INFLUENCE OF STRENGTHENING MATHEMATICS AND SCIENCE EDUCATION TRAINING ON TEACHING / LEARNING OF MATHEMATICS IN PUBLIC PRIMARY SCHOOLS IN BOMET-CENTRAL DIVISION, BOMET COUNTY, KENYA

BY

SITONIK IRINE CHEBET

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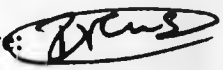
DECLARATION

This research project report is my original work and has not been presented for the award of any degree in any other university.

Signature:  **Date:** 28/11/2012

SITONIK IRINE CHEBET

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This research project report is submitted for examination with my approval as the university supervisor.

Signature:  **Date:** 28-11-2012

DR.LUKETERO STEPHEN WANYONYI

SENIOR LECTURER

SCHOOL OF MATHEMATICS

UNIVERSITY OF NAIROBI.

DEDICATION

This research project report is dedicated to my husband Mr. John K. Ngeno for his encouragement and support and to my children; Brigid Chepkorir , Emmanuel Kiprono , Cephas Kipkoech , Bethuel Kipruto and Adrian Kiprotich for their warm tender company always being by my side, propelled me to work hard and excel in this academic journey .

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ABBREVIATIONS AND ACRONYMS

ASE1	- Activity Student Experiment and Improvisation.
CEMASTEA	- Centre of Mathematics, Science and Technology in Africa Eastern Central and Southern Africa.
DQASOs	- District Quality Assurance and Standards Officers.
ICT	- Information and Communication Technology.
INSET	- In Service Education and Training
JICA	- Japan International Cooperative Agencies
KIE	- Kenya Institute of Education
KCPE	- Kenya Certificate of Primary Education.
KNEC	- Kenya National Examination Council
MOE	- Ministry of Education.
MOEST	- Ministry of Education, Science and Technology.
NICASA	- National Institute of Students Achievements Curriculum and Assessment.
NCTM	-National Council of Teachers of Mathematics
PDSI	- Plan, Do, See and Improve
PTA	- Parents Teachers Association.
SESEMA	- Secondary Science and Mathematics Project (Uganda)
SMASE WECSA	- Strengthening Mathematics, Science Education in Western, Eastern, Central and Southern Africa.
SMASE	- Strengthening Mathematics and Science Education.
SMASSE	- Strengthening Mathematics and Science Education in Secondary Education
SPRED	- Strengthening Primary Education Project (Kenya)

T/L	- Teaching and Learning.
TSC	- Teachers Service Commission
TIMSS	- Third International Mathematics and Science study.
USA	- United States of America
UNESCO	-United Nations Educational Scientific and Cultural Organization
WECSA	- Western, Eastern, Central and Southern Africa

ABSTRACT

This study sat to investigate the influence of SMASE training on teaching and learning of mathematics in primary schools in Bomet Central Division, Bomet County. Mathematics skills are basic requirements for everyday life but student continue to perform poorly in mathematics examinations in Kenya. Research work by Shiundu (1987), Thuo (1985) and Eshiwan (1993) identified factors such as shortage of qualified teachers, poor teaching methods, limited teaching / learning resources among others are blamed for causing poor performance. The MOEST introduced SMASSE program in secondary schools in the year 1998 to curb poor performance. MOE and JICA went further to launch SMASE project in Kenya targeting mainly primary mathematics and science teachers. According to the analysis done by the Kenya Examination Council in KCPE, the general performance of mathematics in the year 2009 had a mean score of 24.78 and that of 2010 was 26.90. This shows that the problem has not been adequately addressed. The study will be guided by the following objective: To examine how the use of ASEI / PDSI practices influence teaching and learning of mathematics in primary schools in Bomet Central Division; To investigate the extent to which lesson study influence teaching and learning of mathematics in primary schools in Bomet Central Division; To establish how ICT integration influence teaching and learning of mathematics in primary schools in Bomet Central Division; To assess the extent to which improvisation of teaching/learning aids influence teaching and learning of mathematics in primary schools in Bomet Central Division and to determine how student participation in classroom influence teaching and learning of mathematics in Bomet Central Division. The influence of these factors on the teaching and learning of mathematics was summarized by a conceptual framework. The research adopted a descriptive survey design which seeks to uncover the nature of factors involved in a given situation, the degree in which it exists and the relationship between them (Travers, 1969). The study targeted a total population of 5, 269 people with 128 headteachers, 460 mathematics and 4681 pupils. According to Krejcie and Morgan (1990) a sample size of 357 is appropriate for a target population of 5269. A sample size of 9 headteachers, 31 mathematics teachers and 317 pupils were used during piloting. The study addressed content validity. Test-retest technique was used to determine the reliability of the instrument. Data collected was presented in form of frequency tables for easier understanding and interpretation. Descriptive statistics were used. It was then edited organized and analyzed using statistical package for social sciences (SPSS). Based on the findings of the study the researcher concluded that ASEI / PDSI practices lesson study and ICT integration were time consuming and costly. Teaching aids needs to be improvised daily using locally available materials and that pupils needs to be punctual and active in their group work discussions and assignments. The research made the following recommendations; SMASE INSETS should be carried out every holiday, headteachers and stakeholders to support mathematics teachers in provision of teaching materials, MOEST and TSC to employ more teachers and motivate SMASE trainees by giving promotions, payment and certificates. The researcher also suggested for further research to be carried out on evaluation of SMASE training on mathematics performance in Bomet-Central Division and ways of getting funds to support ICT materials.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Training is an organized activity aimed at imparting information and / or instructions to improve the recipients. It is the skill, knowledge or experience acquired by one that trains. No single training is enough . Teachers who have undergone pre –service training need in – service education and training (INSET) to meet radical changes in education sector . Lewi's (1984) emphasized the importance of both pre and in –service training as critical determinants of curricular quality .Pre –service training ,introduces a teacher to teacher in-service training making the teacher professional .INSET is important in improving the quality of a teacher in relation to the curriculum , methodology , textbooks and learning resources to be employed (UNESCO , 1970). In USA , the government supports both pre and in-service strongly so as to strengthen quality of teaching and enhances student learning (Barret , 1998).

Britain and other developed countries viewed INSET as staff development process . In 1978 Britain mounted an INSET for its teachers with an aim of equipping them with leadership skills and technological skills (Bolam 1978). Italy used INSET of science and Mathematics teachers for curriculum change in 1977 – 1982 , where teachers were in – serviced on the aspect of the new curriculum (Tomasini and Balandi 1988).

According to TIMSS report 1998, Japan has greatly succeeded effectively in education because they fully embraced continuous in-service program for its teachers through mentorship, research groups and workshop (NICASA , 1998).

The current reform efforts in mathematics and science education recognize the crucial role that teachers play (Van Driel, Biejard and Verloop, 2001) and thus target them as curriculum innovators and implementors through In-Service Education and Training (INSET). There is a consensus that improving students' learning depends on a teaching

force with appropriate beliefs and attitudes towards teaching and learning and who possess the content and pedagogical knowledge quite distinct from the usual instructional practice in most classrooms (Even 1999; Zaslavsky and Leikin 2004). While initial teacher training nurture these characteristics, it is insufficient to prepare teachers for the greater challenges of everybody teaching where, time constraints and pressure from summative assessments overwhelm both newly qualified and experienced teachers.

A study done in USA by Renmin (2000) shows that In-service education programme for science teachers changes their plan and action. In Israel, studies done by Don and Barneas (1994) show that In-service programme was very effective in changing teacher's attitude towards use of computers in classroom.

A study done in Portugal shows that use of In-service programme was very effective in improving teaching and learning (Santos, 1993). And a study done by Lopriore (1998) in Italy shows that In-service education programmes were beneficial to teaching and learning.

Tanzania embraces teacher INSET through partnership with agencies such as JICA and Mid Sweden University. Dutch government has partnered with the University of Dares Salaam in developing teachers professionally by sponsoring teachers for masters and doctoral studies.

The initiatives in Africa in which Japan plays a significant role, seeks to strengthen mathematics and science education and enhance learner's ability through improved teachers' content mastery and pedagogical skills. In addition they seek to positively enhance both teachers and learners attitudes towards mathematics and sciences. These initiatives include SMASSE- Kenya, SMASSE –Malawi, SMASSE –Rwanda, SESEMAT –Uganda, SMATSE –Zambia. All these programmes have an overall objective of upgrading student abilities in Mathematics and sciences. (Nui and Wahome, 2006). A survey done by SESEMAT project targeting Mathematics and sciences in Uganda shows that those teachers who attended pilot INSET had attitudinal change, improved pedagogy and received support from parents and administration. (SESEMAT, 2008).

Evaluation done by SMASSE official from CEMASTEA shows that teachers have received SMASSE programmes so well. They are able to plan better attend to students need better than before, they are more confident, they try out new teaching methods and are able to overcome many challenges arising from lack of resources and large classes. Students in these countries participate more, are punctual, discuss in groups, do their assignments neatly and promptly, have a better attitude and their results have generally improved. (Nui and Wahome, 2006).

There have been a number of initiatives by the government and development in providing INSET. Some of these initiatives are on-going while others have ended. Some cover the whole country while others are carried out only in some parts of the country. SBTD was a component of SPRED. PRISM was targeting school managers such as head teachers, KIE trained teachers on syllabus and curriculum laying a lot of emphasis on content and methodology. KNEC train teachers on invigilation, supervision and marking of national examinations. (KIE, 1993).

Reforms in education including teacher education require informed policies that recognize the need for change, appreciate possible challenges and set guidelines for effecting the changes in Mathematics education. (Advisory committee on Mathematics Education, 2002, 2005).

The SMASE project is an initiative of the Kenyan Government with the support of the Japanese Government through JICA. JICA support in finance, provision of materials and equipment, provision of both long term and short term expertise to support the Kenyan personnel and sponsoring the training in other countries mainly Japan, Malaysia and Philippines for some of the Kenyan personnel. The project has gone through phases 1and 2, between 1998 and 2008 during which it was called SMASE, (JICA, 2007) is now in phase 3, which covers a period of 5 years, starting from January 2009 to December 2013 SMASE –WECSA which comprises both the secondary and primary education in mathematics and science in the member countries was borne out of region conference.

Bomet County is one of the counties found in Kenya. Performance of mathematics in Bomet Central Division, Bomet County has been seen to be wanting and there is need to employ several INSETS including SMASE in order to realize good performance in the subject. In November 2008, MOE and JICA launched SMASE project in Kenya mainly targeting primary mathematics and science teachers. The SMASE project will cover a period of 5 years starting from January 2009 to December 2013. Cluster centres such as Bomet township primary school and Aisaik primary school are set aside as Venues for SMASE in the division. During the training teachers are taught on how to make an ASEI / PDSI lesson plan, lesson study, ICT integration, creativity and innovation and how student should participate or involvement of students during the teaching and learning.

1.2 Statement of the Problem

Mathematics skills are basic requirements for everyday life. However, student continue to perform poorly in mathematics examinations in Kenya. Research work by Shiundu (1987), Thuo (1985) and Eshiwan (1993), identified factors such as shortage of qualified teachers, student family background, overloaded curriculum, poor teaching methods, poor attitude, sex and limited teaching / learning resources among others are blamed for causing poor performance.

The ministry of education took up these challenges and tried to offer some solutions which include introduction of SMASSE program in secondary school in the year 1998. The ministry of education and JICA went further to launch SMASE project in Kenya mainly targeting primary mathematics and science teachers. The SMASE project will cover a period of 5 years starting from January 2009 to December 2013. Teachers of mathematics and science attend the SMASE INSET every August holiday where they are offered an opportunity to share on the principles and practices of ASEI – PDSI to ensure quality teaching and learning. According to the analysis done by Kenya National Examination Council in KCPE, the general performance of mathematics in the year 2009 had a mean score of 24.78 and that of 2010 was 26.90. This shows that the problem has not been adequately addressed. This study investigated the influence of SMASE training on teaching

and learning of mathematics in public primary schools, Bomet - Central Division, Bomet County, Kenya.

1.3 Purpose of the Study

The purpose of this study was to find out the influence of SMASE training on the teaching and learning of Mathematics in public primary schools in Bomet - Central Division , Bomet county , Kenya .

1.4 Objectives of the Study

This study was guided by the following objectives: -

1. To examine how the use of ASEI/PDSI practices influence teaching and learning of Mathematics in public Primary schools in Bomet Central Division.
2. To investigate the extent to which lesson study influence teaching and learning of Mathematics in primary schools in Bomet Central Division.
3. To establish how ICT integration influence teaching and learning of Mathematics in public primary schools in Bomet Central Division.
4. To assess the extent to which improvisation influence teaching and learning of Mathematics in public primary schools in Bomet Central Division
5. To determine how student participation in classroom influence teaching and learning of Mathematics in public primary schools in Bomet- Central Division

1.5 Research Questions

This study was guided by the following research questions: -

1. How does the use of ASEI / PDSI practices influence teaching and learning of Mathematics in public primary schools in Bomet Central Division?

2. How does lesson study influence teaching and learning of Mathematics in public primary schools in Bomet Central Division?

3. Does ICT Integration influence teaching and learning of Mathematics in public primary school in Bomet Central Division?

4. To what extent does improvisation influence teaching and learning of Mathematics in public primary schools in Bomet Central Division?

5. To what extent does student participation in classroom influence teaching and learning of Mathematics in public primary school in Bomet Central Division?

1.6 Significance of the Study

The findings will be useful to the curriculum developers and ministry of Education to modify the present curriculum to suit the needs of SMASE hence enabling Mathematics teachers to use the ASEI/PDSI practices on their classroom teaching.

The findings will provide monitoring and evaluation of information about the project implementation benefiting the government, which is the sponsor of the program, JICA, parents and other stakeholders.

Finally, the findings will enable primary school Mathematics teachers to design appropriate strategies that will significantly assist in translating SMASE in to the classroom.

1.7 Delimitation of the Study

The study was done on mathematics subject which was covered by SMASE programme. The study was confined to public primary schools in Bomet Central Division of Bomet County.

1.8 Limitation of the Study

There were a number of limitations that were expected in this research study which include the state of the roads which are poor. Alternative means of transport in the industry including motorcycle, bicycle and even footing were used.

The other was the failure or unwillingness by the respondent to respond to questionnaires. The design of the questionnaire were such that sensitive issues were concealed from direct interpretation .This minimized failure and unwillingness of the respondent to participate.

1.9 Basic Assumptions of the Study

The assumption was that all Mathematics teachers in Bomet-Central Division have attended SMASE INSET and were fully implementing SMASE program in their teaching. In addition it was assumed that the respondents were co-operative and honest to give correct information.

The other assumption was that other factors that was not studied and influences teaching and learning of Mathematics were minimal.

1.1.0 Definition of Significant Terms used in the Study

Cluster centres - Schools selected as venues for SMASE training.

In-Service Education and Training – Planned courses and activities in which a serving teacher, headteacher or any other educational administrator may participate in for the purpose of improving his / her instructional or professional knowledge, interest or skills.

Pre-service Training – Training in a teachers college where a student is introduced to the knowledge and skills needed to do a professional job in teaching.

Research- A careful study to discover new information

Researcher- A person carrying out a planned exercise that is aimed at allocating or getting rid of a problem

Mathematics- One of the subject being taught in school

Mathematics Teacher – Refers to one who have attended SMASE INSET and is teaching the subject mathematics.

Pupils – Boys and girls in school

Population- A complete set of individuals with common characteristics

Teacher – Is a person who provides education for pupils.

Training – Process of providing employees with specific knowledge and skills, to enable them perform specific work tasks.

1.1.1 Organization of the Study

Chapter one of the study gave the background of the study , statement of the problem , purpose of the study , objectives of the study , research questions , significance of the study, delimitations of the study limitations of the study assumption of the study and definition of significant terms used in the study . Chapter two reviewed the literature related to the study from a global perspective up to the area of study. It also addressed the empirical literature related to the study based on the research objectives. Chapter three described the research methodology used in the study including the research design, target population, sample size and sampling procedures, data collection procedures, data analysis technique and ethical considerations. Chapter four gave the findings of the study guided by research objectives and chapter five of the study summarized, discussed, concluded and gave recommendations based on the findings.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter covered the literature review related to the study. It gave a concept of SMASE INSET on teaching and learning of mathematics, the use of ASEI / PDSI practices in teaching and learning of mathematics, lesson study in teaching and learning of mathematics, ICT integration in teaching and learning mathematics, improvisation in teaching and learning of mathematics and student participation in classroom when teaching and learning of mathematics. It also gives theoretical framework, conceptual framework, definition of operational variables and summary of literature review.

2.2. Concept of SMASE INSET on Teaching and Learning of Mathematics

UNESCO (1983) defines an INSET as a whole range of activities by which serving teachers and other categories of educationists within formal school systems extended and develop their competence and general understanding of roles which they and their schools are expected to play in their changing society. INSETS are used to upgrade teacher's content, certifying new teachers, introducing new curriculum and new teaching methodology according to common wealth secretariat (1995). Whereas In-service teacher education complements initial teacher training, there is lack of adequate and appropriate opportunities for most practising teachers to enhance their skills and align their practice to the reform visions in education. (Britt, Irwin, Ritchie, 2001; Ottevanger, Macfarlane and Clegg, 2005). Moreover, professional development which focuses on practice alone without reflective lenses in terms of theoretical perspective (Krainer, 1999; Even, 1999) runs the risk of reinforcing traditional instruction or promoting practices misaligned with changing trends in education.

A study done in Portugal shows that use of INSET programme was very effective in improving teaching and learning (Santos, 1993). And a study done by Lopriore (1998) in Italy shows that In-service education programmes were beneficial to teaching and learning.

In Ethiopia INSETs have been used to address problems of teachers shortage since 1958. The INSETs are used to improve quality of teachers who are under qualified and untrained, Muller, (2000).

Tanzania embraces teacher INSET through partnership with agencies such as JICA and Mid Sweden University. Dutch government has partnered with the University of Dares Salaam in developing teachers professionally by sponsoring teachers for masters and doctoral studies.

INSETS are used as means of improving science education even though little is known about such courses, (Calloid, Cottleman, Duret and Lewin 1997). Due to shortage of teachers with adequate knowledge and lack of teaching materials most developing countries face serious problems in mathematics and science, (Ware, 1992).

In Kenya, there are a number of initiatives which are on-going while others have ended. Some cover the whole country while others are carried out only in some parts of the country. SBTD was a component of SPRED. PRISM was targeting school managers such as head teachers, KIE trained teachers on syllabus and curriculum laying a lot of emphasis on content and methodology. KNEC train teachers on invigilation, supervision and marking of national examinations. (KIE, 1993). SMASSE which aims at strengthening mathematics and science in secondary schools (SESEMAT, 2008).

The SMASE project is an initiative of the Kenyan Government with the support of the Japanese Government through JICA. JICA support in finance, provision of materials and equipment, provision of both long term and short term expertise to support the Kenyan personnel and sponsoring the training in other countries mainly Japan, Malaysia and Philippines for some of the Kenyan personnel.

In November 2008, MOE and JICA launched SMASE project in Kenya mainly targeting primary mathematics and science teachers. The SMASE project will cover a period of 5 years starting from January 2009 to December 2013.

In Bomet – Central Division, Bomet County cluster centres such as Bomet township primary school and Aisaik primary school are set aside as Venues for SMASE in the division. Std 6, Std 7 and Std 8 mathematics and science teachers are given INSET for one week on SMASE on every August holidays for the next 5 years. During the training teachers are taught on how to make an ASEI / PDSI lesson plan, lesson study, ICT integration, creativity and innovation and how student should participate or involvement of students during the teaching and learning. Teachers are encouraged to implement what they are taught in SMASE in their various primary schools in the division. No study has been done on the influence of the project on teaching and learning of mathematics in primary schools in the division. This paper will reflect on the influence of SMASE on teaching and learning of mathematics in primary schools in Bomet Central Division, Bomet County, Kenya.

2.3. The use of ASEI / PDSI Practices in the Teaching and Learning of Mathematics

The guiding principle of SMASE INSET is ASEI. This principle is implemented based on the PDSI approach (Nui and Wahome, 2006), thus the ASEI-PDSI paradigm. The ASEI-PDSI paradigm was modelled along the considerations of the current trends in the teaching and learning of Mathematics and Science and the findings of several need surveys.

ASEI is an acronym for Activity Student Experiment and Improvisation. (Nui and Wahome, 2006). The ASEI lesson design considers the quality of classroom activities as critical to achieving effective teaching and learning.

Activity implies active meaningful and constructive participation of the learner in learning situations by way of activities. Learners tend to learn a lot more when they are active participants rather than passive recipients of information (Freedman 1997, Hofstein 2003). Retention of what has been learnt depends to a large extend on the approach or the

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combination of approaches used. A lot less is retained when the primary method of learning is hearing. The level of retention increases progressively when hearing is combined with seeing, doing, discussing and presenting reports. Louis and Harris (1968) argue that high school children learn science best through activity based on lessons.

Learner's activities can be hand-on (manipulative), minds-on (intellectual), mouths-on (discussions), hearts-on (activities that stir up the learners feelings/ interests about the subject matter), question and answer, assignments, calculations, experiments, project work and role play activities incorporated in the teaching as the situation demands (Bianchini 2007, Kirschner 1992). Activity of ASEI should help to serve a large bridge to cater for the development of scientific skills of knowledge, comprehension, analysis, synthesis, application and evaluation.

Student (learner) is the main focus in the lesson. The lesson objectives should be geared towards improving the learner's academic achievement and his/ her quality of learning. Emphasis should be to help learners develop critical ability of analysing an argument by reviewing prior knowledge and current understanding of concepts, weighing the evidence and examining the logic, thus revealing which explanation are better, reasonable and meaningful. Thereby enabling the learners to construct and reconstruct meaning directly from their encounters with the empirical world. This leads to naive, constructed, scientific and multidimensional knowledge.

Experiments refer to an activity in which the learners manipulate a variable and observe the effect of some other variables. Use of experiments enhances understanding of scientific/mathematical concepts and principles. The rationale here is the establishment fact that learners working on a problem will learn far much more than just the answer to the problem. Through experiments, learners learn to observe, manipulate, measure, reason, and develop skills of gathering information. When students are involved in planning and designing activities they enjoy learning mathematics and appreciate it more. Such an approach enables teachers to cater for learners differences, intelligence, aptitude, physique and gender (Assumpta, Cuyegkeng, Chona, Madarel and Vallespin, 2001)

Improvisation entails utilisation of available materials in the learner's immediate environment to raise interest and curiosity, modification and simplification of recipe type text book experiments scaling down materials for use in activities and experiments and the use of non-conventional apparatus/ equipment in lesson delivery. The effective practice of ASEI calls for proper Planning, Doing, Seeing, and Improvements hence the acronym PDSI, (SMASSE 2002). PDSI may be defined as a process of an activity against its plan and answering the question of how the activity is being carried out in relation to the intended objectives.

2.4. Lesson Study in the Teaching and Learning of Mathematics

The mission of CEMASTEA is to conduct research on innovative pedagogy and institution INSET for effective delivery of curricula .In line with this mission statement CEMASTEA has been conducting INSET for teachers of mathematics and science in secondary and primary school.

The approach used during INSET did not prepare teachers well on how to identify a problem, plan lesson around the problem and teaching to address it. Neither was lesson observation based on a specific problem nor skills identified .It is because of this that it was recommended to introduce lesson study as a way of teacher professional development but based at school level. This was modelled on the Japanese lesson study approach known as Jogyo Kenkyu.

Lesson study is the process carried out by teachers to improve teaching and learning .This is done through meetings to work on the lesson design implementation, evaluation and improving on one or several lessons. Lesson study is therefore a professional development activity in which team of teacher's systematically and collaboratively examines their practise with the goal of influence increase student learning (Stigler and Herbert 1999). Lesson study is fundamentally a problem solving process. It is a teaching improvement process that has its origin in Japanese elementary education, where it is a widespread professional development practice.

Lesson study has the following steps: Lesson planning; Lesson presentation; Lesson observation and then finally, lesson reflection. Lesson study improve on the lesson delivery, enhance teaching and learning and enhance teamwork among teachers. Lesson study is therefore a professional development activity for teachers (educators).

The lesson study approach aims at lesson improvement by co-operation among colleagues in a school or among schools in the area. Since this is based on daily practice and problems, the teachers are likely to be autonomous and flexible rather than being passive in the institution approach. It requires teachers to be more proactive and positive.

According to the JICA open symposium on January 31st 2009, 12 countries somehow introduce the lesson study approach in technical co-operation projects. Through lesson observation and interviews, changes in teachers are noted as "more teachers write lesson plans, set the lesson objectives I clearly, develop a more interactive lesson process, and increase activities in the lesson". (JICA, 2007PP 21-3).Hence lesson study aims at improving the quality of lesson and teachers competence based on their daily practice.

In United States lesson study practice is used in K-12 education, teacher training and higher education as a form of faculty development. United State and Canada also use lesson study in light of TIMSS results which highlighted the advanced performance and deeper thinking in mathematics by Japan students (Japan International Co-operation Agency, 2004).

In Zambia, lesson study is conducted in a cycle which contain 8 activities, setting an issue and theme, preparing an experimental lesson collaboratively , implementing and observing the lesson, reflecting on the lesson, improving the lesson plan based on reflection, implementing and observing the improved lesson, reflecting on the lesson again; and summarizing the activities (ministry of Education 2007,p.4).In Zambia lesson study was introduced to shift chalk-and-talk lesson which mainly aim at the transmission of knowledge, to participatory lesson ,which aim at the development of children's thinking and activities.

Kenya has adopted lesson study as from the year 2009 through SMASE project. It has been cascaded to all districts in Kenya. Monitoring and evaluation is done by CEMASTEA to establish the extent of its practice.

For continuous improvement in teaching and learning of mathematics and science in both primary and secondary level of Education, one time training is not sufficient. Teachers will need to work together to infuse the best ideas in to study practice. Lesson study provide for this expectation.

2.5. ICT integration in the teaching and learning of mathematics.

Technological advancement has brought with it the information technology (IT) revolution .It is becoming evident that any society that will be left out of this revolution risks total isolation from the global family. Technology has also found considerable use in education. However, not many teachers have the necessary IT knowledge and skills .Capacity building in this critical area can be achieved through INSET.

Among the issues which have been isolated from the need survey which was done on May and June2009 was the ICT competence .Majority of teachers are not ICT literate.

According to currency (1992), most mathematics teachers working today learnt mathematics without the use of technology. Graphing calculators are successful changing how mathematics is taught and learnt and it has the advantage of low cost and high portability. Teachers are using the graphing calculators in visualising concepts, exploration, experimentation, generalizing and checking solutions to algebraic problems (currency 1992).

ICT integrated lessons improve quality of learning and achievement through a medium that illustrate s concepts that would otherwise be abstract to explain traditionally in line with the findings of Selinger (2004).In regard to retention of learnt concepts, student tend to recall mathematics skills long after using computer soft ware than those taught traditionally through verbal instructions.

Ittigson and Zewe (2003) cited that technology is essential in teaching and learning mathematics .ICT improves the way mathematics should be taught and enhances students understanding of basic concepts.

Many researchers have carried out studies to evaluate the benefits of using ICT in mathematics Becta(2003) summarised the key benefits: ICT promotes greater collaboration among students and encourages communication and the sharing of knowledge. ICT gives rapid and accurate feedbacks to students and this contributes towards positive motivation. It also allows them to focus on strategies and interpretation of answers rather than spend time on tedious computational calculations. ICT also support constructivist pedagogy where in the students use technology to explore and reach understanding of mathematics concepts. This approach promotes higher order thinking and better problem solving strategies which are in line with the recommendation forwarded by the NCTM. Students would then use technology to concentrate on problem solving processes rather than on calculations related to the problems (Ittigson and Zewe 2003)

According to Becta (2003,p.10) five factors influence the likelihood that good ICT learning opportunities will develop in schools ICT resourcing, ICT leadership, ICT teaching , schools leadership, and general teaching. Becta (2003) also indicated that the success of the integration of new technology in to Education varies from curriculum to curriculum ,place to place and class to class, depending on the ways in which it is applied.

Dawes (2001) is of the view that new technologies have the potential to support Education across the curriculum and provide opportunities for effective communication between teachers and students in ways that have not been possible before . ICT can play various roles in learning and teaching process.

Wong et al.(2006)point out that technology can play a part in supporting face-to-face teaching and learning in the classroom.

According to Grabe and Grabe(2007),technologies can play a role in student skills, motivation and knowledge They claim that ICT can be used to present information to students and help them complete learning tasks.

Many researchers and theorists asserts that the use of computers can helps students to become knowledgeable, reduce the amount of direct instruction given to them and give teachers an opportunity to help those students with particular needs (Iding, Crosby and Speitel , 2002;Shamatha ,Peressini, and Meymaris 2004; Romeo 2006)

In Australia, computers began to be placed in schools in the early 1980s, and several researchers suggest that ICT will be an important part of education for the next generation too (Brassard ,brown and cockng ,2008,grimus ,2008,yelland ,2001).Modern technology offers many means of improving teaching and learning in the classroom (Lefe bure, Deaudelin and loiselle,2006). A study done in Australia on an INSET known as National Computer Education reveals that despite over 2000 teaches being In-service very few used computers back in school and they used them separately from the way they were trained, (Ingravasan and M C Kenzie, 1988). A study done by OECD (2008), on In-servicing of teachers in ICT in Finland shows that despite intensive training in ICT, very few use in classroom yet they have very good ICT infrastructure.

In Australia research, New house (2002) found that many teachers lacked the knowledge and skills to use computer and were not enthusiastic about the changes and integration of supplementary learning association with bringing computers into their teaching practices. In Israel studies done by Don Barneas (1994) show that in-service programme was very effective in changing teachers' attitudes towards use of computers in classroom especially sciences.

In the developing countries, research reported that teachers' lack of technological competence is a main barrier to their acceptance and adoption of ICT (Pelgrum, 2001; Al-oteawi, 2002). In Syria teachers lack of technological competence has been cited as the main barrier (Albirini, 2006).

Likewise, in Saudi Arabia, a lack of ICT skills is a serious obstacle to the integration of technologies into science education, (Al-Alwani, 2005; Almohaissin 2006).

2.6. Improvisation of Teaching/Learning Aids for Teaching and Learning Mathematics

Improvisation means the act of creating something or using something in the absence of the ideal tools. According to Webster's dictionary (2004) improvisation is to provide, select or make substitute for something not available to use as basis of free invention. Various authors have defined the concept 'improvisation' in different ways. Ogumbiyi, Okebukola and Fafunwa (1990) defines it as the act of substituting for the real thing that is not available. Bajah (1991) takes it to be the use of substitute equipment where the real one is not available. Kamoru and Umeano (2006) further define it as the act of using materials obtainable from the local environment or designed by the teacher or with the help of local personnel to enhance instruction. According to Ihiegbulem (2007), it is the act of substituting for the standard equipment on instructional materials not available, with locally made equipment or instructional materials from readily available natural resources.

Creativity has been described as "a state of mind in which all our intelligences are working together" (Lucas, 2011) and as "the ability to solve problems and fashion products and to raise new questions" (Gardner, 1993). Creative learning is a natural human process that occurs when people become curious and excited. Children prefer to learn in creative ways rather than just memorising information provided by teachers or parents. They also learn better and sometimes faster.

Creativity in the classroom is about how a teacher captivates students and inspires them to learn. They build a repertoire of strategies designed to spark new ideas and bring out a spirit of creativity in students and they adapt and create ideas for their own curriculum needs. What is needed is teaching that is innovative. As Fisher argued, creative learners need creative teachers who provide both order and adventure, and who are willing to do the un expected and take risks (Fisher, 2002).

Simpilicio (2000) sees creativity as a method and approach for thinking and living. The focus on the development of thinking skills can be under stood as a priority of the process over the product. While it has been proven that intelligence is not a necessary prerequisite for creativity (Sternberg, 1999), knowledge seems to be a necessary, but not sufficient, condition for creativity (Borden, 2001; Weisberg , 1999). It is, nevertheless, still unclear how knowledge proficiency shapes creative outputs, as research findings seem to be contradictory, starting on the one hand that extreme expertise will hinder creative outcomes (Simonton,1990)and on the other hand there is no limit to the amount of knowledge needed to be creative(Weisberg,1999)knowledge and expertise are unquestionable attributes of the creative eminent mind regardless of the debate about the kind of knowledge needed (Scott 1999). Creativity allows for the making of connection across different areas of knowledge (Burke 2007) . This is an important point as research shows that student and especially young children find it very difficult to transfer learning from one area to another or to apply former knowledge to a new topic (sharp 2004).

Innovative teachers can use cheaper products to simulate experiments. Teachers can also help students learn improvisation as an important life skill. Teachers can work with students to come up with ways to improvise, forcing students to think critically about the scientific concepts underlying the devices. Through improvisation, students attention are captured and retained for the better part of the lesson. Since they serve as educational materials, students' interest in science and technology education is stimulated, meaningful and interesting. Learning is more permanent and there is development of skill in the psychomotor domain.

Improvisation can be described as a substitute: This means teachers' effort to supplement, substitute or device means, materials and equipment to facilitate effective teaching and learning among the pupils. Improvisation can be explained as composing a careful selection and use of materials as an alternative means of complementing the existing or otherwise. Instructional material / equipment in schools.

Instructional materials ensure that the learners see, hear, feel, recognize and appreciate as they learn, utilizing the five senses modalities at the same time.

Omosewo (2008) and Akinsola (2000), found that many of Nigeria Science teachers were aware of possibility of improvisation but many exhibited poor attitude towards improvisation. They also noted that very few teachers practice improvisation while majority depends on imported equipments and claim that improvisation is a time-consuming and fund depleting. The authors also noted that students too, possessed little or no interest in improvisation.

In Nigeria, the need for improvisation became essential where there were no adequate capital to procure the real materials and equipment. It is also necessary when population outweighs what is available because of the insufficient funding in education.

Onasanya et al (2008), Adebimpe (1997) and Aguisibo (1998) noted that improvisation demands adventure, creativity, curiosity and perseverance on the part of the teacher. The author added that such skills are only realizable through well-planned training programme on improvisation.

Experience over the years has shown that teachers have been depending on excessive use of words to express, to convey ideas or facts in the teaching – learning process. This practice is termed the 'chalk-talk' method. Today, advances in technology have made it possible to produce materials and devices that could be used to minimize the teachers talking and at the same time, make the message clearer, more interesting and easier for the learners to assimilate (Onasanya et al, 2008). According to Soetan et al, (2010), graphics include charts, posters, sketches, cartons, graphs and drawings. Graphics communicate facts and ideas clearly through combination of drawings, words and pictures. The use of graphics in teaching creates definitiveness to the materials being studied. They help to visualize the whole concepts learned and their relationships with one another.

2.7. Student Participation in Classroom when Teaching and Learning of Mathematics

Learning is life-long activity. It begins from the time we are born and goes on until we die. Learning is a relatively permanent change in behaviour due to an experience on practice. Otiato (2002) states that recognition; discrimination, classification and sensory integration are important skills that enhance learning. Through cooperative Learning, learners develop cooperation among each other, positive attitude toward each other, others learn to control their emotions and gain social interaction.

MOEST (2001) states that learning by doing is a process in which pupils are practically involved in the learning process. Participation in lesson facilitates learning. There are a number of ways that students can participate overtly, including their ideas and thoughts, spontaneously volunteering to answer questions, answering questions when called on, demonstrating at the chalkboard, talking to peers or the teacher about the tasks and completing written work. Students may also participate without the behavioural indicators of involvement by watching, listening and thinking. Student participation in classroom therefore can be defined as speaking in class, asking and answering questions, making comments, participating in discussions, reading materials, doing homework, and attending lessons, (Vandrick 2000).

Participation is both a productive work habit, likely to contribute to learning as well as evidence of student motivation to learn. Participation in learning activities is a valuable work habit for several reasons. It provide student with opportunities to learn and practice new knowledge and strategies to explain their reasoning and to examine their thinking processes and recognize the need to revise thinking. It also allows teachers a window into student thinking processes and learning allows them to diagnose learning problems or evaluate learning process or evaluates student progress and provides teachers an opportunity to provide cognitive and affective supports for students' understanding.

Brown et al, (2003) in their study of ''primary student teacher understanding of mathematics and its teaching,'' reveals that the quality of classroom teaching is a key to

improving students learning. Classroom teaching is nearly a universal activity designed to help students to learn. It is the process that brings the curriculum into contact with students and through which educational goals are to be achieved.

Findings of research suggested that several classroom instructional activities was associated with achievement and noted that the ways in which instructional activities are presented in classroom context affects students achievement, (Sewell 1984, Anderson and Brophy 1998; Cooper 1998).

Sommer, (1999) in his study, 'Effect of class size on student achievement and teachers in the third grade' found that quality of instruction influence achievement at class level. The teaching context is established through preconceptions held by the teacher about the process of learning and how that might be facilitated (Mouly 1982).

Smith (1987) in his study observes that an important part of any instructional setting is the teaching style. Research results suggested that teaching style exerted effects on student achievement that were independent of student characteristics.

Halydyna and Shaughness (1983), on their study on "causal analysis at attitude toward mathematics" said that a problem occur when teaching styles conflict with student learning styles ,often resulting in limited learning or no learning .They offers learner-centred ness as a model for responding to classroom challenges because of its viability for meeting divers needs.

Cooper (1998) found that student learn more in classes where they spend most of their time being taught or supervised by teachers than working on their own .Teachers provide variety of instructional methods and techniques for helping learners construct their learning and develop a system for applying knowledge and theory (Brown at all 2003).

Anderson and Prophy (1998) argued that through homework assignment teachers could be assured that student did their learning time beyond schools hours. Homework is seen as contribution towards students learning extending the curriculum beyond the classroom and

it can be conceived as one facet of opportunity to learn in the sense that home assignment offer students the opportunity to continue school work after regular school hours.

According to the sigma a mathematics club in Tenwek High Schools the conqueror (2007) edition ,everybody on earth is best in mathematics only that potentiality is latent and it needs is constant persistent exercise, tender devotion, determination, confidence, steadiness and avoidance of unnecessary hurries to get it solved .They said that mathematics is doing not reading .It needs a lot of exercise and several calculations.

2.8. Theoretical Framework

The teaching and learning of mathematics according to the SMASE (INSET program) needs learners to be active participants and the teachers to adopt learners centred learning method. The researcher based her study on the constructivist theoretical framework, by Bruner (1966) which states that learning is an active process in which learners construct new ideas or concepts based upon their past knowledge. The crucial action of constructing meaning is mental; it happens in the mind. Physical actions, hand-on experience may be necessary for learning especially for children but it is not sufficient; we need to provide activities which engage the mind as well as the hands called this reflective activity, (Duckworth, Easley, Hawking and Henriques, 1990). This theory provides a useful model for studying of SMASE training on teaching and learning mathematics in Bomet-Central division.

2.9. Conceptual Framework

This conceptual framework was developed from ASEI/PDSI practice, lesson study, ICT integration, improvisation and student participation in the classroom as independent variable that influences the teaching and learning of mathematics in public primary schools, the dependent variable. Government policy is the moderating variables.

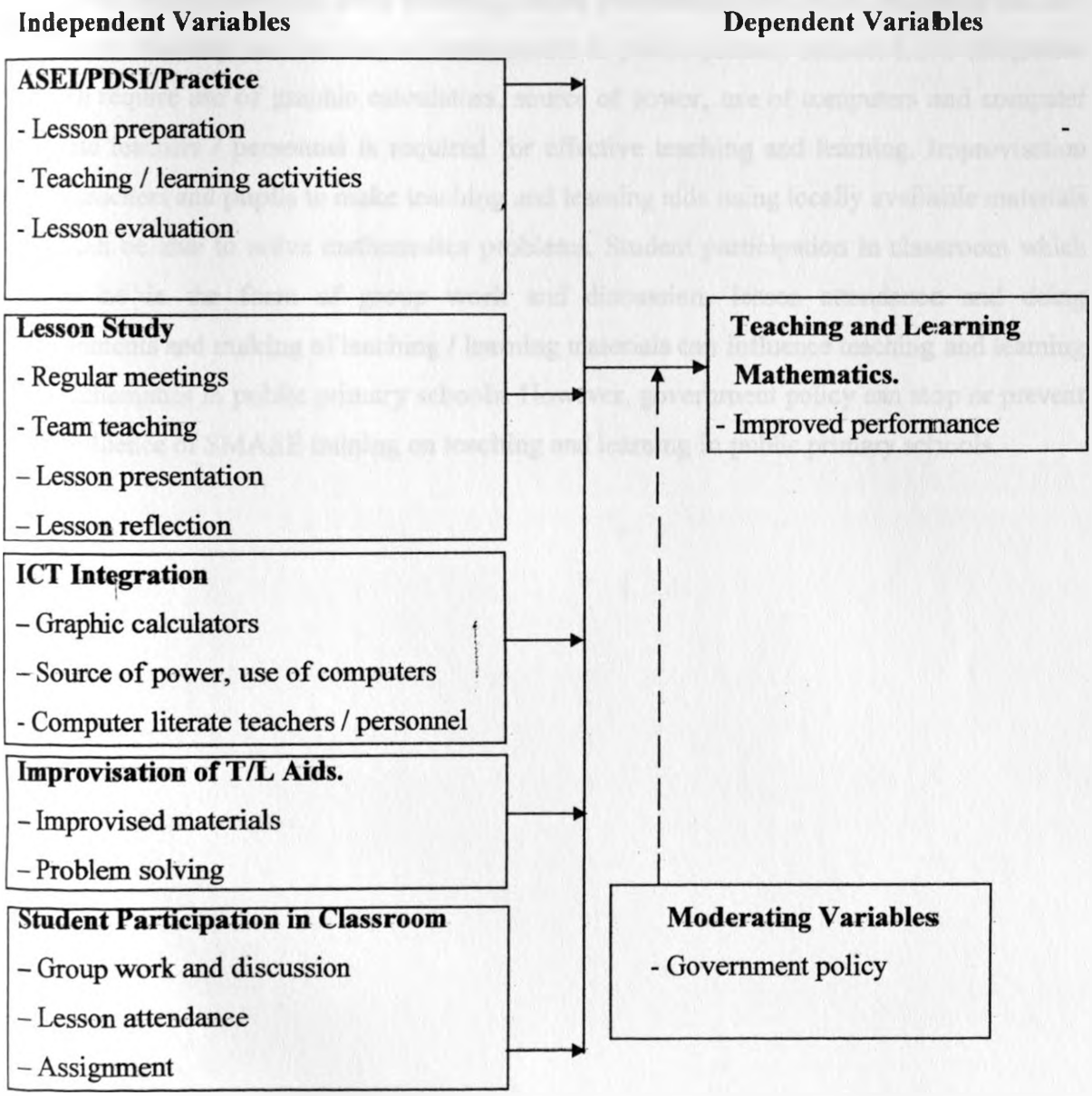

Figure 2.1. Conceptual Framework

2.1.0. Definition of Operational Variables.

SMASE training on teaching and learning of mathematics in public primary schools is influenced by ASEI / PDSI practices which require improvisation of teaching and learning aids using locally available materials, lesson preparation by teachers using ASEI – PDSI lesson plan, teaching and learning activities and lesson evaluation. Lesson study which involves regular meetings, team teaching, lesson presentation and lesson reflection can also influence teaching and learning of mathematics in public primary schools I.C.T integration which require use of graphic calculators, source of power, use of computers and computer literate teachers / personnel is required for effective teaching and learning. Improvisation help teachers and pupils to make teaching and learning aids using locally available materials and can be able to solve mathematics problems. Student participation in classroom which could be in the form of group work and discussion, lesson attendance and doing assignments and making of teaching / learning materials can influence teaching and learning of mathematics in public primary schools. However, government policy can stop or prevent the influence of SMASE training on teaching and learning in public primary schools.

Table 2.1: Operational Definition of Variables

Dependent Variables

Objectives	Variable	Indicators	Measures	Scale
Influence of SMASE in teaching and learning of mathematics in public primary schools in Bomet-Central Division, County, Kenya.	Teaching and learning.	Improved performance	- To know school performance in the last years KCPE analysis in mathematics.	Interval

Independent Variables

Objectives	Variable	Indicators	Measures	Scale
1. To examine how use of ASEI /PDSI practices. influencing teaching and learning of Mathematics in Public primary schools in Bomet- Central Division.	ASEI / PDSI Practice	- Lesson preparation. - Teaching and learning activities - Lesson evaluation.	- If teachers prepare ASEI PDSI lesson plan. - If teachers use the prepared ASEI / PDSI lesson plan. - How frequently other teaching / learning activities such as discussion, homework used in Classroom. - How frequently do students evaluate teachers at the end of the lesson.	Nominal Nominal Ordinal Ordinal

Objectives	Variable	Indicators	Measures	Scale
2. To investigate the extent to which lesson study influence teaching and learning of mathematics in public primary schools in Bomet- Central Division.	Lesson Study.	- Regular meetings to work on lesson design implementation and evaluation.	- How regularly teachers of Mathematics meet to work on lesson design, implementation and evaluation to improving on one or several lessons.	Ordinal
		- Team teaching	- If teachers share topics with other teachers in class so as to teach as a team.	Nominal
		- Lesson presentation.	- If teachers do lesson presentation during lesson study in groups.	Nominal
		- Lesson reflection.	- How frequently teachers sit and reflect on the lesson taught.	Ordinal

Objectives	Variable	Indicator	Measures	Scale
3. To establish how ICT integration influence teaching and learning of Mathematics in public primary schools in Bomet- Central Division.	ICT integration	- Graphing Calculators.	- How frequently teachers use graphic calculators in visualizing concepts, exploration, experimentation, generalizing and checking solutions to mathematics problems.	Ordinal
		- Source of power.	- If there is a source of power in the primary schools.	Nominal
		- Computer literate personnel learners.	- If the school have computer literate personnel/teachers and their level of qualifications.	Nominal.
		- Use of Computers.	- How frequently teachers use computer software in teaching mathematics in their classes.	Ordinal.

Objectives	Variable	Indicator	Measures	Scale
4. To assess the extent to which improvisation influences teaching and learning of Mathematics in public primary sch Bomet- Central Division.	Improvisation	- Making of teaching and learning materials - Problem solving.	- How frequently teachers improvise teaching / learning aids to be used in their teaching. - If teachers uses creativity and innovation to solve problem in mathematics.	Ordinal Nominal
5. To determine how student participation in classroom influences teaching and learning of Mathematics in public primary schools in Bomet -Central Division, Bomet County.	Student participation in classroom	- Lesson Attendance. - Group work and discussion. - Assignment.	- How regular is the learners attending mathematics lessons? - How frequent are learners involved in groups work and discussion. - How frequent do learners do their assignments completely and neatly.	Ordinal Ordinal Ordinal

2.1.1. Summary of Literature Review

According to the common wealth secretariat (1995), INSETS are mounted for various reasons which differs from one country to another. Studies done on INSETS on developed countries shows that in-service education programmes for teachers changes their plan and action and are effective in improving teaching and learning. On the country in some developed countries studies shows that despite intensive INSETS training teachers do not practice what they were trained on or practiced it separitively from the way they were trained.

In developing countries, INSETS are used as a means of improving science ed ucation and to address problems of teachers shortage. They are used to improve quality of teachers who are under qualified and untrained. In Africa, INSETS seeks to strengthen mathematics and science education and enhance learners ability through improved teachers content mastery and pedagogical skills hence enhancing both teachers and learners attitude towards mathematics and sciences.

In Kenya, a number of initiatives by the government are on-going while others have ended. They include SBTD, SPRED, PRISM, KESSP and SMASE. Reforms in education including teacher education requires informed policies that recognize the need for change, appreciate possible challenges and set guidelines for affecting the changes in mathematics education (Advisory Committee on Mathematics Education, 2002, 2005).

In Bomet Central Division SMASE has been done for the last 4 years and teachers are motivated on the use of ASEI / PDSI practices, lesson study, ICT integration improvisation of teaching aids and students participate in the lessons during the teaching and learning of mathematics. No study has been done in Bomet Central Division on the influence of SMASE in the teaching and learning of mathematics. ASEI lesson design considers the quality of classroom activities as critical to achieving effective teaching and learning. ASEI calls for proper Planning, Doing, Seeing and Improvement (PDSI). Lesson study is done

through meetings to work on the lesson design, implementation, evaluation and improving on one or several lessons, ICT integration enables teachers to use graphing calculators in visualising concepts, explorations, experimentation, generalization and checking solutions to algebraic problems (Currency 1992). Most studies show that there is a significant relationship between improvisation of teaching aids and student participation in classroom hence influence the teaching and learning.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presented the methodology to be used in the study. It describes the research design, target population, sample size and sampling procedures, research instrument, piloting of the study, reliability and validity of the research instrument, data collection procedures, data analysis techniques and ethical considerations.

3.2 Research Design

This study used descriptive survey design. Descriptive survey designs are used when the objectives is systematic or description of facts and characteristics of a given population or sample of the population or area of interest is factual and accurate (Kothari, 2007). It gathers data at a particular point in time with the intention of describing the nature of the existing conditions, identify the standards against which existing conditions can be compared and determining the relationship that exists between specific events (Orodho, 2005). Descriptive survey seeks to uncover the nature of factors involved in a given situation, the degree in which it exists and the relationship between them (Travers, 1969).

3.3. Target Population

The research study was carried out in Bomet Central Division of Bomet County. The division has a total of 128 public primary schools. The target population consisted of 128 headteachers, 460 mathematics teachers and 4, 681 pupils (AEO, July 2012 returns) giving a total of 5, 269 people.

3.4. Sample Size and Sampling Procedure

This section described the sample size and sampling procedures.

3.4.1. Sample Size

The sample which was used in the study was made up of 9 headteachers of public primary schools, 31 mathematics teachers and 317 pupils.

3.4.2. Sampling Procedures

The study targets public primary school headteachers, mathematics teachers and Std 6 pupils. The total target population was 5, 269; 128 public primary school headteachers, 460 mathematics teachers and 4, 681 pupils.

According to Krejcie and Morgan (1970) a sample size of 357 is appropriate for a target population of 5, 269. Stratified sampling identifies sub groups in the population and their proportions and select from each sub groups to form a sample as follows:

$$\frac{\text{Target population}}{\text{Total population}} \quad X \quad \text{sample size}$$

A sample size of 9 headteachers, 31 mathematics teachers and 317 pupils was then be obtained. The number of respondents was then be randomly selected.

3.5. Research Instruments

To obtain data, three types of questionnaires were used; one for the headteachers, the students and another for the mathematics teachers to collect primary data. The questionnaire which is a device with a list of questions which a respondent is required to respond to (Mugenda, 1999), was taken by the researcher to the school and given to the sampled population. Kothari (2008) observes that questionnaires are more objective than interviews because, they gather responses in a standardized way while ensuring confidentiality.

Both closed-ended and open-ended questionnaires were used. Close-ended questionnaire was presented on a Likert Scale, which will allow participants to respond with degree of agreement or disagreement.

3.5.1 Piloting of the Study

Pilot study was done in Bomet – Central Division, Bomet County. According to Mugenda and Mugenda (2003) a pre test sample of a tenth of the total sample with homogenous characteristics is appropriate for the pilot study. Questionnaires designed for the study were administered to 1head teacher, 3 mathematics teachers and 31 Std 6 Pupils. Test – retest technique was used for the study. The instrument was administered to the same respondents twice without prior notification. Data collected and analysed from the pilot study gave the researcher an insight of nature of expected results after the study was completed. The researcher knew the validity of the instruments by studying the responses to the question. The researcher was also able to identify gaps in the instruments in relation to the research objectives and how to address them prior to the study. Those sampled for pilot studies were not involved in actual survey.

3.5.2 Validity of the Research Instruments

Validity is the degree to which a test actually measures the variables it claims to measure, Kathuri & Pacs (1998). Validity refers to the systematic error in measurement. The validity of an instrument represents the degree to which a test measures what it purports to measure (Borg and Gall 1983). The study addressed content validity.

According to Mugenda and Mugenda (2003) content validity is a degree to which data collected using a particular instruments represent a specific domain of indicators or content of particular concept. Opinion of colleagues, project evaluators and the supervisors were given the questionnaires to check whether all the themes in objectives were captured. This helped to assess the content validity.

3.5.3 Reliability of Research Instruments

An instrument is reliable when it can measure a variable accurately and consistently and obtain the same results under the same condition over time. Reliability is a measure of the

degree to which a research instrument yields consistent results after repeated trials Mugenda and Mugenda (2003).

Test-retest technique was used to determine the reliability of the instruments. The same questionnaire was administered twice at an interval of three weeks from the first test.

Pearson's moment correlation co-efficient was then used to compute the correlation coefficient. A coefficient of 0.7 and above was accepted.

3.6 .Data Collection Procedures

After getting the sample population, the researcher collected the data from selected respondents after seeking consent from the relevant authority of the respective schools. The respondents was not required to disclose their personal information such as names. The researcher went further and requested the respondents to fill in the questionnaire as honest as possible. She then followed up to check if the questionnaires were duly filled. If the respondents was not able to complete they were given a day or two to complete. Data collected was presented in form of frequency tables for easier understanding and interpretation.

3.7 Data Analysis Techniques

Data analysis refers to the process which the researcher interprets the data collected systematically in order to make sense out of it. Raw data from the field was collected using questionnaires. The data was mainly descriptive and was translated from qualitative to quantitative. All the questionnaires were carefully examined to check on their completeness and consistency. A serial number was given and the number identified for each respondent. The data was used to generate tabular reports. Data was analyzed through descriptive statistics where frequencies, percentages and totals were used. The descriptive statistics were the most appropriate for the study because they helped in description, analysis and interpretation of circumstances the way they were at the time of study. The data collected was edited, organised and analysed using SPSS statistical package.

3.8 Ethical Considerations

First the researcher identified herself to the respondents. She briefed the respondents on the study and why she was carrying out the study .To ensure confidentiality names of the respondents were not used in the study and that they were not forced to fill questionnaires.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1. Introduction

The presentation in this chapter is guided by the questionnaire which is attached in the appendix section. The data collected has been analyzed by use of percentages, frequencies and cumulative percentages. This analysis shows Questionnaire Return Rate and demographic characteristics of the respondent. It also shows influence of ASEI / PDSI practices, lesson study, ICT integration, improvisation and student participation in classroom when teaching and learning mathematics in public primary schools in Bomet-Central Division.

4.2. Questionnaire Return Rate

The researcher issued by hand delivery 357 questionnaires. 9 questionnaires for the school headteachers, 31 for the mathematics teachers and 317. All the 357 questionnaires which represented 100% were returned. This was possible because the researcher was assisted by the deputy headteachers of all the schools visited. The study proceeded because Shutt (1999) argues that 60% and above return rate of questionnaires is adequate since it is a representative of the sample.

4.3. Demographic Characteristics of the Respondent

The demographic characteristics of the respondents such as gender, age, qualification, experience, type of school, number of SMASE cycles among others were sought to ascertain their influence on SMASE training on teaching and learning of mathematics in primary schools in Bomet Central Division.

4.3.1. Headteachers' Demographic Characteristics

The headteachers' gender, age, level of qualification and the type of school they are managing was important to ascertain their influence on SMASE training on teaching and

learning of mathematics in the division. The headteachers' demographic characteristics are shown on table 4.1.

Table 4.1. Headteachers' Demographic Characteristics.

Respondent	Category	Frequency	Percentage (%)	Cumulative percentage (%)
Gender	Female	2	22.2	22.2
	Male	7	77.8	100
Age	36 – 45	7	77.8	77.8
	46 – 55	2	22.2	100
Level of qualification	Certificate	4	44.5	44.5
	Diploma	2	22.2	66.7
	Graduate	3	33.3	100
Type of school	Mixed day	9	100	100

N = 9

22.2% of the headteachers understudy were female. This implies that most female teachers run away from responsibilities. They do not attend interviews so that they can be promoted as headteachers. Girls student may lack role model and this may influence SMASE training on teaching and learning in public primary schools in the division. 77.8% were male. This shows that most of the headteachers in Bomet Central Division are male. Majority of the headteachers 77.8% were in the age bracket of 36 – 45 years showing that they are energetic and mature enough to manage their schools.

44.5% of the headteachers with certificates, 22.2% had diploma and 33.3% were University graduate. Headteachers needs to be diploma holders in management skills to be able to manage the school well. 44.5% of the headteachers with certificate might not be able to enhance SMASE implementation or practices at school level and this may influence SMASE training on teaching and learning in primary schools.

4.3.2. Mathematics Teachers' Demographic Characteristics

The gender, age, level of qualification, teaching experience and the number of SMASE cycles attended by mathematics teachers were considered in this study. These characteristics were important to ascertain if they have any influence on the way they were translating SMASE into classroom. Mathematics teachers' demographic characteristics are shown on table 4.2.

Table 4.2. Mathematics Teachers' Demographic Characteristics

Respondent characteristics	Category	Frequency	Percentage (%)	Cumulative percentage (%)
Gender	Female	11	35.5	35.5
	Male	20	64.5	100
Age	Below 25	1	3.2	3.2
	26 – 35	12	38.7	41.9
	36 – 45	10	32.2	74.1
	46 – 55	6	19.4	93.5
	56 and above	2	6.5	100
Level of qualification	Certificate	15	48.4	48.4
	Diploma	10	32.2	80.6
	Degree	6	19.4	100
Teaching experience	Less than one yr	1	3.2	3.2
	1 – 5	6	19.4	22.6
	6 – 10	4	12.9	35.5
	11 – 15	9	29.0	64.5
	21 and above	11	35.5	100
Number of SMASE cycles attended	1	9	29.0	29.0
	2	7	22.6	51.6
	3	12	38.7	90.3
	4	3	9.7	100

N = 31.

Both genders were represented in the study. Female teachers 35.5% and male teachers of mathematics were 64.5%. This implies that most male teachers like teaching mathematics this might be because mathematics has been considered to be a male subject. Female teachers do not like teaching mathematics and this might influence SMASE training on teaching and learning mathematics in Bomet-Central Division. 3.2% of the mathematics teachers were age below 25 years, this is because most of the teachers below the age of 25 years have not been employed by the TSC. A few which might constitute the 3.2% are lucky to have been employed. 38.7% were in the age bracket of 26 – 35 years, this is the percentage of all the age brackets. This is because teachers in this age bracket are still young and energetic. They are very active and want to know more hence influencing SMASE training on the teaching and learning of mathematics in the division. 32.2% were in the age bracket of 36 – 45 years, this implies that they are also still energetic but might be committed because of family work. 19.4% were in the age bracket of 46 – 55 years. This might be because of commitment and are tired and waiting for retirement hence they do not see the need for SMASE training and those above 56 years were 6.5% smallest percentage. This might be because most of the teachers in this age bracket have retired and the few who have not retired are in lower classes where SMASE training are minimal or not practiced at all.

All the teachers' studied were qualified to teach mathematics as required by SMASE. Those with certificate were 48.8%, diploma were 32. 3% and those with degree were 19.4%. Their teaching experience ranged from less than one year (3.2%), 1 – 5 years (22.6%), 6 – 10 years (35.4%), 11 – 15 years (64.5%) and above 21 years (35.5%). Those in the age bracket of (11 – 15) were well experienced hence influencing SMASE training on teaching and learning of mathematics in the division.

The division has mounted 4 cycles of SMASE training so far and 9.7% have attended all the mounted cycles. 38.7% have attended 3 cycles, 22.6% 2 cycles and 29% have attended 1 cycle. Those who have attended 1 and 2 cycles might be missing some SMASE training concept hence influencing SMASE training.

4.3.3. Pupils' Demographic Characteristics

Pupils' gender, age and class were taken into consideration. This was important to ascertain if it has any influence on the way pupils' were learning mathematics. Pupils' demographic characteristics are shown on table 4.3.

Table 4.3. Pupils' Demographic Characteristics

Respondent characteristics	Category	Frequency	Percentage (%)	Cumulative percentage (%)
Gender	Female	157	49.5	49.5
	Male	160	50.5	100
Class	Std 6	317	100	100
Age	10 – 11	45	14.2	14.2
	12 – 13	215	67.8	82.0
	14 – 15	45	14.2	96.2
	16 and above	12	3.8	100

N = 317

Table 4.3. Shows that the percentage of boys 50.5% was higher than that of girls which was 49.5% by only 1%. All the pupils' were in class 6. It also showed that majority of the respondents were in the age bracket of (12 – 13) years which is the right age for Std 6 pupils'. The smallest percentage of 3.8% in the age bracket of 16 years and above and 14.2% in the age bracket of (14 – 15) years showed that those pupils were old to be in that class. This might influence SMASE training on teaching and learning of mathematics in the division. Those in the age bracket of (10 -11) were young to be in that class. This can also influence SMASE training on teaching and learning of mathematics in the division.

4.4. The Influence of ASEI / PDSI Practices on Teaching and Learning of Mathematics in Public Primary Schools in Bomet Central Division

The guiding principle of SMASE INSET is ASEI. This principle is implemented based on the PDSI approach (Nui and Wahome, 2006), thus the ASEI – PDSI paradigm. ASEI is an acronym for Activity, Student, Experiment and Improvisation (Nui and Wahome, 2006). ASEI calls for Proper Planning, Doing, Seeing and Improvements hence the acronym PDSI, (SMASE 2002).

All the sampled teachers have attended SMASE INSETS. Therefore the researcher sought for opinions from various groups on how teachers are practicing the ASEI / PDSI in their classes. Table 4.4. Gives the Headteachers opinions on the ASEI / PDSI practice in classroom.

Table 4.4. Headteachers' Opinion on ASEI / PDSI Practices in Classroom

Item	Response	Frequency	Percentage (%)	Cumulative percentage (%)
a) Teachers prepare ASEI / PDSI lesson plan.	Strongly agree	2	22.2	22.2
	Agree	4	44.4	66.6
	Neutral	3	33.3	100
b) Teachers use the prepared ASEI / PDSI lesson plan.	Strongly agree	2	22.2	22.2
	Agree	4	44.4	66.6
	Neutral	3	33.3	100
c) Teachers use teaching activities such as discussion and group work.	Strongly agree	3	33.3	33.3
	Agree	5	55.6	100
d) Teachers allow students to evaluate their lesson at the end.	Strongly agree	1	11.1	11.1
	Agree	5	55.6	66.7
	Neutral	3	33.3	100
e) Teachers allow colleague teachers to evaluate their lessons.	Strongly agree	1	11.1	11.1
	Agree	2	22.2	33.3
	Neutral	5	55.6	88.9
	Disagree	1	11.1	100

N = 9

Table 4.4 shows that 66.6% of the headteachers agreed that teachers prepare and use ASEI / PDSI lesson plan when teaching implying that teachers were well taught during SMASE training. 33.3% of the mathematics teachers do not prepare the ASEI / PDSI lesson plan hence do not use it. This may be because they are not motivated to prepare and use it or because they are committed hence finding it to be time consuming and costly. All the headteachers also agreed that mathematics teachers use teaching activities such as discussion and group work when teaching mathematics.

66.7% headteachers agree that mathematics teachers allow students to evaluate their lesson at the end while 33.3% of the headteachers were neutral of that. They also agreed that 33.3% of mathematics teachers allow colleague teachers to evaluate their lesson while 66.7% disagree on that. This might influence SMASE training in teaching and learning of mathematics in the division.

The researcher went further to sought for pupils' opinions as concerns the ASEI PDSI practice when teaching mathematics and is shown in table 4.5.

Table 4.5. Pupils' Opinion on ASEI /PDSI Practices on Teaching and Learning Mathematics

Item	Response	Frequency %	Percentage (%)	Cumulative percentage (%)
i. Teachers of	Strongly agree	200	63.1	63.1
mathematics frequently	Agree	70	22.1	85.2
use other teaching/	Neutral	15	4.7	89.9
learning activities such	Disagree	6	1.9	91.8
as discussion, group	Strongly disagree	26	8.2	100
work when teaching.				
ii. Pupils' frequently	Strongly agree	167	52.6	52.6
evaluate teachers at the	Agree	100	31.5	84.1
end of the lesson.	Neutral	20	6.4	90.5
	Disagree	10	31.1	93.6
	Strongly disagree	20	6.4	100

N = 317

Table 4.5 shows that 85.2% of the pupils' agree that teachers of mathematics frequently use other teaching / learning activities such as discussion and group work. This makes learning easier and interesting hence motivating learners to learn more and encourage high retention. 14.8% of them disagree. This shows that they will learn less and also retain less. On the other side of frequently evaluating teachers at the end of the lesson, 84.1% agree. This shows that mathematics teachers are well prepared and are not afraid of being evaluated. However, 15.9% of them disagree. This shows that a few of the teachers do not like to be evaluated by pupils because they might not be prepared in their lessons and they may feel ashamed to be told their weaknesses.

The researcher also sought for opinions from mathematics teachers on the ASEI / PDSI practices and is shown in table 4.6.

Table 4.6. Mathematics Teachers' Opinion on ASEI / PDSI Practices on Teaching and Learning Mathematics

Item	Response	Frequency %	Percentage (%)	Cumulative percentage (%)
i. Prepare ASEI / PDSI	Strongly agree	7	22.6	22.6
lesson plan	Agree	24	77.4	100
ii. Use the prepared	Strongly agree	10	32.3	32.3
ASEI / PDSI lesson	Agree	20	64.5	96.8
plan when teaching in	Neutral	1	3.2	100
class.				
iii. Use other teaching/	Strongly agree	20	64.5	64.5
learning activities	Agree	10	32.3	96.8
when teaching in class.	Neutral	1	3.2	100

N = 31

Table 4.6 Shows that all mathematics teachers (100%) agree that they prepare the ASEI / PDSI lesson plan. 96.8% of them agree that they use the prepared ASEI / PDSI lesson plan when teaching in class while 3.2% of them were neutral on that. This shows that mathematics teachers were well taught on how to prepare and use ASEI / PDSI lesson during SMASE training.

4.5. Influence of Lesson Study on Teaching and Learning Mathematics in Bomet-Central Division

In this objective the researcher sought for opinions from the school headteachers, mathematics teachers as well as the pupils' views on lesson study. Table 4.7 gives the headteachers' opinion on lesson study when teaching and learning mathematics after attending SMASE INSET.

Table 4.7. Headteachers Opinions on Influence of Lesson Study on Teaching and Learning Mathematics

Item	Response	Frequency %	Percentage (%)	Cumulative percentage (%)
i. Regularly meet to work on the lesson design, implementation, evaluation improving on one or several lessons.	Agree	5	55.6	55.6
	Neutral	4	44.4	100
ii. Share topics with other teachers in class.	Strongly agree	1	11.1	11.1
	Agree	6	66.7	77.8
	Neutral	1	11.1	88.9
	Disagree	1	11.1	100
iii. Do lesson presentation during lesson study in groups.	Strongly agree	10	11.1	11.1
	Agree	20	77.8	88.9
	Neutral	1	11.1	100
iv. Sit and reflect on the lesson.	Strongly agree	20	11.1	11.1
	Agree	10	55.6	66.7
	Neutral	1	33.3S	100

N = 9.

Table 4.7 shows that 55.6% of headteachers agree that mathematics teachers regularly meet to work on lesson design, implementation, evaluation and improving on one or several lesson. This shows that teachers are willing to sit together and work on difficult areas in mathematics hence improving way of teaching and learning mathematics thus better performance in mathematics. 44.4% of them were neutral. This shows that some teachers do not know the importance of meeting in groups and this may hinder better performance in mathematics. 77.8% that mathematics teachers share topics with other teacher in classes. This shows that there is a team work 22.2% of them disagree on that. Showing that they do not know the importance of team teaching.

Most of the headteachers 88.9% agree that mathematics teachers do lesson presentation during lesson study in groups while 11.1% of them were neutral. 66.7% agree that maths teachers sit and reflect on the lesson taught while 33.3% of them were neutral. Lesson presentation and reflection is important in that teachers learn to improve in their lesson and hence gaining of experience. The researcher also sought for opinions from pupils as shown in table 4.8.

Table 4.8. Pupils' Opinion on Lesson Study when Teaching and Learning Mathematics

Item	Response	Frequency %	Percentage (%)	Cumulative percentage (%)
i. Other teachers assist your teacher in teaching different topics in mathematics	Strongly agree	100	31.5	31.5
	Agree	62	19.6	51.1
	Neutral	40	12.6	63.7
	Disagree	45	14.2	77.9
	Strongly disagree	70	22.1	100
ii. You frequently sit and reflect on your teachers' lesson.	Strongly agree	180	56.8	56.8
	Agree	100	31.5	88.3
	Neutral	6	1.9	90.2
	Disagree	9	2.8	93.0
	Strongly disagree	22	6.9	100
iii. You frequently evaluates teachers at the end of the lesson.	Strongly agree	180	56.8	56.8
	Agree	30	9.5	66.3
	Neutral	48	15.1	
	Disagree	23	7.2	
	Strongly disagree	36	11.4	

N = 317

Table 4.8 shows that 51.1% of the pupils agree that other teachers assist their teacher in teaching different topics in mathematics hence team work while 48.9% of the pupils disagree on that showing that there is no team work. 88.3% of the pupils agree that they frequently sit and reflect on their teachers' lesson hence improved learning. 11.7% of them

disagree showing that there was minimal learning. Most of the pupils 66% agree that they frequently evaluate their teachers at the end of the lesson but 33.7% of them did not agree on the same. Pupils' who evaluate their teachers are serious with their learning and wants to learn more but those who doesn't are lazy and not motivated to learn. The researcher went further to sought for opinions from mathematics teachers and it is shown in table 4.9.

Table 4.9. Mathematics Teachers' Opinion on Influence of Lesson study when Teaching and Learning Mathematics

Item	Response	Frequency %	Percentage (%)	Cumulative percentage (%)
After attending SMASE INSET you can:				
i. Meet to work on lesson design, implementation and evaluation to improve on one or several lessons.	Strongly agree	10	32.3	32.3
	Agree	16	51.6	83.9
	Neutral	5	16.1	100
ii. Share topics with other teachers in class so as to teach as a team.	Strongly agree	15	48.4	48.4
	Agree	11	35.5	83.9
	Neutral	5	16.1	100
iii. Do lesson presentation during lesson study in groups.	Strongly agree	16	51.6	51.6
	Agree	15	48.4	100
iv. Sit and reflect on the lesson taught.	Strongly agree	15	48.4	48.4
	Agree	16	51.6	100

N = 31

Table 4.9 shows that after attending SMASE INSET 83.9% of teachers agree that they can meet in groups to work on lesson design, implementation and evaluation to improve on one or several lessons. This shows that these teachers are very organized, motivated and very ready to work on difficult areas in mathematics hence improving the subject. While 16.1% were neutral on that showing that they are lazy and didn't know the importance of meeting

in groups to work on lesson design, implementation and evaluation and this can influence SMASE training on teaching and learning of mathematics in Bomet-Central Division. 83.9% also of the teachers are able to share topics with other teachers in class so as to teach as a team but 16.1% of those mathematics are neutral on the same. This may be because of ignorance or lack of cooperation due to lack of love for one another.

All mathematics teachers (100%) agreed that they were able to do lesson presentation during lesson study in groups and all of them also agree that they were able to sit and reflect on the lesson taught. This can make SMASE training successful.

4.6. Influence of ICT Integration when Teaching and Learning Mathematics in Bomet-Central Division

Data for this objective was collected by use of three questionnaires. One was for the headteacher, the other for the pupils' and the other for the mathematics teachers. Table 4.10 Shows headteachers responses.

4.1.0 Headteachers Opinions on Influence of ICT Integration on Teaching / Learning Mathematics

Item	Response	Frequency %	Percentage (%)	Cumulative percentage (%)
i. Use graphic calculators in visualizing concepts, exploitation, experimentation, generalizing and checking solutions to mathematics problems.	Strongly agree	1	11.1	11.1
	Agree	4	44.4	55.5
	Neutral	1	11.1	66.6
	Disagree	2	22.2	88.8
	Strongly disagree	1	11.1	100
ii. Have a source of power in their schools.	Strongly agree	2	22.2	22.2
	Agree	2	22.2	44.4
	Neutral	1	11.1	55.5
	Disagree	1	11.1	66.6
	Strongly disagree	3	33.3	100
iii. Are computer literate.	Agree	1	11.1	11.1
	Neutral	1	11.1	22.2
	Disagree	4	44.7	66.6
	Strongly disagree	3	33.3	100
iv. Use computer software in teaching mathematics in class.	Agree	1	11.1	11.1
	Neutral	2	22.2	33.3
	Disagree	2	22.2	55.5
	Strongly disagree	4	44.4	100

N = 9

Table 4.1.1 Pupils' Opinion on Influence of ICT Integration on Teaching and Learning Mathematics

Item	Response	Frequency %	Percentage (%)	Cumulative percentage (%)
i. Your teachers frequently use graphic calculators when doing mathematics.	Aree	16	5.0	5.0
	Neutral	45	14.2	19.2
	Disagree	54	17.1	36.3
	Strongly disagree	202	63.7	100
ii. There is a source of power in your school.	Strongly agree	85	26.8	26.8
	Agree	62	19.6	46.4
	Disagree	100	31.5	77.9
	Strongly disagree	70	22.1	100
iii. Your teachers frequently use computer software in teaching mathematics in class.	Aree	17	5.4	5.4
	Neutral	12	3.8	9.2
	Disagree	33	10.4	19.6
	Strongly disagree	255	80.4	100

N = 317

Table 4.1.1 shows that 95% of the pupils disagree that their maths teachers frequently use graphic calculators when doing mathematics and only 5% of them agree on the same. This shows that teachers might be using the graphic calculators in the office without the consent of the pupils'. This might be because it is believed that those who use graphic calculators aref lazy or do not know some mathematics concepts. s46.4% of them agree that their is a source of power in their school and 53.6% do not have a source of power in their school.

Only 5.4% of the pupils agree that their teachers frequently use computer software in teaching mathematics in class and a large percentage of 94.6% disagree on the same. Mathematics teachers should be given an INSET on computer literacy so that they are able to use it in their classes. The schools with the assistance of the stakeholders and MOE should avail computers in primary schools so that they can be used when teaching and learning mathematics. The researcher went further to sought for opinions from mathematics teachers and is shown on table 4.12.

Table 4.1.2 Mathematics Teachers' Opinion on ICT Integration on Teaching and Learning Mathematics

Item	Response	Frequency %	Percentage (%)	Cumulative percentage (%)
i. Use graphic calculators in visualizing concepts, exploitation, experimentation. generalizing and checking solutions to mathematics problems.	Strongly agree	4	12.9	12.9
	Agree	10	32.3	45.2
	Neutral	2	6.4	51.6
	Disagree	11	35.5	87.1
	Strongly disagree	4	12.9	100
ii. Have a source of power in their schools.	Strongly agree	4	12.9	12.9
	Agree	10	32.3	45.2
	Disagree	2	6.4	51.6
	Strongly disagree	15	48.4	100
iii. You are computer literate.	Strongly agree	8	25.8	25.8
	Agree	7	12.9	38.7
	Neutral	6	19.4	58.1
	Disagree	5	16.1	74.2
	Strongly disagree	8	25.8	100
iv. Use computer software in teaching mathematics in your classes.	Strongly agree	4	12.9	12.9
	Agree	2	6.4	19.3
	Neutral	6	19.4	38.7
	Disagree	4	12.9	51.6
	Strongly disagree	15	48.8	100

N = 31.

Table 4.1.2 shows that 45.2% of mathematics teachers agree that they use graphic calculators in visualizing concepts, exploration, experimentation, generalizing and checking solutions to mathematics problem and that they have a source of power in their school. 54.8% disagree on the same. This shows that a high percentage on teachers do not use graphic calculators since most of them were used to the olden traditional methods and most of them believed that those who use graphic calculators are lazy or might be lacking some mathematics concepts. 38.7% of them agree that they are computer literate and that 19.3% use computer software in teaching mathematics in their class. This is a small percentage as most schools do not have computers in their schools. On the other side 61.3% are not computer literate and that 80.7% of them do not use computer software in teaching mathematics in their classes.

4.7. Influence of Improvisation of Teaching/ Learning Aids for Teaching and Learning Mathematics in Bomet-Central Division.

Data for this objectives was collected by use of two questions. The first question required the respondents to indicate whether there is frequent improvisation of teaching / learning aids to be used in teaching and whether improvisation is used in solving problems in mathematics. Headteachers opinion is shown in table 4.13.

Table 4.1.3 Headteachers' Opinions on Improvisation of Teaching/Learning Aids for Teaching and Learning Mathematics

Item	Response	Frequency %	Percentage (%)	Cumulative percentage (%)
i. Improvising teaching / learning aids to be used when teaching.	Strongly agree	4	44.4	44.4
	Agree	5	55.5	100
ii. Use improvised teaching/ learning aids to solve problems in mathematics.	Strongly agree	4	44.4	44.4
	Agree	5	55.5	100

N = 9

Table 4.1.3 shows that all the headteachers (100%) agree that mathematics teachers make teaching / learning aids and that they use improvised teaching aids to solve problems in mathematics. This might be because there are several locally available materials that can be used for improvisation and that it is cheaper to improvise than to purchase. Opinions from the pupils is shown on the table 4.1.4.

Table 4.1.4 Pupils' Opinions on Improvisation of Teaching/Learning Aids for Teaching and Learning Mathematics

Item	Response	Frequency %	Percentage (%)	Cumulative percentage (%)
i. You frequently improvise	Strongly agree	202	63.7	63.7
teaching / learning aids to be	Agree	67	21.1	84.8
used in teaching and learning.	Strongly disagree	48	15.2	100
ii. You use improvised	Strongly agree	192	60.6	60.6
teaching / learning aids to	Agree	90	28.6	89.0
solve problems in	Disagree	35	11.0	100
mathematics.				

N = 317.

Table 4.1.4 shows that 84.8% of the pupils agree that they frequently improvise teaching / learning aids to be used in teaching and learning. This might be because there are several locally available materials that can be used for improvisation in the division. 15.2% of the pupils disagree on the same. This might be because they are lazy or are not ready to do so. 89% agree that they use improvised teaching aids to solve problems in mathematics this might be because they made it themselves and are aware of how to use them. 11% disagree on that. Opinions from the mathematics teacher are shown on table 4.1.5.

Table 4.1.5 Opinions of Mathematics Teachers on Improvisation of Teaching/Learning Aids for Teaching and Learning of Mathematics

Item	Response	Frequency %	Percentage (%)	Cumulative percentage (%)
i. Frequently improvise teaching / learning aids to be used when teaching.	Strongly agree	25	80.6	80.6
	Agree	6	19.4	100
ii. Use improvised teaching aids to solve problems in mathematics.	Strongly agree	16	51.6	51.6
	Agree	15	48.4	100

N = 31.

Table 4.1.5 shows that all mathematics teachers (100%) agree that they frequently improvise teaching / learning aids to be used when teaching and that they all use the improvised teaching aids to solve problems in mathematics. This was possible because there were several locally available materials from the environment in the division. It was also cheaper to improvise than to purchase.

4.8. The Influence of Student Participation in Classroom when Teaching and Learning Mathematics in Bomet-Central Division

The study sought to examine how student participation in classroom influence teaching and learning mathematics in public primary schools in Bomet Central Division. Table 4.1.6 shows headteachers opinions.

Table 4.1.6 Opinions of Headteachers' on Pupils Participation in Classroom when Teaching and Learning Mathematics

Item	Response	Frequency %	Percentage (%)	Cumulative percentage (%)
i. Learner regularly attend	Strongly agree	4	44.4	44.4
mathematics lessons.	Agree	5	55.6	100
ii. Learners are frequently	Strongly agree	3	33.3	33.3
involved in group work and	Agree		66.7	100
discussion.		6		
iii. Learners frequently do	Strongly agree	4	44.4	44.4
their assignments completely	Agree	5	55.6	100
and neatly.				

N = 9

Table 4.1.6 shows that all headteachers agree that learners regularly attend mathematics lessons. This might be possible because class teachers always mark the registers and may be punishments are given to those who fail to attend lessons. All of them also agree that learners are frequently involved in group work and discussions. All the headteachers also agree that learners frequently do their assignment completely and neatly. This might be due to high motivation and good teaching / learning methods used by mathematics teachers in their lessons. Mathematics teachers opinions on the same was sought for and is shown in table 4.1.7.

Table 4.1.7 Mathematics Teachers Opinions on Pupils' Participation in Classroom when Teaching and Learning of Mathematics

Item	Response	Frequency %	Percentage (%)	Cumulative percentage (%)
i. Learners frequently attend	Strongly agree	23	74.2	74.2
mathematics lessons.	Agree	8	25.8	100
ii. Learners are frequently	Strongly agree	18	58.1	58.1
involved in group work and	Agree	13	41.9	100
discussion.				
iii. Learners frequently do	Strongly agree	25	80.6	80.6
their assignment completely	Agree	6	19.4	100
and neatly.				

N = 31

Table 4.1.7 shows that all mathematics teachers agree that learners frequently attend mathematics lessons. This might be because of register marking and punishment given to those who do not attend lessons. All mathematics teachers also agree that learners are involved in group work and discussion. They also agree that learners frequently do their assignment completely and neatly. This might be because of high motivation by their teachers and frequent marking and checking of the assigned work. The researcher also sought for opinions from the pupils and is shown in table 4.1.8.

Table 4.1.8 Pupils' Opinions on their Participation in Classroom when Teaching and Learning Mathematics

Item	Response	Frequency %	Percentage (%)	Cumulative percentage (%)
i. You regularly attend	Strongly agree	215	67.8	67.8
mathematics lessons.	Agree	58	18.3	86.1
	Disagree	44	13.9	100
ii. You are frequently	Strongly agree	210	66.2	66.2
involved in group work and	Agree	62	19.6	85.8
discussion.	Neutral	7	22.2	88.0
	Strongly disagree	38	12.0	100
iii. You frequently do your	Strongly agree	194	61.2	61.2
assignments completely and	Agree	75	23.7	84.9
neatly.	Strongly disagree	48	15.1	100

N = 317.

Table 4.1.8 shows that 86.1% of the pupils agree that they regularly attend mathematics lessons this might be because they like the lesson or may be because of the punishment given if they fail to attend. Only a few of 13.9% disagree. 85.8% said that they are frequently involved in group work and discuss while 14.2% of them disagree. 84.9% agree that they frequently do their assignments completely and neatly as 15.1% disagree on that.

CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATION

5.1. Introduction

This chapter gives the summary of the research findings, discussion of the findings, conclusions, recommendations and suggestions for further research.

5.2. Summary of the Findings

This research was based on the topic; Influence of SMASE training on teaching and learning of mathematics in public primary schools in Bomet Central Division, Bomet County, Kenya.

On the first research question; How does the use of ASEI / PDSI practices influence teaching and learning of mathematics in public primary schools in Bomet Central Division? The study indicated that 66.7% of the headteachers and 100% of the mathematics teachers indicated that mathematics teachers prepare ASEI / PDSI lesson plan. On the use of the prepared ASEI / PDSI lesson plan when teaching in class 96.8% of the mathematics teachers and 66.6% of the headteachers indicated that they use it. 100% of the headteachers, 96.8% of mathematics teachers and 85.2% of pupils indicated that mathematics teachers use other teaching and learning activities such as discussion and group work when teaching and learning mathematics. 66.7% of the headteachers and 84.1% of the pupils indicated that teachers are frequently evaluated at the end of the lesson. A small percentage of 33.3% of the headteachers indicated that mathematics teachers allow colleague teachers to evaluate their lesson.

On the second research question; How does lesson study influence teaching and learning of mathematics in public primary schools in Bomet- Central Division? The findings show that 55.6% the headteachers and 83.9% of the mathematics teachers indicated that they regularly meet to work on lesson design, implementation and evaluation to improve on

one or several lessons. 77.8% of the headteachers, 51.1% of the mathematics teachers indicated that they share topics with other teachers in class so as to teach as a team. 88.9% of the headteachers and 100% of mathematics teachers indicated that mathematics teachers do lesson presentation during lesson study in groups. 66.7% of the headteachers and 100% of the mathematics teachers indicated that mathematics teachers frequently sit and reflect on the lesson taught.

The third research question was; Does ICT integration influence teaching and learning of mathematics in public primary schools in Bomet- Central Division? The findings showed that 45.2% of the mathematics teachers, 19.2% of the pupils and 55.5% of the headteachers indicated that mathematics teachers use graphic calculators in visualizing and concepts, exploration, experimentation, generalizing and checking sollutions to mathematics problems. 46.4% of the pupils, 45.2% of the mathematics teachers and 44.4% of school headteachers indicated that there is a source of power in their schools. 38.7% of mathematics teachers and 11.1% of the headteachers indicated that mathematics teachers are computer literate after attending SMASE. 5.4% of the pupils, 19.3% of the mathematics teachers and 11.1% of the headteachers indicated that teachers of mathematics use computer software in teaching mathematics in their classes.

On the fourth research question; To what extent does improvisation of teaching aids influence teaching and learning mathematics in public primary schools in Bomet -Central Division? The findings shows that 84.8% of the pupils, 100% of the mathematics teachers and headteachers indicated that mathematics teachers improvise teaching and learning aids to be used when teaching. 89% of the pupils, all the mathematics teachers and all the headteachers indicated that mathematics teachers use the improvised aids to solve problems in mathematics after attending SMASE training.

On the fifth research question; To what extent does student participation in classroom influence teaching and learning of mathematics in public primary school in Bomet-Central Division? The findings show that 100% of the mathematics teachers, headteachers and 86.1% of the pupils indicated that the pupils regularly attend

mathematics lessons. 85.8% of the pupils, 100% of mathematics teachers and headteachers indicates that pupils are frequently involved in group work and discussion. 84.9% of the pupils, all the headteachers indicate that pupils frequently do their assignments completely and neatly.

5.3. Discussion of the Findings

This section discusses the findings of the study based on research objectives. The guiding principle of SMASE INSET is ASEI (Activity, Student, Experiment and Improvisation). This principle is implemented based on the PDSI (Plan, Do, See and Improve) approach (Nui and Wahome, 2006), thus the ASEI – PDSI paradigm. After attending SMASE training, teachers of mathematics were able to prepare and use the ASEI / PDSI lesson plan when teaching mathematics in their classes. They were also able to use other teaching activities such as discussion and group work when teaching and learning mathematics. This findings agree with earlier studies done by JICA in2007 which revealed that teachers who had attended the SMASE INSETS were able to plan their lessons better, allow evaluation and improvise than teachers who had not attended the INSETS. (Kibe. Odhiambo and Ogwel, 2008). However on the aspect of evaluation by the pupils and other colleagues a small percentage of 33.3% of the headteachers indicated that mathematics teachers allow colleagues to evaluate their lessons.

Lesson study is a professional development activity in which team of teachers' systematically and collaboratively examines their practice with the goal of influence increase student learning (Stigler and Herbert 1999). Lesson study is done by teachers to improve teaching and learning and is fundamentally a problem solving process. In primary schools in Bomet Central Division 83.9% of mathematics teachers agree that they regularly meet to work on lesson design, implementation and evaluation and to improve on one or several lessons. During this lesson study, mathematics teachers do lesson presentation in groups, they also encourage one another to share mathematics topics hence teaching as a team. They also sit and reflect on the lesson taught. This is in agreement with lesson study in Zambia which was conducted in a cycle which setting an

issue and theme, preparing and experimental lesson collaboratively, implementing and observing the lesson, reflecting on the lesson and observing the improved lesson.

Among the issues which have been isolated from the need survey which was done on May and June 2009 was the ICT competence. ICT integrated lessons improve quality of learning and achievement through a medium that illustrates concepts that would otherwise be abstract to explain traditionally in line with the findings of Selinger (2004). The findings showed that 46.4% of the peoples, 45.2% of the mathematics teachers and 44.4% of the headteachers indicated that there is a source of power in their schools. This showed that most of the schools in Bomet-Central Division do not use computers in schools. This is not in agreement with the findings in Australia where computers began to be placed in schools in the early 1080s. After attending SMASE training still most of the mathematics teachers are not computer literate hence are not able to use computer software in teaching mathematics in their classes. This is in agreement with research in Australia, New house (2002) which found than many teachers lacked the knowledge and skill to use computer and were not enthusiastic about the changes and integration of supplementary learning associations with bringing computers into their teaching practices. Also in Saudi Arabia, lack of ICT skills is a serious obstacle to the integration of technologies into science education (Al – Alwani, 2005; Almohaissin 2006).

Creativity allows for the making of connection across different areas of knowledge (Burke 2007). This is an important point as research shows that student and especially young children find it very difficult to transfer learning from one area to another or to apply former knowledge to a new topic (Sharp 2004). The notion of innovative teaching stems from creative learning. After attending SMASE mathematics teachers are able to make pupils to be creative i.e. to make connection across different areas of knowledge. They are therefore able to improvise teaching and learning aids and are able to use the improvised materials to solve problems in mathematics. This is in agreement with Burke 2007 who said that creativity allow for the making of connection across different areas of knowledge.

Student participation in classroom can be defined as speaking in class, asking and answering questions, making comments, participating in discussions, reading materials, doing homework and attending lessons, (Vandrick 2000). 86.1% of the pupils' in primary schools in Bomet-Central Division agreed that they regularly attend mathematics lessons, are frequently involved in group work and discussion and 84.9% agree that they frequently do their assignments completely and neatly. This is in agreement with the findings of the MOEST (2001) which states that learning by doing is a process in which pupils are practically involved in the learning process.

5.4. Conclusions

Based on the findings of the study, several conclusions were drawn. Although mathematics teachers in primary schools in Bomet Central Division prepare and use the ASEI / PDSI lesson plans they argue that these methods are costly in terms of resources needed, time consuming when preparing and putting it into practice.

Teachers find lesson study to be time consuming as they are to sit in a meeting to work on lesson design, implementation and evaluation to improve on one or several lessons. Although teachers share topics with other teachers so as to teach as a team some of them are not comfortable on lesson presentation and sometimes are not able to sit and reflect on the lesson taught.

Mathematics teachers acknowledged that ICT integrated lessons improve quality of learning and achievement through a medium that illustrates concepts that would otherwise be abstract to explain traditionally in line with the findings of Selinger (2004). Most of the mathematics teachers are not computer literate. There are no computers in most primary schools: - this is because they are costly and furthermore to install a source of power is quite expensive.

Improvisation of teaching aids is not done with limited time. It needs quite a lot of time for it to be achieved. Teachers should approach the pupils in a way that they are able to be creative i.e. they are able to connect across different areas of knowledge. Teaching

aids should be improvised on a daily basis using locally available materials. On student participation, the study reveals that although pupils regularly attend mathematics lessons they need to be punctual in their group work, discussion and assignments.

5.5. Recommendations

From the findings of the study the following recommendations were suggested:- SMASE INSET to be carried out every holiday and not August holiday only hence it should be done three times in a year and not once. From the study there is still need to re-address attitude of other teachers towards ASEI / PDSI practices and that scheme of work should also be developed so that ASEI / PDSI lesson plan is drawn from it.

The headteachers should support mathematics teachers in provision of teaching materials e.g. manila papers, felt pens and others for making teaching aids. They should also ensure that all teachers use the new skills and knowledge learnt in teaching mathematics and all other subjects.

The stakeholders should provide storage facilities so that teachers keep their improvised teaching and learning aids safely. They should also provide ICT materials and put up a source of power in their schools. Parents should support their children in acquiring locally available materials to be used during the improvisation of teaching and learning aids. They should also motivate their children to develop a positive attitude towards mathematics.

Ministry of education and teachers' service commission should employ more teachers to curb teachers' shortage and reduce high workloads of mathematics teachers. This will enable teachers to prepare well for lessons.

Ministry of education and teachers' service commission should motivate SMASE trainees by giving them a promotion, paying them promptly and giving certificates.

5.6. Suggestions for Further Research

Further research is suggested to be done on the following: -

Mathematics teachers were found to be implementing what they were taught on SMASE training. A research should be done on evaluation of SMASE training on mathematics performance in Bomet Central Division.

Availability of funds for putting up a source of power, purchasing of computers and training of mathematics teachers on computer literacy was found to be a problem. Research should be carried out on projects that schools can engage in that can provide funds that could go into supporting ICT materials.

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APPENDICES

APPENDIX I: LETTER OF TRANSMITTAL

SITONIK IRINE CHEBET,

P.O BOX 92,

BOMET.

TEL: 0723 268 121.

17TH OCTOBER 2012.

TO

THE AREA EDUCATION OFFICER,

BOMET CENTRAL DIVISION,

P.O BOX

BOMET.

Dear Sir / Madam,

REF: REQUEST FOR RESEARCH DATA COLLECTION.

I am a master's student in Project Planning and Management at Bomet Extra-Mural Centre university of Nairobi. I'm required to submit a research project as part of my assessment. Consequently, I have written a proposal entitled "Influence of SMASE Training on Teaching and Learning of Mathematics in Primary Schools in Bomet Central Division, Bomet County, Kenya".

Based on the proposal, I have designed a questionnaire to help me collect data. The public primary schools in your district make my area of study. I therefore, seek your permission to collect the relevant data from these schools. The information obtained will purely be used for academic purpose. Findings of the study shall upon request be available to you. Your assistance and co-operation will be highly appreciated.

Thank you in advance.

Sitonik Irine Chebet.

APPENDIX II: Morgans' Table for Determining Sample Size from a given Population

Population size	Sample size	Population size	Sample size
10	10	300	169
20	19	400	196
30	28	1, 500	306
40	35	2, 000	322
50	44	3, 000	341
60	52	4, 000	351
70	59	5, 000	357
80	66	6, 000	361
90	73	7, 000	364
100	80	10, 000	370
150	108	20, 000	377
200	132	50, 000	381
250	162	100, 000	384

Source: R.V Krejcie and D Morgan (1990).

APPENDIX III: School Headteacher Questionnaire

I am a Master of Arts in Project Planning and Management Student at University of Nairobi. I am currently doing a research on Influence of SMASE in Teaching and Learning of Mathematics in Primary Schools in Bomet Central Division, Bomet County.

You have been identified as a potential respondent in this research. The information you provide is expected to enhance practice of SMASE approaches at school and in classroom level, in teaching and learning of mathematics. The information will also guide SMASE programme planners in improving the INSET as well. The information you give will be treated as confidential. Kindly provide the information that is well known to you.

Your support and co-operation is very important and will be highly appreciated.

Thank you.

SECTION A:

1. Demographic Characteristics

Please answer the following questions by putting a tick (√) in the appropriate spaces.

i. Name (Not a must) _____

ii. Gender (a) Male [ ] (b). Female [ ]

iii. Age Below 25 ☐ 26 – 35 years ☐

36 – 45 years ☐ 46 – 55 years. ☐

56 and above ☐

iv. Highest professional qualification attained.

a) Certificate [ ] b) Diploma [ ]

c) Graduate [ ] d) Masters [ ]

e) Other (specify)_____

2. School Characteristics

i) Name of school _____

ii) Division (where) _____

iii) Type of school.

i) (a) Day school [ ] (b) Boarding school [ ]

(c) Day / Boarding [ ] (d) Mixed day [ ]

Please consider the given statement and indicate your opinion by ticking in the appropriate column.

KEY: SA – Strongly Agree, A – Agree, N – neutral, D – Disagree, SD – Strongly Disagree.

3. **ASEI / PDSI Practices in Classroom when Teaching and Learning Mathematics**

	STATEMENT	OPINION				
	After attending the SMASE programme mathematics teachers:	**SA**	**A**	**N**	**D**	**SD**
i	Prepare the ASEI/PDSI lesson plans as part of teaching and learning.					
ii	Use the prepared ASEI/PDSI lesson plan when teaching in class.					
iii	Use the following teaching activities: i) Discussion ii) Homework					
iv	Allow students to evaluate their lesson at the end.					
v	Allow colleague teachers to evaluate their lessons.					

4. **Lesson Study when Teaching and Learning Mathematics**

	STATEMENT	OPINION				
	After attending SMASE INSET teachers of mathematics	SA	A	N	D	SD
i	Regularly meet to work on the lesson design, implementation, evaluation and improving on the one or several lessons.					
ii	Share topics with other teachers in classes.					
iii	Do lesson presentation during lesson study in groups					
iv	Sit and reflect on the lesson.					

5. **ICT Integration when Teaching and Learning Mathematics**

	STATEMENT	OPINION				
	After attending SMASE programme mathematics teachers.	SA	A	N	D	SD
a	Use graphic calculators in visualizing concepts, exploration, experimentation, generalizing and checking solutions to mathematics problems.					
b	Have a source of power in their school.					
c	Are you computer literate?					
d	Use computer software in teaching mathematics in the classes.					

6. **Improvisation of Teaching/Learning Aids for Teaching and Learning Mathematics**

	STATEMENT	OPINION				
	After attending SMASE programme mathematics teachers.	SA	A	N	D	SD
i	Improvise teaching / learning aids to be used when teaching.					
ii	Use improvised aids to solve problems in mathematics.					

7. **Student Participation in Classroom during the Teaching and Learning of Mathematics**

	STATEMENT	OPINION				
		SA	A	N	D	SD
i	Learners regularly attend mathematics lessons.					
ii	Learners are frequently involved in group work and discussion.					
iii	Learners frequently do their assignments completely and neatly.					
iv	Learners are frequently involved in making teaching and learning materials.					

Suggest activities that each of the following groups should do to influence the teaching and learning of mathematics for better performance in future.

i) SMASE INSETS.....

.....

ii) School headteachers .....

iii) Mathematics teachers .....

.....

iv) Pupils .....

.....

v) Any other stakeholder .....

.....

vi) Ministry of education .....

.....

APPENDIX IV: Mathematics Teacher Questionnaire

I am a student at University of Nairobi under taking Master of Arts in Project Planning and Management. I am currently doing a research on Influence of SMASE in teaching and learning of Mathematics in primary schools in Bomet Central Division, Bomet County. You have been identified a potential respondent in this research. The information you gave is expected to enhance practices of SMASE approaches at school and classroom level and in teaching and learning of mathematics. The information will also guide the SMASE programme planners in improving the INSET as well. Kindly give the information well known to you. Your co-operation is highly appreciated.

Thank you.

SECTION A:

1. Demographic Characteristics

Please answer the questions by putting a tick (√) in the appropriate spaces.

i) Name (Not a must).....

ii) Gender (a) Male [ ] (b) Female [ ]

iii) Age (a) below 25 years [ ] (b) 26 – 35 years [ ]

(c) 36 – 45 years [ ] (d) 46 – 55 years [ ]

(e) 56 and above years [ ]

iv) Highest professional qualification

a) Certificate [ ] b) Diploma [ ] c) Degree [ ]

b) Masters [ ] c) Others (Specify).....

v) Teaching experience.

a) Less than one year [ ] b) 1 – 5 years [ ]

c) 6 – 10 years [ ] d) 11 – 15 years [ ]

e) 16 – 20 years [ ] f) 21 and above [ ]

vi). Name of your school ..... division.....

vii). How many SMASE cycles have you attended? .....

viii). When did you attend the last SMASE INSET? .....

SECTION B:

2. ASEI / PDSI Practice in Classroom

Please consider the following statements and indicate response that reflects your opinion or the situation by ticking the appropriate column.

KEY: SA – Strongly Agree, A – Agree, N – Neutral, D – Disagree, SD – Strongly Disagree.

	STATEMENT	OPINION				
	After attending SMASE INSET you can;	SA	A	N	D	SD
i	Prepare ASEI / PDSI lesson plan.					
ii	Use the prepared ASEI / PDSI lesson plan when teaching in your class.					
iii	Use other teaching / learning activities when teaching in your class.					

3. **Lesson Study when Teaching and Learning Mathematics**

	STATEMENT	OPINION				
	After attending SMASE INSET you can;	SA	A	N	D	SD
i	Meet to work on lesson design, implementation and evaluation to improve on one or several lessons.					
ii	Share topics with other teachers in class so as to teach as a team.					
iii	Do lesson presentation during lesson study in groups.					
iv	Sit and reflect on the lesson taught.					

4. **ICT Integration when Teaching and Learning Mathematics**

	STATEMENT	OPINION				
	After attending SMASE programme you;	SA	A	N	D	SD
a	Use graphic calculators in visualizing concepts, exploration, experimentation, generalizing and checking solutions to mathematics problems.					
b	Have a source of power in your school.					
c	You are computer literate?					
d	Use computer software in teaching mathematics in your classes.					

5. Improvisation of Teaching/Learning Aids for Teaching and Learning Mathematics

	STATEMENT	OPINION				
	After attending SMASE INSET you can;	SA	A	N	D	SD
i	Frequently improvise teaching/ learning aids to be used when teaching.					
ii	Use improvised materials to solve problems in mathematics.					

6. Student Participation in Classroom when Teaching and Learning Mathematics

	STATEMENT	OPINION				
	After attending SMASE INSET	SA	A	N	D	SD
i	Learners frequently attend mathematics lesson.					
ii	Learners are frequently involved in group work and discuss					
iii	Learners frequently do their assignment completely and neatly.					
iv	Learners are frequently involved in making teaching and learning materials.					

7. **Suggest activities that each of the following groups should do to influence the teaching and learning of mathematics for better performance in future.**

vii) SMASE INSETS.....

.....

viii) School headteachers .....

ix) Mathematics teachers .....

.....

x) Pupils .....

.....

xi) Any other stakeholder .....

.....

xii) Ministry of education .....

.....

APPENDIX V: Pupils Questionnaire

I am a Master of Arts in Project Planning and Management student at University of Nairobi. I am currently doing a research on Influence of SMASE on teaching and learning of mathematics in primary schools in Bomet Central Division, Bomet County. You have been identified as the potential respondent in this research. The information you give is expected to enhance practice of SMASE approaches at school and classroom level and in teaching and learning mathematics. The information will also guide the SMASE programme planners improve the INSET.

Kindly give the information well known to you. Your co-operation is highly appreciated.

Thank you.

SECTION A.

1. **Demographic Characteristics**

Please answer the questions by putting a tick (√) in the appropriate spaces.

i) Gender (a) Male [ ] (b) Female [ ]

ii) Age of the participant

(a) 10 – 11 years [ ] (b) 12 – 13 years [ ]

(c) 14 – 15 years [ ] (d) 16 and above [ ]

iii) Which class are you in?

a) Std 6 [ ] b) Std 7 [ ] c) Std 8 [ ]

iv) What is the name of your school?.....

SECTION B

Please consider the following statements and indicate the response that reflects your opinion about the situation by ticking (√) in the appropriate column.

KEY: SA – Strongly Agree, A – Agree, N – Neutral, D – Disagree, SD – Strongly Disagree.

2. ASEI / PDSI Practices in Teaching Learning Mathematics

	STATEMENT	OPINION				
		SA	A	N	D	SD
i	The teachers of mathematics frequently use other teaching / learning activities such as discussion, homework when teaching.					
ii	Pupils frequently evaluate teachers at the end of the lesson.					

3. Lesson Study in Teaching and Learning of Mathematics

	STATEMENT	OPINION				
		SA	A	N	D	SD
i	Other teacher assists teacher in teaching different topics in mathematics.					
ii	You frequently sit and reflect on your teachers' lesson.					
iii	You frequently evaluate teachers at the end of the lesson.					

4. ICT Integration when Teaching and Learning Mathematics

	STATEMENT	OPINION				
		SA	A	N	D	SD
i	You frequently use graphic calculators when doing mathematics.					
ii	There is a source of power in your school.					
iii	Your teachers frequently use computer software in teaching mathematics in class.					

5. Improvisation of Teaching/Learning Aids for Teaching and Learning Mathematics

	STATEMENT	OPINION				
		SA	A	N	D	SD
i	You frequently improvise teaching / learning aids to be used in their teaching.					
ii	You use improvised teaching aids to solve problems in mathematics.					

6. Student Participation in Classroom when Teaching and Learning Mathematics

	STATEMENT	OPINION				
		SA	A	N	D	SD
i	You regularly attend mathematics lessons.					
ii	You are frequently involved in group work and discussion.					
iii	You frequently do your assignments completely and neatly.					
iv	You are frequently involved in making teaching and learning materials.					

REPUBLIC OF KENYA

NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

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Our Ref: **NCST/RRT/12/1/SS-010/164/0**

Date: **19th July 2012**

Sitonik Irene Chebet
P.O. Box 92
Bomet

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on **"Influence of strengthening mathematics and science education, training and teaching learning of mathematics in public primary schools in Bomet .** I am pleased to inform you that you have been authorized to undertake research in **Bomet Central, Division, Bomet County, Kenya** for a period ending ***November***

You are advised to report to the **District Commissioner & the District Education Officer, Bomet County, Kenya** before embarking on the research project.

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

for

P.N. NYAKUNDI
FOR: SECRETARY/CEO

Copy to:

The District Commissioner
Bomet Central, Division Bomet.

The District Education Officer
Bomet Central, Division Bomet.