library materials contain content that is recommended in the school curriculum. Anything else outside this may distract the students leading to poor performance in examinations.

4.4.6 Adequacy Level of the Library Materials

An item was included in the principals and students questionnaire, which sought information on the adequacy teaching/learning resources available in the school's library and the results reflected on table 4.15.

Table 4.13 Opinion of Principals/Students on Adequacy of the Library Materials

Adequacy Level	Students	Percentage	Principals	Percentage
Very Adequate	23	14.6	0	0
Adequate	61	38.6	1	11.1
Inadequate	74	46.8	4	44.4
N/A	0	0	4	44.4
Total	158	100	9	100

Table 4.13 shows a contradiction between the principals and students on adequacy of library materials. While the principals said library materials were not very adequate, some students agreed that they were very adequate. To the principals, very adequate means availability of books to the students in the ratio one to one while to the students' availability of few copies may be interpreted as adequate. A number of the principals said that their schools did not have libraries. This means that they have rooms which serve as a library but are not stocked with books. Adequate reading materials enable students to revise even in the absence of the teacher especially over the holidays.

4.4.7 Teaching Aids

An item from the students' questionnaire, sought information on the usefulness of teaching/learning aids and the results reflected on table 4.13

Table 4.14 Students' Opinion on Usefulness of Teaching Aids

Useful	Frequency	Percentage
Yes	101	63.9
No	8	5.1
N/A	49	31
Total	158	100

Table 4.14 shows the opinion of students on the usefulness of teaching aids. More than half of the students agreed that teaching aids are very useful as they promote learning. Bell (1978) concurs by noting that teaching and learning resources are used to promote students' interest in mathematics, motivate, drill and practice of skills, to illustrate and clarify mathematical concepts and principals and provide remedial work for slow learners and supplemental activities for faster or highly motivated students. Teaching aids enable the teacher to explain abstract concepts to appear real while the students are able to visualize imaginary concepts. Wilkins (1976) observes that teaching aids are resources that the teacher employs when teaching to supplement oral explanations and descriptions and to use in demonstrations. They can be visual (to look at and handle) or audio (to listen to – tapes, records, radio). They may be part of the school equipment or the teacher may make them by him or herself. As a general rule, every lesson requires some kind of teaching aid. Students with poor attitude towards mathematics may not understand concepts in the absence of teaching aid. SMASSE project advocates use of teaching aids to promote teaching and learning mathematics.

4.4.8 Use of Teaching Aids and Involvement of Students in their Preparation

An item from the students' questionnaire, sought information on the use of teaching/learning resources by the teachers and whether they involve their students in their preparation and the results reflected on table 4.15.

Table 4.15 Students' Opinion on Teachers' use of Teaching Aids & their Involvement

In use	Frequency		Frequency	
	Yes	%	Yes	%
Teachers use	101	63.9	57	36.1
Engages students	65	41.1	93	58.9

Table 4.15 indicates that majority of the teachers use teaching aids and but less than half said that they involved their students in the preparation of the teaching aids. Teachers did not engage their students in preparation of teaching aids due to time factor. Majority of the teachers had high teaching loads and therefore were not able to spare some time to engage the students in preparation of teaching aids. Mondoh (2005) notes that active experimentation in which a child handles concrete objects and observes what happens precedes formal operation stage in learning mathematical ideas.

Resources offer very powerful image for representing and understanding number operations which children are able to internalize and use for mental calculations. Gates (2003) notes that there is no mathematics in a resource but mathematics is brought to the

resource by those who interact with it or is developed by them as they use it to support their thinking. After analyzing the results it was clear that all teachers are using various teaching resources. All teachers were preparing lesson notes, schemes of work and performance records. The teachers were using teaching aids such as cubes, cuboids, sphere, cone, frustrum of a cone, pyramids and frustrum of a pyramid. Models illustrate a specific concept, provide a basis for development or are used as a vehicle for student discovery. SMASSE project advocates use of teaching and learning resources as they are used to improve students' interest in mathematics, to motivate, drill and practice of skills, to illustrate and clarify mathematical concepts and principles and to provide remedial work for slow learners and supplemental activities for faster or highly motivated students.

4.5 Students' Attitude towards Mathematics

An item from the students' questionnaire, sought information on their performance in mathematics and the results reflected on table 4.16.

Table 4.16 Students' Performance in Mathematics

Score scale	Frequency	Percentage
01-29	51	32.3
30-49	32	20.3
50-60	39	24.7
61-79	29	18.4
80-100	7	4.4
Total	158	100

Table 4.16 shows that almost one third of the respondents said their performance range between 0-29 marks and a relatively small number scored between 80-100. More than half of the students score less than 50%. This is contributed by poor attitude towards mathematics. For one to perform well in a certain task, he or she should be positively motivated. Positive attitude motivates one to work hard and the end result is good performance. Ndimbwire (1975) notes that lack of interest, motivation and confidence makes students view mathematics as a hard subject. The results in table 4.16 explain why Nkuene division has been registering poor results in KCSE exams. In cases where students have positive attitude towards mathematics, they spare more time to practice the subject and this leads to good performance. SMASSE project is about attitude change.

4.5.1 SMASSE Attedance by the Teachers

An item from the principals and teachers questionnaire, sought information on the SMASSE attendance by the teachers and the results reflected on table 4.17

Table 4.17 SMASSE Cycle Attended

Cycle	Teachers	Percentage	Principals	Percentage
Cycle 1	1	3	-	-
Cycle 2	2	6.1	-	-
Cycle 3	9	27.3	1	11.1
Cycle 4	12	36.4	2	22.2
Cycle 4& ICT	5	15.2	1	11.1
N/A	4	12.1	5	55.6
Total	33	100	9	100

From Table 4.17 it is evident that over one third of the teachers had attended SMASSE INSETS up to cycle 4. Teachers who had not attended SMASSE insets up to the fourth cycle comprise those who had enrolled but later dropped to enroll for other programmes like postgraduate diploma in education, degree and masters degree programmes. The other group was the lady teachers who had been out on maternity leave. Teachers who had not attended any of the INSETS comprised of the newly employed and the untrained teachers. School principals who had not attended any of the INSETS belong to art based subjects. Teachers who had attended SMASSE insets were using resources and student centered teaching methodologies to teach mathematics. The teachers also took time to encourage students on attitude change and emphasized the importance of good performance in mathematics.

4.5.2 SMASSE Training Benefits

An item from the teachers' questionnaire sought information on the SMASSE attendance by the teachers and whether it was voluntary and the results reflected on table 4.18.

Table 4.18 SMASSE Training Benefits & Attended Voluntary

Attended	Beneficial	Percentage	Voluntary	Percentage
Yes	20	60.6	13	39.4
No	2	6.1	12	36.4
N/A	11	33.3	8	24.2
Total	33	100	33	100

Table 4.18 shows that majority of the teachers had positive regard towards SMASSE programmes as they agreed that it is beneficial in their teaching profession. On attendance quite a number of teachers agreed to have attended the INSETS without external pressure. This means that teachers are applying concepts learnt from SMASSE insets in teaching mathematics. This explains why there was a marked improvement in performance in results trend over the years in which a majority of the headteachers agreed that there has been a notable improvement in performance in Mathematics.

4.5.3 Students' KCSE Results

An item from the principals' questionnaire, sought information on KCSE results before SMASSE and after SMASSE and the results reflected on table 4.19.

Table 4.19 Results before SMASSE and after SMASSE Project.

Comparison	Frequency	Percentage
Improved	6	66.7
Similar	1	11.1
N/A	2	22.2
Total	9	100

From Table 4.19referring to schools that had done the KCSE examinations majority noted improved performance. However in others schools, no comparison could be made since the researcher used results for years up to 2006. By this time some of the schools particularly the mixed day schools had not registered candidates for KCSE exam. The

results in table 4.19 show that a greater majority of the schools in Nkuene division registered notable improvement in KCSE mathematics results after the introduction of SMASSE project. This implies that SMASSE project can be rated a success.

4.5.4 Results Trend over the Years

An item from the principals' questionnaire, sought information on the performance trends in mathematics over the years after SMASSE was implemented and the results reflected on table 4.20.

Table 4.20 Results Trends over the years

Results Improved	Frequency	Percentage
Yes	8	88.9
No	1	11.1
Total	9	100

Table 4.20 shows that majority of the respondents said that the results had improved which was attributed to SMASSE methodologies used in teaching, students changed attitude towards mathematics and use of resources in teaching and learning mathematics.

4.5.5 Influence of the Improved Performance

An item from the principals' questionnaire, sought information on the influence of the improved performance and the results reflected on table 4.21.

Table 4.21 SMASSE Influence on the Results

Influenced	Frequency	Percentage
Yes	7	77.8
No	2	22.2
Total	9	100

Table 4.21 demonstrates that SMASSE programme contributed positively to improved performance in mathematics. Teachers applied SMASSE methodologies in content delivery which also helped change attitude of the learners.

4.6 Teaching Methods Applied by Teachers of Mathematics

An item from the teachers' questionnaire wanted to test the main teaching methods applied by teachers of mathematics and the results reflected on table 4.22.

Table 4.22 Statements on Teachers Use of Instructional Methods.

Teachers Instructional approach	Frequency %		Frequency %	
	(Yes)		(No)	
Adopted the ASEI-PDSI approach	15	45.5	18	54.6
Use teaching/Learning aids	31	93.3	2	6.1
Aids promote teaching	33	100	0	0
Engage learners in making T/L aids	26	78.8	7	21.2
Administration support on T/L aids	31	93.9	2	6.1
Use discussion method	31	93.9	2	6.1
Use lecture method	11	33.3	22	66.7
Use Demonstration method	22	66.7	11	33.3
Use Question & Answer	28	84.8	5	15.2
Emphasize importance of Maths	29	87.9	4	12.1

From the results in Table 4.22 all teachers agreed that teaching aids promote learning. Majority of the teachers use teaching/learning aids, engaged learners in making teaching/learning aids, used discussion, demonstration, question and answer methods in teaching and also took time to emphasize to students the importance of learning and good performance in mathematics. Less than half of the teachers said they were using lecture method and had adopted ASEI-PDSI approach to teaching. All the instructional methods used by teachers are all advocated by SMASSE project.

4.6.1 Teaching Methods

An item from the observation guide wanted to test the main teaching method applied by teachers of mathematics and the results reflected on table 4.23.

Table 4.23 Instructional Methods used in Classes by Teachers

Instructional method used	Frequency %		Frequency %	
	(Yes)		(No)	
Discussion	8	100	0	0
Lecture	6	75	2	25
Experiment	0	0	8	100
Demonstration	7	87.5	1	12.5
Project	0	0	8	100
Brainstorming	3	37.5	5	62.5
Cooperative learning	2	25	6	75
Question & Answer	8	100	0	0

Using the results in Table 4.23 all schools were using discussion and question & answer methods to teach Mathematics. Majority of the schools used lecture and demonstration methods of teaching. A small proportion used brainstorming and cooperative learning while none used project method.

According to Oyaya (2000), Student-Centered Experiment and Improvisation (ASEI) movement and Plan Do See and Improve (PDSI) concepts considers quality of classroom activities as critical to achieving effective teaching and learning and hence good performance. It embraces virtues of teaching/learning that are first and foremost activity focused. These are meaningful hands-on (manipulation), minds-on (intellectual thinking, reasoning), mouths-on (discussions) and hearts-on (those that stir up the learner's interest/feeling about the subject) activities. Use of teaching/learning aids and their preparation by learners and use of instructional methods like discussion method, experiment, brainstorming and question and answer methods provides for learners participation. These activities should be student-centered designed to involve the participation of the learner. The rationale is the established fact that human beings are more likely to remember what they see more than what they are told. Experiments enhance learning by promoting curiosity and interest. While performing experiments, improvisation is encouraged for effective utilization of locally available materials in the learner's environment to improve learning.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND
RECOMMENDATIONS

5.1 Introduction

This chapter gives a summary of the main findings, conclusions and recommendations. The findings are presented according to the research objectives and the research questions formulated from the objectives and the respondents' opinions on what can be done by the ministry of education to improve SMASSE project.

5.2 Summary of the Findings

This study sought to investigate the contribution of SMASSE project on students' performance in mathematics in KCSE examination in Nkuene Division, Meru County, Kenya.

5.2.1 Importance of Learning and Good Performance in Mathematics

From the study findings it is clear that the students understand the importance of learning and good performance in Mathematics. Majority of the students were practicing mathematics with their main aim being to perform well in KCSE examination. Majority of the respondents agreed that their target careers demand that they do well in Mathematics. SMASSE project was started with the sole purpose being to promote performance in Mathematics and Sciences. Since the inception of SMASSE project performance in Mathematics in KCSE examinations has been improving with the mean

score increasing from 4.686 which is a C- (minus) in 2002-2003 to an average of 5.749 which is a mean grade of C (plain) for schools in Nkuene Division.

5.2.2 Use of Resources to Promote Teaching/Learning Mathematics

Resources are aids that transmit information and learning via senses. They include books and programmed devices of instruction, visual materials including charts, three dimensional aids such as models and realia. Through use of resources in teaching and learning, a number of skills may be developed in students. From the research findings, the head teachers in Nkuene Division agreed to be providing resources such as text books and models for use by teachers and students. However, the head teachers acknowledged the fact that mathematics teachers are inadequate. Teachers design, use locally available resources and students' real life situations to improvise teaching/learning materials that enhance learner participation. Students agreed that teachers were using models like cubes, cuboids, sphere, cone, and pyramids among others. SMASSE project advocates use of teaching/learning materials to enhance learning.

5.2.3 Students' Attitude towards Learning Mathematics.

From the research findings, the researcher concluded that students' attitude towards learning Mathematics had changed to be positive. Two thirds of the respondents were scoring thirty marks and above in the exams. Majority of the students said that mathematics was among their favourite subjects and that it should remain a compulsory subject in the school curriculum. Students also agreed to have a personal study timetable which they were following closely and that their target career demands that they pass

well in mathematics. SMASSE project addressed attitude change among students which was initially negative. Improved mean scores over the years in Nkuene Division is an indicator that students' attitude had changed from negative to positive.

5.2.4 Teaching Methods Applied by Teachers of Mathematics

SMASSE project is very particular on pedagogy. Learner centered approaches through Activity- Student- Experiment- Improvisation (ASEI) pedagogic paradigm and the Plan- Do- See- Improve (PDSI) approach are the focus of SMASSE inset. In Nkuene Division, teachers who have undergone SMASSE training are extensively using the discussion and demonstration methods of teaching. Discussion method enables the learner to air out his or her views on the subject of discussion. Discussion method can also be used by students to clarify concepts not clearly understood in class as the teacher is teaching. Demonstration teaching is the process of teaching through examples or experiments. Demonstrations help to raise the students' interest and reinforce memory retention because they provide connections between facts and the real world application of those facts. Discussion and demonstration methods of teaching have made learning become more interesting as they arouse curiosity of the learners. This has led to improved performance in national examinations among students in Nkuene Division.

5.3 Conclusion

After the analysis of the research results, the researcher concluded that the objectives of the research were supported by the data and the research questions answered. It is

apparent that SMASSE project has contributed greatly to improved results in Nkuene Division, Meru County.

The study revealed that the SMASSE project has contributed positively on students' performance in mathematics in KCSE examination in Nkuene Division, Meru County, Kenya. Before the inception of SMASSE project in 2002-2003 the average mean score was 4.686 which is a mean grade of C- (minus) and after the SMASSE project inception the average mean score in 2005-2006 was 5.749 which is a mean grade of C (plain). Majority of the respondents said the improved performance was as a result of introduction of the SMASSE project.

The study also revealed that the SMASSE project has managed to equip mathematics teachers with new approaches in lesson delivery like the ASEI- PDSI which help the students in understanding of abstract scientific concepts. The results of the study are in agreement with Jean Piaget's theory of Intellectual Development which posts that knowledge is a construct of interaction between heredity and environmental factors. A first principle drawn from Piaget's theory is the view that learning has to be an active process, because knowledge is a construction from within. In this case Piaget saw teachers as facilitators of knowledge that is they are to guide and stimulate the students.

Children are allowed to make mistakes and learn from them. Learning is more meaningful if the child is allowed to experiment on his own rather than listening to the teacher lecture. The teacher should present students with materials, situations and occasions that allow them to discover new learning. This was evident from the results of

the study because many teachers said they continue to receive training and apply the skills learnt in the class rooms e.g. ICT and ASEI approach which has eased their work in lesson delivery and change the student attitude towards Mathematics because they are able to discover things on their own.

Through SMASSE training majority of the teachers have learnt to integrate various teaching aids in their lessons and to involve their students in the preparation of the teaching aids. This has had a very positive impact on the students improved attitude towards Mathematics and has contributed to the positive improvement of Mathematics results from a mean score of 4.686 before introduction of SMASSE to a mean score of 5.749 after the inception of SMASSE.

This study has contributed to the insight on the understanding of the contribution of SMASSE project on students' performance in Mathematics in KCSE examination not only in Nkuene Division, but also the entire country and other nations where the project was started.

5.3.1 The Importance of Learning and Good Performance in Mathematics

From the study findings it is clear that the students understand the importance of learning and good performance in Mathematics. It is very clear that almost all the career opportunities available today will require the knowledge of mathematics, starting from aircraft engineer to the mama Mboga in the market. This was evident from the research findings because majority of the students' respondents said that their target career

demand that they do well in mathematics, that mathematics should remain a compulsory subject in the school curriculum that mathematics was their favourite subject and that individual students had a personal study time table. Only very small percentage was of the contrary opinion.

Majority of the students said that mathematics appear in their time table once a day. Half of the students said that they followed their time tables strictly and a negligible number doesn't have a time table at all. The above results are a clear testimony of the importance of learning hence good performance in mathematics and the value the respondents attached to Mathematics.

5.3.2 Use of Resources to Promote Learning Mathematics

After analyzing the results it was clear that the teachers are using various teaching resources to promote teaching/ learning of mathematics. From the results all the teachers were preparing lesson notes, schemes of work and performance records. However, one third of the teachers were not preparing record of work while half of the teachers were not preparing ASEI lesson plans. Majority of the respondents were using the following teaching resources to promote teaching/learning mathematics; Cube, Cuboids, Sphere, Cone, Frustrum of a Cone, Pyramids, Frustrum of a Pyramid, Prisms, Meter rule, Protractor, Set Squares, Pair of Compasses, Mathematical Sets Calculators, Measuring Tapes and Mathematical tables. Majority of the respondents said their teachers use teaching aids and that the teaching aids are useful in learning Mathematics. Less than half of the respondents said that their teachers involve them in the preparation of the teaching

aids. Use of resources has made abstract concepts real and this has led to improved grades in mathematics in Nkuene Division.

5.3.3 Students' Attitude towards Mathematics since the Implementation of SMASSE

Half of the respondents said their performance was below average, the contributing factor being negative attitude towards the subject. This was seen from the frequency mathematics appeared in the respondents' personal study time table with a quarter of them practicing mathematics once a week, twice a week and other none. A notable percentage of the respondents said that mathematics was not one of their favourite subjects and that it should not remain a compulsory subject in the school curriculum.

On results trend over the years since the implementation of SMASSE project, majority of the principals said the results had improved, which is an indicator that application of SMASSE concepts in teaching helped to change the attitude of students hence the improved performance. The average mean score before SMASSE was 4.686 which is a mean grade of C- (minus). The average mean score after SMASSE was 5.749 which is a mean grade of C plain. One third of the teachers' respondents said the improved performance was as a result of introduction of SMASSE. On the other hand two thirds of the teachers' respondents said that SMASSE project was beneficial because it equipped teachers with new methodologies of teaching mathematics hence changing the students' attitude towards mathematics and as a result there is an upward trend in performance despite the fact that the results are still low compared to other subjects.

5.3.4 Main Teaching Methodologies in Mathematics.

From the findings the following were identified as the main teaching methods employed to teach mathematics. Discussion method, question and answer method, demonstration method and lecture method were the most commonly used teaching methodologies. A few teachers used brainstorming and cooperative learning methods. None preferred to use project method as it is mainly used at higher levels of learning. Teachers have also adopted ASEI-PDSI approaches, use teaching aids, engage learners in preparation of learning aids so as to capture students of different abilities and emphasize the importance of learning and good performance in Mathematics. This has led to improved performance in Mathematics.

5.4 Recommendations

The research findings show that SMASSE project has contributed to the improvement of performance in mathematics in KCSE examination in Nkuene Division, Meru County, Kenya. It is also clear that a lot need to be done to realize its full potential and achieve the desires of the Japanese Government for starting the project.

Therefore, the following recommendations are necessary in light of responses from the respondents and in views of the research findings.

- i. The ministry of education should incorporate the SMASSE training curriculum in the teacher training institutions and make it a compulsory requirement to get employment with the TSC.

- ii. The ministry should involve teachers in the planning of the SMASSE programmes because they are the key stakeholders and implementers.
- iii. The ministry should emphasize more on the ICT training because that is the blueprint of the initial concept of SMASSE and the main pillar of achieving vision 2030.
- iv. The ministry should provide ICT equipments and other teaching aids to schools.
- v. The ministry should ensure that they have qualified facilitators to boost the attitude of the teachers towards the project.
- vi. The ministry should motivate teachers to learn through proper remuneration and promotion of those teachers who have undergone SMASSE training insets.

5.5 Suggestions for Further Research

The researcher suggests that:-

- i. A similar study could be replicated to a larger sample in Kenya to elaborate on the results.
- ii. There is need to establish the challenges facing the implementation of SMASSE project in Kenya.

- iii. There is need to assess the teachers attitude towards the SMASSE project and its implication on the students' performance in mathematics.

- iv. Research should be carried out to investigate the challenges facing the students in their endeavor to perform well in mathematics and how the challenges can be addressed.

REFERENCES

Bell, F.H (1978) *Teaching and Learning Mathematics in secondary school*. W.M.C
.Brown Company Publishers.

CEMASTE, (2008). *Hand Book on Management of District SMASSE
Programmes*. Nairobi.

Cockcroft, W.H. (1981). *Mathematics Counts: Report of the Committee of Inquiry into
the Teaching of Mathematics in Schools*.

Commonwealth Secretariat (2002). *Popularization of Science and
Technology*. Malborough House, London.

Development in School Management Education Around the World: Volume 4,
(1998). *Proceeding of the Forth UCSMP International Conference on
Mathematics*. Chicago, Illinois.

Draft, R.L. & Marcaic, D. (2001). *Understanding Management*. Harcourt College Publishers,
New York.

Eshiwani, G.S (1993). *Mathematics Requirements and Tools*. Nairobi University Press.

Gates, P. (2003). *Issues in Mathematics Teaching*. New York.

Golby, M, Greenwald, J & West, R (1983). *Curriculum Design*. Groom Helm, London.

Griffiths, H.B & Howson, A.G. (1974). *Mathematics Society and Curricular*. Cambridge
University Press.

Ho Stein, A. (2005). *Chemistry Teachers' Professional Development for the
Implementation of New Content and Pedagogical Standards*. Chemical
Education International.

- Japan International Cooperation Agency. (2004). *The History of Japan's Educational Development: What Implications can be drawn for Developing Countries Today?* Institute For Internal Cooperation.
- Kingsley, H.L (1957). *The Nature and Condition of Learning*. Prentice – Hall, USA.
- Kusek, J. & Rist, R. (2004). *Ten Steps to a Result-Based Monitoring and Evaluation System*. World Bank, Washington DC.
- Lenga, F.K. (2001). *Innovative Approaches to the Teaching of Mathematics and Science to Girls in Secondary School*. A Publication of Female Education (FEMSA) Center Kenya.
- Mathematics Education in the Common Wealth; Draft Commissioned Paper, 20-27 March 1982.
- Mayer, R.E. (2008). *Learning and Instruction*. Pearson Education Inc, New York.
- Ministry of Education Science and Technology. (2005). *Kenya Education Sector Support Programme 2005-2010: Delivering Quality Education to all Kenyans*. Nairobi.
- Mondoh, H.O. (2005). *Methods of Teaching Mathematics: A Handbook for Teachers and Students*. Egerton University Press, Njoro.
- Mouly, G.J. (1973). *Psychology for Effective Teaching*. Holt, Rinehart and Winston Inc.
- Mutunga, P. & Breakell, J. (1992). *Mathematics Society and Curricula*. Cambridge University Press.
- National Council of Teachers of Mathematics (2003). *Principles and Standards for School Management*.

- Ndimbirwe, J.B. (1995). *Factors Causing Under Achievement in Mathematics among Secondary Schools in Zambia*. Academy Science Publishers.
- Newstrom, J.W. & Davis, K. (2002). *Organizational Behavior*. Mc.Graw, Irwin.
- Njuguna, B.M. (1999). *The Findings from Baseline Studies by SMASSE Project*. SMASSE Project Bulletin, Journal.
- Nui N.W. & Wahome, A.N. (2006). *Baseline Studies and Intervention Strategies*.
- Orodho, J.A. (2008). *Techniques of Writing Research Proposals and Reports in Education and Social Sciences*. Kanezja HP Enterprises, Maseno.
- Orodho, J.A. (2009). *Elements of Education and Social Science Research Methods*. Kanezja Publisher, Maseno.
- Orton, A. and Wain, G. (1996). *Issues in Teaching Mathematics*. London.
- Oyaya, E. (2000). *Strengthening Mathematics and Sciences in Secondary Education*. Unpublished Paper Presented at the Annual Conference of the Kenya National Heads Association held in Nairobi, June 2000.
- Report on the Kenya Educational Research Awards Seminar on the Quality of Secondary Education in Kenya. Bureau of Education Research, Kenyatta University, Nairobi.
- Robbins, S.R. & DeCenzo, D. (2008). *Fundamentals of Management*. Prentice Hall, Usenet.
- Sadker, D.M. & Zittleman, K.R. (2010). *Teachers, School and the Society*. McGraw-Hill, New York.
- Shiundu, J.S. & Omulando, S.J. (1992). *CURRICULUM; Theory and Practice in Kenya*. Oxford University Press, Nairobi.
- SMASSE INSET- Fact Findings Report. (12th AUGUST, 2004)

Teklemariam, A.A. (2009). *Managing Education. A Handbook for Student-Teachers, Trainers and School Principals*. The Catholic University of Eastern Africa, Nairobi.

Wilkins, E. (1976). *An Introduction to Teaching*. Evans Brothers Limited, London.

APPENDIX A

LETTER OF INTRODUCTION

Dear Sir/Madam

Re: Letter of Transmittal of Data Collection Materials

My name is JannisKinanuM’Kiambi, a masters student, Kenyatta University. I am pursuing a masters degree in Curriculum Studies in the Department of Educational Management, Policy and Curriculum Studies.

The main purpose of writing this letter is to seek permission to issue your office, mathematics teachers and students with questionnaires for my research. I am carrying out a research on Contribution of SMASSE Project on Performance in Mathematics in KCSE Examination and your school has been selected to aid in the study. The study is designed to investigate whether use of resources in teaching promotes learning and if SMASSE project was able to change attitude of students towards mathematics.

Your assistance will be highly appreciated.

Thanks in advance.

Yours sincerely

.....

JannisKinanuM’Kiambi

APPENDIX B

QUESTIONNAIRE FOR HEADTEACHERS ON PERFORMANCE IN MATHEMATICS BEFORE AND AFTER IMPLEMENTATION OF SMASSE PROJECT

Dear Sir/Madam,

Kindly answer the following questions. The information gathered will be kept confidential and will be used for research purposes only. Usefulness of the information will depend on your honesty. Your assistance will be highly appreciated.

Thanks in advance.

Please tick (✓) where appropriate or fill in the gaps as precisely as possible.

A. Background Information

(1) Name of the school.....

(2) Current grade

- | | | | |
|------------------|-----|---------------------|-----|
| SI | [] | Diploma | [] |
| BA/BSc with PGDE | [] | BA/BSc without PGDE | [] |
| B.Ed | [] | Masters | [] |
| Phd | [] | | |

(3) Type of school

- | | | | |
|---------------|-----|----------------|-----|
| Boys boarding | [] | Girls boarding | [] |
| Mixed day | [] | Mixed boarding | [] |

(4) Students enrolment per sex

- | | |
|--------|-------|
| Male | [] |
| Female | [] |
| Total | |

B. Academics

1. Fill in the table below indicating the mean grade and mean score for mathematics for the indicated years.

Table 1.

Year	2002	2003
Mean score		
Mean grade		

Table 2.

Year	2005	2006
Mean score		
Mean grade		

2. In your own opinion, how do the results in the two tables (1) and (2) compare?

.....
.....

3. Do you think the SMASSE project has in any way influenced the results as seen in tables (1) and (2) above?

.....
Give a comment.....

4. Has the school registered improved mean scores over the years?

.....

C. Resources

1. How many mathematics teachers does your school have?

.....

2. Are mathematics teachers in your school adequate?

.....

3. Has your school provided for teaching resources like the models of solids?

.....

4. Does your school have library?.....

5. If the answer to (12) above is yes, how adequate are the library materials?

- a) Very adequate [] b) Adequate [] c) Inadequate []

D. Attitude

1. Does your school embrace the role of motivational speakers in enhancing students' attitude towards learning mathematics?.....

2. What other measures have you put in place to enhance performance in mathematics?

i).....

ii).....

iii).....

E. Teaching Methods

1. Have all mathematics teachers in your school attended SMASSE insets?

If Yes, to what level?

If No, give reasons

.....

2. Does your school sponsor mathematics teachers for seminars, workshops and other Exchange programmes to enhance content delivery?

.....

If No, give reasons.

.....

.....

APPENDIX C

QUESTIONNAIRE FOR MATHEMATICS TEACHERS ON PERFORMANCE IN MATHEMATICS BEFORE AND AFTER IMPLEMENTATION OF SMASSE PROJECT.

Dear Sir/Madam,

Kindly answer the following questions. The information gathered will be kept confidential and will be used for research purposes only. The usefulness the information will depend on your honesty.

Thanks in advance.

Please tick (√) where appropriate or fill in the gaps as precisely as possible.

A. Background Information

(1) Name of the school.....

(2) Current grade

SI [] Diploma []

BA/BSc with PGDE [] BA/BSc without PGDE []

B.Ed [] Masters []

Phd []

Others (specify).....

(3) Type of school

Boys boarding [] Girls boarding []

Mixed day [] Mixed boarding []

(4) Position held at school level

HOD [] Subject [] Classroom teacher []

B. Academics

1. How many lessons do you teach per week?

12 – 19 lessons [] 20 – 29 lessons [] 30 and above []

2. How does your teaching load affect your performance in teaching mathematics?

.....
.....

3. On average, what is the student enrollment in your classes?

10-25 [] 26-45 [] 46 and above []

C. Good Performance in Mathematics

1. Do you take time to emphasize the importance of leaning mathematics?

.....

2. Do you manage to cover your syllabus on time?

.....

If no, give reasons

(i).....

(ii).....

3. How does the size of your class affect teaching and learning mathematics?

.....

D. Resources

1. Do you use teaching/learning aids in teaching mathematics?.....

2. Does use of teaching/learning aids promote teaching and learning mathematics?

.....

Give a comment.....

3. Do you engage learners in making some of the teaching/learning aids?

.....

4. Is the school administration supportive in provision of teaching/learning aids?

.....

E. Teaching Methods

1. Have you undergone the SMASSE training insets?.....

If yes, to what cycle?.....

2. If you have undergone SMASSE training, do you think it is beneficial to the students?

.....

Give a reason.....

3. Have you adopted the ASEI-PDSI approach in teaching mathematics?.....

If yes, give a comment.....

If no, why?.....

4. Which methods do you employ to teach mathematics?

a) Discussion method []

b) Lecture method []

c) Demonstration method []

d) Question & Answer Method []

17. What recommendations would you make to the Ministry of Education as pertains SMASSEproject?

(i).....

(ii).....

APPENDIX D

**QUESTIONNAIRE FOR STUDENTS ON PERFORMANCE IN MATHEMATICS
AFTER INTRODUCTION OF SMASSE PROJECT**

Dear student,

Kindly answer the following questions. The information gathered will be kept confidential and will be used for research purposes only. The usefulness of the information will depend on your honesty.

You need not to write your name on the questionnaire.

Please tick (√) where appropriate or fill in the gaps as precisely as possible.

A. Background Information

- 1. Name of the school.....
- 2. Class.....
- .
- 3. Sex: Male [] Female []

B. Good Performance in Mathematics

- 1. What is your target career?.....
- 2. Does your target career demand that you pass well in mathematics?.....
- 3. Do you think that mathematics should remain a compulsory subject?.....

Give reasons

.....
.....

- 4. Does your teacher cover the syllabus on time?

.....

C. Attitude

1. Is mathematics your favorite subject? Yes [] No []

If yes, give a reason.....

If no, give a reason.....

2. Where do you place your performance in mathematics?

01 – 29 [] 30 – 49 [] 50 – 60 [] 61 – 79 [] 80 – 100 []

3. If your score lies between 01-49, what do you think are the contributing factors?

(i)

(ii)

4. Do you have a personal study timetable?.....

If yes, do you strictly follow it particularly when it reads mathematics?.....

5. How often does mathematics appear on your personal study timetable?

None [] Once a day []

Once a week [] Twice a day []

Twice a week []

D. Resources

1. Does your teacher use teaching aids like cubes, cuboids, sphere, cone, playing cards during mathematics lesson?

If yes, are they helpful?.....

2. Does your teacher engage you in the preparation of teaching aids like cubes and cuboids?.....

If yes, do you strictly follow it particularly when it reads mathematics?.....

3. Does your school have a library?.....

Yes [] No []

4. If yes to (12) above, how relevant are the mathematics reference materials?

a) Very relevant [] b) Relevant [] c) Irrelevant [] d) Not available []

5. Are the reference materials readily available from the library?

Yes [] No []

6. If yes to (12) above, how adequate are the materials?

a) Very adequate [] b) Adequate [] c) Inadequate []

APPENDIX E

INTERVIEW SCHEDULE TO SMASSE INSET TRAINER IN CHARGE OF MATHEMATICS

Dear sir/madam,

Kindly answer the following questions. The information gathered will be kept confidential and will be used for research purposes only. The usefulness of the information will depend on your honesty.

Thanks in advance.

Please tick (√) where appropriate or fill in the gaps as precisely as possible.

A. Background Information

1. Current grade of the teacher

- | | | | |
|------------------|-----|-----------------------|-----|
| SI | [] | BA/BSc without PGDE | [] |
| Diploma | [] | PhD | [] |
| BA/BSc with PGDE | [] | Others (specify)..... | |

2. Name of your training center.....

Division.....

District.....

B. Training

1. Did you apply to be a SMASSE trainer?

.....

If no, how were you selected?

.....

2. How long did you take to train as a SMASSE trainer?.....

3. When the first cycle was introduced in your district, how was it received by the trainees?

.....

4. What benefits go hand in hand with being a SMASSE trainer?

.....

5. How has SMASSE project affected performance in mathematics in your Division?

.....

6. Do you rate SMASSE project a success or a failure?.....

Give reasons.....

.....

7. What recommendations would you give to the Ministry of Education concerning SMASSE project?

.....

.....

APPENDIX F
RESEARCHER'S OBSERVATION GUIDE
FACILITIES

Library

- i. Does the school have an operating library?.....
- ii. Does the school have a librarian?.....
If no, who is in charge of the library?
Teacher [] Library Prefect [] Store keeper []
- iii. Is the library stocked with mathematics reference materials?.....
If yes, how relevant are the reference materials?
Very relevant [] Relevant [] Irrelevant []
How adequate are the reference materials?
Very Adequate [] Adequate [] Inadequate []
- iv. At what time are students allowed to use the library?
Class Time [] After Classes [] Weekends []

Instructional Methods.

Which among the following teaching methods are being applied to teach mathematics?

(Tick the applicable)

- Discussion Method []
- Lecture Method []
- Experiment Method []
- Demonstration Method []
- Project []
- Brain storming []
- Cooperative Learning []
- Question & Answer Method []

Teaching Aids.

Are the following teaching aids available in the school?

(Tick the available teaching aids)

Nets of Solids

Cube	[]
Cuboid	[]
Sphere	[]
Cone	[]
Frustrum of a Cone	[]
Pyramids	[]
Frustrum of a Pyramid	[]
Prisms	[]

Geometrical Instruments

Metre Rule	[]
Protractor	[]
Set Squares	[]
Pair of Compasses	[]
Clinometers	[]
Paying Cards	[]
Dice	[]
Mathematical Sets	[]
Calculators	[]
Measuring Tape	[]
Mathematical Tables	[]

Instructional Materials

Are the teachers preparing the following instructional materials?

(If yes tick appropriately)

Lesson Notes

Schemes of Work

ASEI Lesson Plans

Record of Work

Performance Records

APPENDIX G

RESEARCH TIME TABLE

ACTIVITY	2011									2012								
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
1. Concept paper	■																	
2. Literature review		■																
3. Proposal development			■															
4. Forwarding proposal			■															
5. Research permit				■														
6. Research instruments					■													
7. Piloting						■												
8. Data collection							■											
9. Data analysis								■										
10. Report writing										■	■							
11. Submission proposal to department												■						
12. Submission of proposal to graduate school													■					
13. Clearance with finance department														■				
14. Graduation																		■

APPENDIX H

BUDGET

ACTIVITY	COST (KSHS.)
1. Proposal typing	1,500
2. Concept paper typing	1,000
3. Binding of proposal	500
4. Literature review	
Library charges	2,000
Lunches	1,500
Travelling	3,000
5. Research instruments	
Typing	300
Photocopying	2,700
6. Data collection	
Travelling	3,000
Lunches	1,000
7. Data analysis	15,500
8. Report writing	7,000
9. Report binding	2,000
10. Contingency costs	1,000
11. Total	42,000

LOCALE MAP: NIKUMENE DIVISION, MERU COUNTY, KENYA

SOURCE: MERU CENTRAL DISTRICT 1, SOUTH IMENGI CONSTITUENCY - SHEET 053

