SCHOOL FACTORS INFLUENCING STRENGTHENING OF MATHEMATICS AND SCIENCE EDUCATION PROGRAMMEIMPLEMENTATION IN PUBLIC SECONDARY SCHOOLS IN MAKUENI SUB COUNTY, KENYA.

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DECLARATION

I understand that plagiarism is an offence and I declare therefore that this project is my original work and has not been presented to any other institution for any other award

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DEDICATION

This research work is dedicated to my mother, Agnes Kavisi.

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ABBREVIATIONS AND ACRONYMS

ASEI-PDSI	Activity, Student Centred Experiment and Improvisation-Plan Do See and Improve
CEMASTEA	Centre for Mathematics Science and Technology Education in Africa
INSET	In-Service Education and Training
JICA	Japan International Cooperation Agency
KNEC	Kenya National Examination Council
MOEST	Ministry of Education Science and Technology
NACOSTI	National Commission of Science Technology and Innovation
OECD	Organisation for Economic Cooperation and Development
SMASE	Strengthening of Mathematics and Science Education
TSC	Teachers Service Commission
UNESCO	United Nations Educational Scientific and Cultural Organization
WESCA	Western Eastern Central and Southern Africa

ABSTRACT

The purpose of this study was to determine school factors influencing implementation of Strengthening of Mathematics and Science Education programme in Public Secondary Schools in Makueni Sub County. The objectives of the study sought to; establish the influence of availability of teaching resources, influence of teachers' attitude, influence of teacher training and influence of Principals training on implementation of Strengthening of Mathematics and Science Education programme in Public Secondary Schools in Makueni Sub County. The study adopted descriptive survey research design. The target population was 44 Principals, 88 HODs for Science and Mathematics and 241 Science and Mathematics teachers in public secondary schools in Makueni Sub County. A sample of 16 Principals,32 Heads of Department for Science and Mathematics and 64 Science and Mathematics teachers were selected through both purposive and simple random sampling. Data was collected by use of a questionnaire and was analyzed using descriptive statistics. Quantitative data was presented using frequency distribution tables, pie charts and bar graphs. Qualitative data was categorized in themes in accordance with research objectives and presented in narrative form. The study established that majority of the respondents, the Principals, Heads of Departments and Science and Mathematics teachers indicated that science laboratories, computer laboratories, science and mathematics models and real objects were inadequate.. Science apparatus were adequate as indicated by 56.3% of Principals and 50% of Science and Mathematics teachers however majority of the Heads of Departments 62.5% indicated that Science apparatus were inadequate. Laboratory reagents were adequate as indicated by most respondents, 50% of the Principals, 59.4% of the Heads of Departments and 64% of the Science and Mathematics teachers. Majority of the respondents 81.3% of the Principals, 81.3% of the Heads of Department and 87.5% of the Science and Mathematics teachers indicated teachers had positive attitude towards implementation of Strengthening of Mathematics and Science Education programme. The Principals indicated that, 31% of all teachers have attended Strengthening of Mathematics and Science Education programme training. Majority of the Principals 62% indicated that they had attended Strengthening of Mathematics and Science Education programme training. The study recommended among others that the BOM and principal should ensure that laboratories are equipped with chemicals and reagents to enhance teaching of science subjects.

CHAPTER ONE

INTRODUCTION

1.1Background to the Study

Education is a powerful tool in any society and it is considered as an indispensable instrument for bringing positive change in the social, political, economic and cultural life of people(Republic of Kenya, 2014). The whole process is shaped by many important agents, and the teacher is one of them. The teacher plays a central role in education. Preparing teachers for the teaching profession is a priority in any country since this profession is challenging and critical, and may lead to nations' rising and progress in the different domains (Borko, 2004). According to Clark (2009), as a huge agent, education has great importance in building strong and developed societies, and the teacher is one of the primary agents for achieving that. For such reasons, it is important that teachers receive adequate educational and professional training on teaching skills so as to dedicate themselves to the teaching profession(Clark 2009).Teachers training should address mastery of content and pedagogy. Whereas mastery of content makes teachers knowledgeable in their teaching areas, pedagogy equips them with skills of transmitting content to learners.

In Japan, the strengthening of in-service training, with the aim of supporting the qualitative upgrading of teachers, is an ongoing aim (CEMASTEA, 2013). Globally, there has been growing sophistication and diversification of education that has accompanied turbulent and rapid social change. This has been with the aim of enabling teachers to respond to social demands and changes the roles of teachers and school. To address the current tendency increasing weight has been put on the importance of undertaking in-service training after the initial appointment, and many different kinds of training are now carried out on an everyday basis(Kuan, 2013). As noted by the Japan International Cooperation Agency (JICA, 2004), in-service courses are mandatory for new recruited teachers.

In Nigeria, improving quality of Mathematics and Science education is essential for national development, more specifically, joining one of the top industrial countries in the world in accordance with the Vision 2020 (Federal Republic of Nigeria, 2009). Teacher development, especially at the primary and secondary schools, is the key factor. To this end, JICA is now implementing a technical cooperation project, titled "Strengthening Mathematics and Science Education Project" (SMASE) jointly with the Federal Ministry of Education. The Federal Ministry of Education and JICA conducted a baseline survey in 2005 to ascertain the strategies in use, the needs and challenges facing teaching learning of mathematics and science at primary education level. Major findings of the survey presented to stakeholders showed a mirage of difficulties such as poor Teacher-Pupil strategy, perceived difficult concepts, and monotonous use of lecture method of teaching and inadequate and poor utilization of available teaching materials to mention but few.

SMASE was introduced in Kenya in 1998 in order to raise the quality of teaching mathematics and science in primary and secondary schools as teachers lacked opportunities to be capacity-built and the quality of education was considered to have deteriorated that time (CEMASTEA, 2003). This was done by JICA in conjunction with the Kenyan government through In-service Education and training (INSET) of teachers. The INSET was divided into three phases. The first phase (1998-2003), the "Strengthening of Mathematics and Science in Secondary Education (SMASE) Programme" was launched in 1998 on a pilot basis in 9 districts namely; Gucha, Butere, Kakamega, Kisii, Lugari, Makueni, Maragwa, Muranga and Kajiado. The project was then scaled up to all districts in the country in 2003 in the second phase. During the second phase, the Kenyan government established the Centre for Mathematics Science and Technology Education in Africa (CEMASTEA) and initiated the African component of INSET by through the formation of SMASE – WECSA (Western, Eastern, Central and Southern Africa) members (CEMASTEA, 2013).This shows government commitment to support implementation of SMASE programme in Kenya.

The underpinning principle of SMASE INSET is Activity- based, Student-centred teaching/learning, Experimental work as opposed to theoretical teaching along with Improvisation (ASEI) of teaching/learning resources when necessary. The principle is implemented based on the Plan, Do, See and Improve (PDSI) approach so that remedial measures are taken in subsequent cycles of activity to avoid major disruptions. The main aim of SMASE INSET programme is to shift classroom practices from being ineffective to being effective (CEMASTEA,2013). Despite these initiatives, the implementation of SMASE seems to be ineffective as indicated by poor performance of science and mathematics subjects in national examinations. There are some variables that are likely to have contributed to the above cited scenario namely; availability of teaching and learning resources, attitude of teachers towards the SMASE programme, teacher participation in SMASE training and the participation of Principals in training on the programme.

Teaching resources are essential for effective implementation of the SMASE in-service programme. These include instructional materials and equipment, writing materials, real objects and science apparatus (Mwagiru,2014). Limited procurement and supply of these resources in schools hampers teachers effectiveness (Dean, 2001).This may be particularly so if classrooms are overcrowded and learners are made to share whatever little material is available (Mwagiru,2014). In such situations it becomes almost impossible for teachers to render individual pupil attention. SMASE programme recommends improvisation and utilization of teaching learning resources when necessary (CEMASTEA, 2013). Where teaching and learning resources are available, it is easier for teachers to implement SMASE programme.

Teachers' attitude towards an education programme influences the implementation of the resolution of the said programme (mwagiru,2014). Some of the indicators of positive attitude are levels to which teachers engage students in practical work and the extent to which the teachers make learning environment friendly to learners (CEMASTEA, 2013). Whitaker (2000) notes that, teachers' understanding and attitude towards implementation of any curriculum is crucial, more so because teachers are the ones who present the

curriculum materials to learners. Positive altitude of teachers towards SMASE programme will positively influence its implementation.

Teacher participation in training is critical if there is to be effective implementation of the SMASE programme. According to UNESCO (2008), in many worldwide schools and universities, a variety of teachers' training and professional development programs are available to help teachers learn and improve themselves year after year. Besides that, as Macmillan (2007) notes, it is a common belief that learning is a continuous process that contributes in improving teachers' teaching skills and acquiring new knowledge in subject areas, and this will, in turn, help improve students' learning.

Training of the Principals on the tenets of SMASE is key to its successful implementation. This is largely because they play a central role in running the institutions for instance they are the ones to facilitate the teachers in attending the seminars and capacity building workshops on the implementation of the SMASE programme. Further, the Principals being the persons in charge of the institutions' finances, they are responsible for the procurement of the teaching and learning resources that are key in the implementation of the SMASE programme. The foregoing underscores the need to train the Principals on SMASE.

To show commitment to the implementation of SMASE programme, the government of Kenya through the Ministry of Education, Science and Technology, embarked on an elaborate programme to finance SMASE activities in secondary education. Funds were guaranteed by the Kenyan Government (Republic of Kenya, 2008) and the amount of a maximum up to KES 200.00 per learner was agreed; (Republic of Kenya, 2008). Despite the above overwhelming commitment by the government through inter-governmental partnership and funding of the SMASE programme through the exchequer, the performance of Science and Mathematics continue to be dismal according to data available in Makueni Sub County Education Offices. This state of affairs would make someone to suspect that implementation of SMASE is not being done as required since

the key objective is to improve the performance of Science and Mathematics. If there exists a gap between objectives of a programme and actual performance then it is imperative that a review of the programme is done to check on its implementation. Besides, there is no documented study in the sub county on what may be contributing to the declining performance in science and mathematics as shown in Table 1.1 below. It is against this backdrop that the current study sets out to investigate the school factors influencing implementation of SMASE Programme in Public Secondary Schools in Makueni Sub County, Makueni County.

Table 1.1 Student Performance in Sciences and Mathematics (2015-2017)

Year	Mathematics	Chemistry	Biology	Physics	Aggregate Mean Score
2015	4.35	4.52	5.16	6.02	5.01
2016	2.59	2.53	3.39	4.83	3.33
2017	3.79	3.0	2.5	4.98	3.31
2018	3.86	3.5	3.7	4.8	3.9

Source: Makueni Sub County Education Office

1.2 Statement of the Problem

SMASE was introduced in Kenya in 1998 and Makueni District (now Makueni County) was among the pilot Districts. Its aim was to improve Mathematics and Science Education through In-Service Education and Training (INSET) for teachers with innovative approach in order to upgrade the capability of young Kenyans in Mathematics and Science. However, despite the completion of all cycles of SMASE programme with nearly all teachers having undergone training on effective teaching approaches of ASEI/PDSI, implementation of these skills seems not to be taking place since student performance in mathematics and science is still poor in Makueni Sub County. Statistics at makueni Sub County education office shows that student performance in science and mathematics has been declining as shown in Table 1.1 in the background.

This is despite intervention measures such as Science Technology Engineering and Mathematics programmes (STEM) which is conducted through science fairs. As Ainley, Kos & Nicholus(2008) note, STEM is premised on the believe that students' experiences in the primary and early secondary years of schooling establish a sense of competence that students have in the foundations of Mathematics and Science and can kindle their interest in science related fields. Makueni County on its part has had remedial measures to correct the current state of affairs; one of them being a one week training programme conducted in April 2017 for secondary school Mathematics and Science teachers at County level which targeted Mathematics and Science teachers with 14-20 years teaching experience. The theme of the training was 'enhancing effective learner involvement through inquiry based learning' (CEMASTEA, 2017).

Irungu(2011), in a study on evaluation of Strengthening of Mathematics and Science in Secondary Education (SMASE) programme on teaching and learning of Chemistry in secondary schools of Makuyu Division in Murang'a County established that, teachers found it hard to improvise for a Chemistry lesson, huge classes and lack of facilities hindered learners' involvement, and SMASE trainers kept on recycling activities with

little or no new innovation. The study sample was 182 chemistry teachers in Makuyu Division and used a survey design.

The aforecited study in Murang'a county implies that, implementation of SMASE programme faces challenges and yet in Makueni Sub County, data available at the Sub County Education Office shows that, there is no known documented study on the challenges facing the effective implementation of SMASE despite the declining performance in Science and Mathematics. Therefore, the current study sets out to investigate school based factors influencing implementation of SMASE programme in Public Secondary Schools.

1.3General Objective of the Study

The general objective of the study was to find out the school based factors influencing implementation of SMASE Programme in Public Secondary Schools in Makueni Sub County.

1.3.1Specific Objectives of the Study

The specific objectives of the study included the following;

i) To establish the influence of availability of teaching resources on implementation of SMASE programme in public secondary schools in Makueni Sub County.

ii) To establish the influence of teachers' attitude towards implementation of SMASE programme in public secondary schools in Makueni Sub County.

iii) To determine the influence of teacher training in SMASE on implementation of SMASE programme in public secondary schools in Makueni Sub County.

iv) To determine influence of Principals' training in SMASE on implementation of SMASE programme in public secondary schools in Makueni Sub County.

1.4Research Questions

The study was guided by the following research questions;

i) What is the influence of availability of teaching and learning resources on implementation of SMASE programme in Public Secondary Schools in Makueni Sub County?

ii) How does teachers' attitude influence implementation of SMASE programme in Public Secondary Schools in Makueni Sub County?

iii) What is the influence of teacher training in SMASE on implementation of SMASE programme in Public Secondary Schools in Makueni Sub County?

iv) To what extent does Principals' training in SMASE influence implementation of SMASE programme in Public Secondary Schools in Makueni Sub County?

1.5Significance of the Study

The findings could be used by Ministry of Education to reinforce areas that contribute to students' achievements in science like provision of adequate instructional materials and continued capacity building of both teachers and Principals. The findings might be used by TSC to identify staffing requirements especially in areas of science and mathematics in secondary schools. The findings might also be instrumental to school administration and the Board of Management that organizes coordinates and monitors all educational activities in the school including providing resources for curriculum implementation to overcome the challenges of implementing the SMASE programme approach. Further, the findings may contribute to a pool of knowledge in the area of education on administration.

1.6Limitations of the Study

Mugenda and Mugenda(2008) defines limitations as the anticipated difficulties that might hinder effective data collection process of any study and which might also reduce the scope, the sample and the extent to which generalization of findings can be made. The results of the study might have been subjective since the Principals and teachers could have given information voluntarily hence a lot of biased responses might have been recorded or even especially the teachers might have given socially acceptable answers for fear of victimization if they gave answers that may paint a grim picture especially to their seniors. To overcome this limitation, confidentiality was enhanced by requiring them not to indicate their identities in the questionnaires. Principals on the other hand may have given biased information for fear of being reprimanded for ineffective implementation of SMASE programme; to curb this, the researcher assured them that the information would be used for the purposes of the study only.

1.7 Delimitations of the Study

Simon, (2011), the delimitations are those characteristics that limit the scope and define the boundaries of your study. The study delimited itself to Public Secondary schools in Makueni Sub County. There could be many factors influencing the implementation of SMASE programme, but the study only concentrated on school based factors. Such school factors included provision and use of teaching and learning resources, teacher's attitude, teachers' participation in training and the Principals' training on SMASE. It was delimited to responses of Principals, HODs of Sciences and Mathematics and Science and Mathematics teachers who have attended SMASE INSET programme.

1.8Assumptions of the Study

Leedy and Ormrod(2010) assumptions of a study in are things that are somewhat out of your control, but if they disappear the study would become irrelevant. The researcher made the following assumptions on the study;

i) Respondents are conversant with SMASE programme so that they can provide reliable data

ii) ASEI/PDSI concept is applied in mathematics and science lessons

iii) The respondents gave genuine, truthful and honest responses to the questionnaire

1.9 Operational Definition of Terms.

Attitude: Refers to a settled way of thinking or feeling about something.
Implementation: Refers to the act of putting into practice set procedures, policies or projects to meet certain objectives.

Influence: Refers to the capacity to have an effect on the character, development, or behaviour of someone or something, or the effect itself.

Principal: Refers to the lead educator or administrator in a public secondary school appointed by the TSC and responsible for the implementation of the educational policy and professional practice.

Programme: Refers to a planned series of future events or performances

Student: Refers to someone who attends an educational institution for learning purposes. The usage of the term in this study will be reserved to those attending secondary education.

Teacher: Refers to a person employed in an official capacity for the purpose of imparting knowledge, competencies, skills and attitudes to learners and has undertaken recognized pedagogical training and attained accredited certification.

Teaching Resources: Refers to teaching materials that a teacher uses to deliver instruction.

Training: Refers to the process of acquisition of knowledge, skills and competencies of vocational or practical skills and knowledge.

1.10 Organization of the Study

This study comprises of six chapters. Chapter one consists of background to the study, statement of the problem, study objective, objectives of the study, research questions, significance of the study, limitations of the study, delimitations of the study and assumptions of the study. Chapter two gave a review of the existing literature on the topic under study, theoretical and conceptual framework and a summary of literature review. Chapter three discussed the research methodology which included research design, target population, sampling techniques and sample size, research instruments, validity and reliability of research instruments, data collecting procedures, data analysis techniques and ethical considerations. Chapter four comprises of research findings. Chapter five comprises of discussion of research findings. Chapter six comprises of conclusions and recommendations

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CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the related literature on school based factors influencing implementation of SMASE programme. It is organized into the following themes, influence of teaching resources, teachers' attitude, and teacher training on SMASE and Principals' training in SMASE on implementation of SMASE INSET programme. The chapter also contains summary of literature review, theoretical and conceptual framework.

2.2 Teaching Resources and Implementation of SMASE

Teaching resources are materials teachers use to deliver instruction. Each teacher requires a range of tools to draw upon in order to assist and support student learning (Kearney & Carol, 2000). In the teaching of science and mathematics teaching resources include, models, science apparatus, chemicals, realia.

A Study conducted in Australia by the Australian School Library Association, (ALRC, 2001)shows that the purpose of a teaching resources is to provide a basis for learning experiences for students. Learning resources include not only textbooks, workbooks, and audio-visual teaching aids produced by the Education Department (ED) or other organizations but also web-based learning materials, IT software, the Internet, the media, resources in the natural environment, people, libraries. Kearney & Carol (2000) note that, all of these should be drawn upon to help students to learn, broaden their learning experiences and meet different learning needs. If used effectively, they will help students to construct knowledge for themselves, and develop the learning strategies, generic skills, values and attitudes they need, thus laying a solid foundation for lifelong learning.

An ICT policy in Education by the Republic of Rwanda, Ministry of Education, Science, Technology and Scientific Research emphasizes on the use of resources to achieve education objectives. The policy commits to match resource availability with resource

requirements, increase infrastructure and provide equipment in accordance with set standards, provide relevant textbooks, equip Science and ICT labs in schools to meet curricula demands especially teaching and learning materials for science and technology, expand education facilities specifically laboratories and equipment for priority subjects, improve learning environment in terms of space, equipment and learning materials(Republic of Rwanda, 2009).

Orodho and Waweru (2013) conducted a study on Resource Management Strategies and Learners Academic Performance in National Examinations in Public Secondary Schools in Makindu District, Makueni County, Kenya. The study adopted a descriptive survey design and used a combination of purposive and simple random sampling techniques to draw a total sample of 250 respondents. From the study it emerged that, there was a positive and significant correlation between the effectiveness of resource management strategies and learners' academic performance in national examination. This is in line with Bruners constructivist's theory of 1966 upon which this study is anchored and states in part that, for a true instructional designer, a learner even of a very young age is capable of learning any material so long as the instruction is organized appropriately. Most of the studies reviewed were on the effect of the use of teaching and learning resources on academic performance however the current study is on the influence of such materials on the implementation of the SMASE programme. This study will seek to establish whether learning materials have influenced the implementation of the principles of SMASE hence the poor performance of Mathematics and Science in Makueni sub County.

2.3 Attitude of Teachers and the Implementation of SMASE

Attitude can be defined as the individual's prevailing tendency to respond favourably or unfavourably to an object, event or a process. Attitudes determine what each individual will see, hear, think and do (Nedelsky, 2005). Research findings by Ballone and Czernik (2001) indicate that perception towards a certain behaviour is a strong determinant of teachers' intention to engage in that specified behaviour. INSETs should therefore focus

on teachers attitude change in order for the teachers to implement intended recommendations.

Studies done in Brazil by Barros and Elia (2014) on teaching attitudes affecting negatively the learning process identified the lack of coherence between the teachers' classroom attitudes and their expressed belief on active methods of interaction as having an impact on the academic attainment of the students in Sciences and Mathematics. Black (2009) reported a study made in a physics classroom where the teacher strongly believed in his ability to conduct an interactive science class. When observed, he was talking to the class 90% of the time. Activity dominated learning situation studies show that students listen to the instructor more than 50% of the laboratory time (Hegarthy-Hazel, 2010). Bliss and Orgborn (2007) did a naturalistic study in secondary schools in Brazil and reported 43 stories about the science laboratory. More than half of the students had bad recalls from their laboratory work. Carvalho (2002) mentions the dichotomy between the liberal discourses in opposition to repressing action that dominates the teacher training courses.

An empirical study by Fairbank (2010)in Syria secondary schools on why some teachers are more adaptive than others found that knowledge alone does not lead to the kind of thoughtful teaching every one strives to maintain. The study revealed that teachers with similar professional knowledge and qualification were found to have differences in their teaching practices depending on how they perceived teaching. They suggested the need to go beyond knowledge in teacher education with the aim of exploring question about preparing thoughtful teachers. Research findings by Ballone and Czernik (2001) indicate that attitude towards a certain behaviour is a strong determinant of teachers intention to engage in a specified behaviour.

According to a study done by Ngetuny, (2013) in Kenya on the effectiveness of SMASE in Bomet sub County, if a teacher has a negative attitude towards the use of ASEI/PDSI approaches, this would be evidenced by their tendency to move away from it, that is,

avoid using the approaches. If on the other hand, a teacher had a positive attitude towards the use of ASEI/PDSI, this would be made evident by their tendency to use them when one has a choice to do so. If it can be ascertained that teachers who have a negative attitude towards the use of ASEI/PDSI, it can easily be predicted how they (teachers) are likely to behave if they are provided with the apparatus and chemicals to be used in classroom teaching. A good step, therefore, is to change their attitude towards these approaches. Similarly, if it can be ascertained that their attitude towards the approaches is positive, then the logical step here is to avail the necessary apparatus, chemicals and all the support. The reviewed studies did no establish the extent to which attitude affects the implementation of the SMASE programme. This underscores relevance of the current study, which sets out to investigate the influence of teachers' attitude on the implementation of SMASE programme.

2.4 Teacher Training in SMASE and the Implementation of SMASE Programme

Training is teaching, or developing in oneself or others, any skills or knowledge that relate to specific useful competencies(Borko, 2004).Training has specific goals of improving one's capability, capacity, productivity and performance.

A study by Jackson and Davis (2000), on educating adolescents in New York, reported that teacher training improved teaching skills and knowledge thus enhancing their content delivery. In addition, a study by Gamoran (2006), in the University of Wisconsin, indicated that teacher training enhanced student learning through its effects on teaching practices like content delivery.

A review of SMASE programme conducted in Burkina Faso concluded that, Improvement in teachers' pedagogical practices was observed using learner-centered approach in science and mathematics lessons at the secondary school level, through the results of monitoring and evaluation conducted by the Project. More than 97% of the pedagogical advisors and inspectors were trained by the Project, which contributed

substantially to the realization of the national training sessions by Ministry of Basic Education and Literacy. The Project developed all the lesson plans for science and mathematics of 6 grades in primary school level and it is in the process of the preparation for distributing the lesson plans to all the public schools. This is expected to contribute to further improvement in teachers' practice of ASEI-PDSI approach in class. The project has implemented planned activities, contributing to improvement in teachers' pedagogical practices in public secondary schools, and is expected to achieve the Project Purpose which is Teachers Training Improvement in Science and Mathematics at the secondary Level (SMASE-WECSA, 2011).

In Kenya, a study by Inyega (2002) which was a multi-site qualitative research case study, examined multi-site cases of teachers' practices and experiences about the chemistry unit lesson planning and implementation following the in-service teacher education SMASE programme in Kenya. In the study, a descriptive comparison was made of chemistry district teachers in the SMASE Programme in-service program in four different school settings (boys' boarding, girls' boarding, mixed boarding, and mixed day). The intent of the study was to determine what changes, if any, teachers made in the design and implementation of their lessons, how these changes were implemented, and why the teachers made such changes. The study established that the teachers, who attended the INSET programme, greatly improved their teaching skills and were able to improvise teaching/learning equipment during their chemistry lessons. Whereas the study dealt with chemistry only, the current study will set out to establish the school factors influencing the implementation of SMASE programme in the teaching of Sciences and Mathematics.

2.5 Principals' Training in SMASE and Implementation of SMASE Programme

The secondary SMASE INSET system has a two-tier cascade system: Training is conducted at national and sub county level. Various workshops for principals are also

organized to strengthen the INSET system for them to effectively supervise and monitor the INSET activities.

In June 2016, 14 lawmakers from 12 states in the United States of America descended on Denver to tackle leadership issues in rural schools during the "Legislative Action: Rural School Principals" meeting . From the meeting, it was concluded that, effective school principals are key to improving schools and raising student achievement (Maccini & Gagnon, 2000). In fact, principals are second only to teachers among school-related influences on student learning. According to Maccini and Gagnon(2000), nearly 60 percent of a student's performance is attributable to teacher and principal effectiveness, with principals accounting for about a quarter of a school's total impact on a student's academic success. There are virtually no documented instances of troubled schools being turned around without intervention by an outstanding Principal. While teachers have a direct impact on students in their classroom, principals affect all students in the school.

The Centre for Mathematics, Science and Technology Education in Africa (CEMASTEA) organizes and conducts sensitization workshops for various stakeholders with a view to build their capability to support the implementation of training activities. One of the main objectives of such workshops is to sensitize stakeholders on CEMASTEA's Strengthening of Mathematics and Science Education (SMASE) activities. Principals of secondary schools are among key stakeholders sensitized through such workshops (CEMASTEA, 2013). This is owing to the fact that, Principals play a critical role in the supervision of classroom practices on implementation of learner-centred lessons and provide pedagogical leadership in the school.

In Kenya, according to Ngetuny (2013), in a study in Bomet Sub County established that, Principals of secondary schools play a key role in the supervision and providing pedagogical leadership for quality curriculum implementation at the school level. CEMASTEA's TNA 2015 report indicated that 19% of serving principals were newly appointed hence required capacity development in pedagogical leadership. Principals of

schools play key role in the success of SMASE for they are the Chief Executive Officers in their schools. Their decisions in the prioritization of initiatives in schools, for instance, purchase of basic apparatus, equipment and chemicals to be used in the teaching of mathematics and science, significantly affect results in these subjects and hence the success of SMASE (Ngetuny, 2013). The above studies by Maccini and Gagnon (2000) in the United States and by Ngetuny (2013), in Bomet Sub County, Kenya emphasized on the need for Principals' training but did not establish the influence of principals' training on SMASE and the effective implementation of the programme hence the current study will give an insight on whether SMASE training of principals influences the effective implementation of SMASE in secondary schools of Makueni Sub County.

2.6 Summary of Literature Review.

From the reviewed literature, it has emerged that many studies have been carried out to investigate the effectiveness of the SMASE programme, for instance a study by Ngetuny (2013) in Bomet Sub County sought to establish the attitude of teachers towards SMASE. The current study however focuses on the influence of the attitude of teachers towards the SMASE project on its effective implementation. Reviewed studies on SMASE project conducted by SMASE-WECSA (2011) in Burkina Faso, indicated the need for teacher training for effective implementation of SMASE programme, the current study however will focus on the influence of teacher training on SMASE on its effective implementation. The study by Orodho and Mutungwa (2013) was based in Makindu Sub County in which most of the schools are in a rural set up, however the current study is based in Makueni Sub County which is in a fairly urban setting with most of the schools being around the County Headquarters. Further from the reviewed literature it has emerged that there is no known documented study that has ever been carried out in the Sub County on the school based factors that may have an effect on the effective implementation of SMASE programme in the Sub County. Besides the above cited inconsistencies, the reviewed studies are consistent with the current study in that most of the studies are on the factors influencing implementation of SMASE programme.

2.7Theoretical Framework

The research study is based on constructivist theory by Bruner 1966. The first proponents of this theory were Piaget (1936), John Dewey (1938) and Vygotsky (1962).The theory holds that, the intelligent mind creates from experience "generic coding systems that permit one to go beyond the data to new and possibly fruitful predictions" (Bruner, 1957). So, to Bruner, important outcomes of learning include not just the concepts, categories, and problem-solving procedures invented previously by the culture, but also the ability to "invent" these things for oneself. Bruner's constructivist theory suggests it is effective when faced with new material to follow a progression from enactive to iconic to symbolic representation. A true instructional designer, Bruner's work also suggests that a learner even of a very young age is capable of learning any material so long as the instruction is organized appropriately. For Bruner (1961), the purpose of education is not to impart knowledge, but instead to facilitate a child's thinking and problem solving skills which can then be transferred to a range of situations. The constructivist theory best suits this study because it advocates for active participation of learners in the learning process rather than being passive receivers of knowledge. Learners should be involved in physical action, hand-on experience that engages the mind as well as the hands and this is what SMASE advocates for in the ASEI/PDSI approach to teaching hence the relevance of the theory to the current study.

According to Duffy, Thomas and Jonassen (1992) the strengths of the theory are that the children learn more and enjoy learning more when they are actively involved rather than passive listeners, education works best when it concentrates on thinking and understanding rather than on rote memorization, constructivism gives learners ownership of what they learn, since learning is based on pupils questions and explorations and often the students have a hand in designing the assessment as well. They further note that, the weaknesses of constructivist theory is that it can lead students to be confused and frustrated because they may not have the ability to form relationships and abstracts between the knowledge they already have and the knowledge they are learning for themselves.

The constructivist theory is best for this study because the method of teaching is effective for students who learn better in a hands-on environment and helps the learners to better relate the information learned in the classroom to their lives, it also caters to the students' prior knowledge. Since the students work in groups, this approach helps them to learn social skills, support each other's learning process and value each other's opinion and input. In a critique to the constructivist theory (Calia2016) notes that, the disadvantages of this theory include the fact that the training necessary for constructivism teaching is extensive and mostly requires expensive long term professional development. Also with an average number of students in one classroom, teachers may be unable to customize the curriculum to each student as their prior knowledge will vary. Despite the above weaknesses and disadvantages, this theory is suitable for this study because SMASE advocates for the use of concrete materials in teaching and learning together with learner centered teaching and learning through the ASEI/PDSI approach to teaching and learning.

2.8The Conceptual Framework

According to Orodho (2008), conceptual framework is a model of presentation between variables in the study and their relationship diagrammatically. In the current study, the independent variables include the influence of the availability of teaching and learning resources, attitude of teachers, teacher participation in SMASE training and Principals training on SMASE on the effective implementation of SMASE programme.

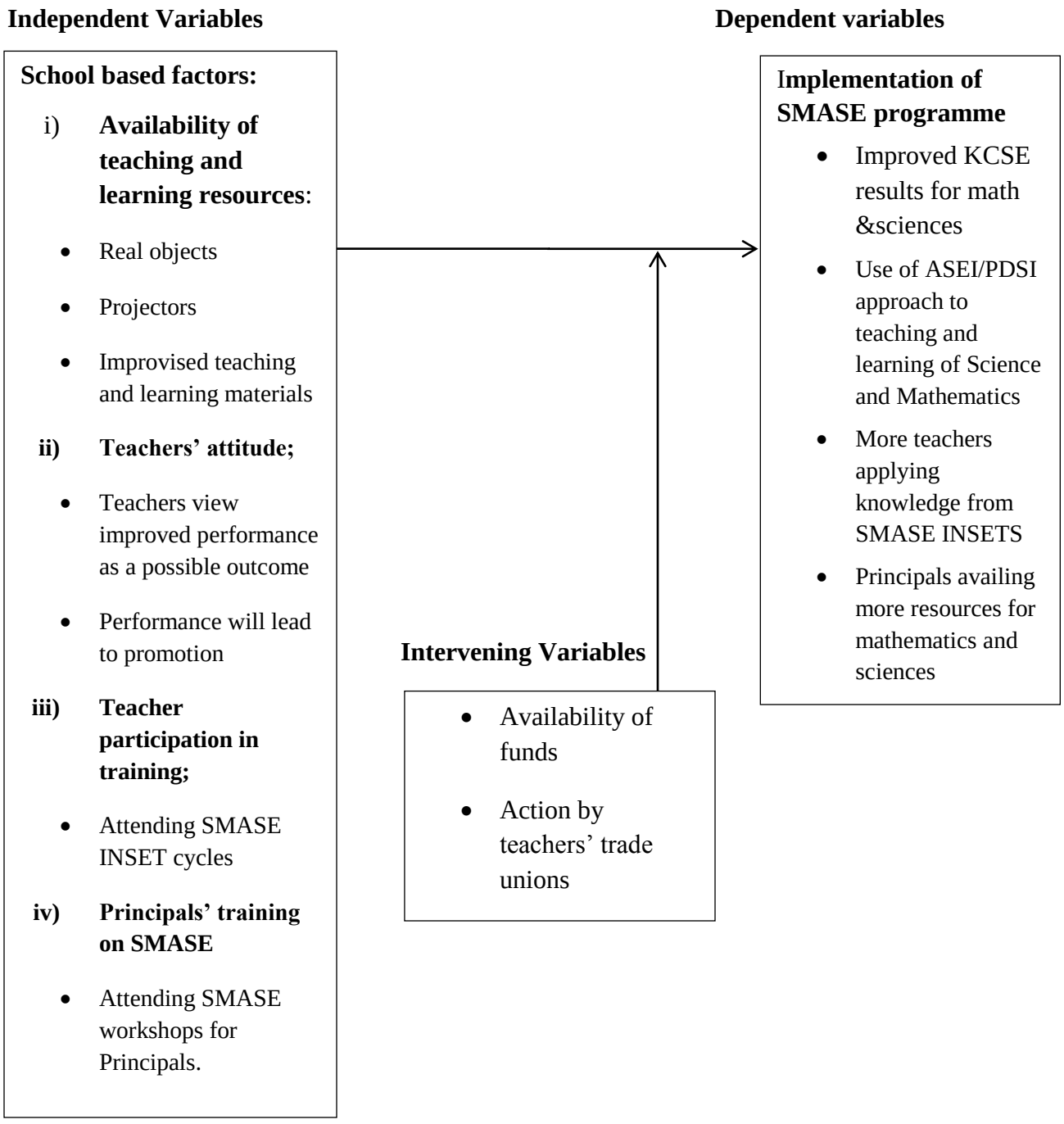
Independent Variables
Dependent variables
School based factors:
i) Availability of teaching and learning resources:
Real objects
Projectors
Improvised teaching and learning materials
ii) Teachers' attitude;
Teachers view improved performance as a possible outcome
Performance will lead to promotion
iii) Teacher participation in training;
Attending SMASE INSET cycles
iv) Principals' training on SMASE
Attending SMASE workshops for Principals.
Implementation of SMASE programme
Improved KCSE results for math &sciences
Use of ASEI/PDSI approach to teaching and learning of Science and Mathematics
More teachers applying knowledge from SMASE INSETS
Principals availing more resources for mathematics and sciences
Intervening Variables
Availability of funds
Action by teachers' trade unions

Figure 2.1 Conceptual Framework

These variables are discussed as follows; if the teaching and learning resources are available and are used appropriately in the teaching and learning process, then implementation of SMASE will be effective hence academic performance of the learners is likely to be improved. Teachers with a positive attitude towards implementing the SMASE programme are likely to be innovative in the teaching process, this will go a long way in boosting the thought process of the learners as opposed to those teachers who are not willing to embrace what SMASE advocates for. Teachers and principals who have participated in SMASE training are likely to have an upper hand in the implementation of the programme, and this is likely to translate to high level of performance of mathematics and science in the national examinations

The SMASE process is implemented through the Activity Student-centred Experiment Improvisation/ Plan Do See Improve (ASEI/PDSI) approach to teaching. This approach requires the teacher to use activities that are learner-centred which emphasize more on the use of experiments done through locally available materials that have been improvised to suit the context. Implementation of the approach endeavors to shift teaching and learning from knowledge-based teaching to activity-based teaching; teacher-centred teaching to student-centred learning; chalk and talk to experiment and improvisation.

Implementation of ASEI-PDSI approach equips teachers for effective classroom practices, believing that the battle against poor performance in Mathematics and Sciences must be won in the classroom. ASEI-PDSI is based on the premise that learners learn better when they are involved in the doing, through discussions, experiments and other activities, hence the emphasis on the learners as the central focus of learning (SMASE-WECSA, 2011).The teacher is expected to plan ahead of the lesson, help the students do the tasks, see where there are weaknesses and improve on them. If all steps of the

approach are followed, then implementation of SMASE will be effective hence high performance of Science and Mathematics.

The intervening variables are; availability of funds and action by teachers' trade unions. If a school has enough funds to purchase teaching and learning resources, the school is more likely to implement SMASE programme effectively and the performance of Science and Mathematics is expected to be high leading to a high transition rate of students to universities. The trade unions usually visit the training centers to evaluate the training environment and the materials if they are satisfied, then the training may be successful, however they may sometimes interfere with the training of SMASE teachers.

The depended variable is the effective implementation of SMASE programme in teaching Mathematics and Sciences whose performance may be low or high depending on how the independent variables interact in the process. Intervening variables are constructs that make it difficult to quantify how much of the experimental results are due to the independent variables, and how much are due to each of the intervening variables. In the current study variables such as availability of funds, actions by teacher unions may affect the way the depended and independent variables interact with each other.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The chapter presents the research design, target population, sampling techniques and sample size, research instruments, validity of research instruments, reliability of research instruments, data collection procedures, data analysis techniques and ethical considerations.

3.2 Research Design

According to Kombo and Tromp (2006) a research design is an arrangement of conditions for collection of data in a manner that aims at combining relevance with the research purposes. The study used descriptive survey research design. Descriptive survey was appropriate for the current study to collect data from Principals, HODs for science and mathematics and teachers on how teachers have implemented SMASE in their respective schools and the outcome of each school.

3.3 Target Population

Target population is defined as all the members to which a researcher wishes to generalize the results of the research study (Borg & Gall, 1989).Makueni Sub County has one national school, 5 extra county secondary schools,7 county secondary schools and 31 sub county secondary schools; a total of 44 public secondary schools (Ministry of Education,2018).The target population was thus all the 44 Principals, all the 88 Heads of Departments and all the 19 science and mathematics teachers in the national school, 28 in the extra county schools, 33 in the county schools and 161 in the sub county schools; giving a total of 241 Science and Mathematics teachers in public secondary school in Makueni Sub County. The target population was therefore 373. Principals were involved

because they are the institutional heads in the schools. The HODs were targeted since they are involved in coordinating teaching and learning in their various departments. Science and Mathematics teachers were targeted since they are the actual implementers of the SMASE programme.

3.4 Sampling Techniques and Sample Size

Sampling is the process of selecting a number of individuals for a study which represents the characteristics found in the entire group Orodho (2003). Mugenda and Mugenda (2003) note that a sample size of between 10 and 30% is adequate for descriptive research. The schools in Makueni Sub County were stratified into National, Extra County, County and Sub County schools. Since there is only one national school in Makueni Sub County it's Principal and the two HODs for Mathematics and Science were purposively included in the study. 30% of the 5 extra county schools were selected through simple random sampling, 30% of the 7 county schools were randomly sampled to participate in the study and finally, 30% of the 31 Sub County schools were selected as shown in Table 3.1. From the sampled schools, the two HODs for science and mathematics.

Table 3.1 Sample Size for the Study

School Category	**Target Population**			**Sample Size**		
	Principals	**HODS**	**Teachers**	**Principals**	**HODS**	**Teachers**
National	1	2	19	1	2	4
Extra County	5	10	28	2	4	8
County	7	14	33	3	6	12
Sub County	31	62	161	10	20	40
Total	**44**	**88**	**241**	**16**	**32**	**64**

participated then four teachers one for Mathematics, Physics, Chemistry and Biology were selected through simple random sampling to participate in the study. In total, the sample size comprised 16 Principals, 32 HODs for Science and Mathematics and 64 Science and Mathematics teachers giving a total of 112 respondents which represents 30% of the target population.

3.5 Research Instruments

The study used a questionnaire as a data collection tool in this study. According to Kombo and Tromp (2006), a questionnaire is a research instrument consisting of a series of questions and other prompts for the purpose of gathering information. Questionnaires were used because they are the most suitable research instrument for descriptive research design (Kombo & Tromp, 2006). Both open ended and closed ended questions were used.

The questionnaires for the Principals had two sections, Section A collected biographic data about the Principals and the school. Section B gathered data on implementation of SMASE programme. This section was further divided into four sub-themes according to the research objectives as follows; a) availability of teaching and learning resources, b) teachers' attitude towards implementation of SMASE programme, c) influence of teacher training in SMASE on the effective implementation of the programme and finally d) influence of Principals' training in SMASE on the implementation of the programme.

Questionnaires for the HODs for science and mathematics had two sections, Section A collected biographic data about the HoDs .Section B gathered data on implementation of SMASE programme. This section was further divided into four sub-themes according to the research objectives as follows; a) availability of teaching and learning resources, b) teachers' attitude towards implementation of SMASE programme, c) influence of teacher training in SMASE on the effective implementation of the programme and finally d) influence of Principals' training in SMASE on the implementation of the programme.

Questionnaires for science and mathematics teachers had two sections, Section A collected biographic data about the science and mathematics teachers. Section B gathered data on implementation of SMASE programme. This section was further reorganized into four sub-themes according to the research objectives as follows; a) availability of teaching and learning resources, b) teachers' attitude towards implementation of SMASE programme, c) influence of teacher training in SMASE on the effective implementation of the programme and finally d) influence of Principals' training in SMASE on the implementation of the programme.

3.6 Validity of Research Instruments

Mugenda and Mugenda (2008) define validity as the degree to which results obtained from the analysis of the data actually represent the phenomenon under study. To ensure content validity of the instruments, piloting was done in two schools in the Sub County and that were not included in the sample. After the piloting, the questionnaires were adjusted to cater for any inconsistencies with the conceptual framework and objectives that may have been detected. The instruments were then subjected to expert judgment of the study supervisors and lecturers in the Department of Educational Administration and Planning. Their comments were incorporated to improve the content validity of the instruments and ensured that questions were relevant to the study objectives.

3.7 Reliability of Research Instruments

Mugenda and Mugenda (2008) define reliability as a measure of degree to which a research instrument will yield consistent result or data after repeated trials. To determine the reliability of the questionnaires, the researcher used test- re-test method during piloting. The questionnaire was administered twice within an interval of two weeks in two selected schools which were excluded from the final study. To determine the coefficient correlation, Pearson product moment formula was used. This established the extent to which the questionnaire elicits the same responses every time it was administered

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[\, n\Sigma x^2 - (\Sigma x)^2 \,][\, n\Sigma y^2 - (\Sigma y)^2 \,]}}$$

Where: r is the coefficient correlation.

n is the number of respondents in each test

x is the scores in first test.

y is the scores in second test.

Σ is the summation sign.

Mugenda and Mugenda (2003) note that, a coefficient of 0.80 or more implies a high degree of reliability of the data. The instruments in the current study yielded a correlation coefficient of 0.80 meaning that the instruments were reliable to be used in the study.

3.8 Data Collecting Procedures

The researcher obtained an introductory letter from the South Eastern Kenya University. A research permit was then obtained from the National Commission for Science Technology and Innovation (NACOSTI). The researcher then presented copies of the research permit to the Makueni County Commissioner, Makueni County Director of Education and the Makueni sub County Director of Education and obtained the necessary authority to proceed with the study. The researcher then booked an appointment with the sample schools through the Principals to visit and administer the questionnaires.

3.9 Data Analysis Techniques

Malhotra and Birks (2006)note that, data analysis techniques include the editing, coding, transcription and verification of data. To analyse the data obtained from the research study, questionnaires were cross checked to ascertain their accuracy, completeness and uniformity of information. Both quantitative and qualitative approaches were used for data analysis. Descriptive statistics was used to analyse data with the aid of Statistical Package for Social Sciences (SPSS) version 22. Quantitative data was presented using

frequency distribution tables, pie charts and bar graphs. Qualitative data generated from open ended questions was categorized in themes in accordance with research objectives and presented in narrative form.

3.10 Ethical Considerations

According to the Australian Law Reform Commission and Australian Health Ethics Committee, ALRC (2001), ethical considerations are an accumulation of values and principles that address questions of what is good or bad in human affairs. In order to address ethical considerations the researcher acquired permit and letters of authorization to conduct research from South Eastern Kenya University, NACOSTI and the County Government. The researcher ensured voluntary participation of respondents. The researcher further ensured that respondents participated on the basis of informed consent. Privacy and anonymity or respondents was ensured by requiring the respondents no to write their identification on the questionnaire.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND DISCUSSION

4.1 Introduction

This chapter covers results of the study based on study objectives. The results are arranged as follows; response rate of the respondents, demographic information of the respondents, teaching resources and implementation of SMASE programme, teachers attitude towards implementation of SMASE programme and training of the principals and teachers on SMASE and implementation of SMASE programme.

4.2 Response Rate

Out of 16 principals targeted, 32 heads of departments and 64 science teachers in the study sample, there was 100% questionnaire return rate. The principals' questionnaires were fully filled with all the sections having responses as well as the heads of department questionnaires and the science teachers' questionnaire. This gave 100% questionnaire return rate and responses. Questionnaire return rate is the proportion of questionnaires returned after they have been issued to the respondents to fill in the various sections of the questionnaire and then the researcher collects the filled questionnaires (Baruch, 1999). Table 4.1 shows questionnaire return rate for the study.

Table 4.1 Questionnaire Return Rate

Category of Respondent	Questionnaires Issued	Questionnaires Returned	Return Rate Percentage (%)
Principals	16	16	100
Heads of Department	32	32	100
Science Teachers	64	64	100
Total	**112**	**112**	**100**

All the respondents filled and returned the questionnaires on the same day they were administered. The return rates were 100% and hence deemed adequate for data analysis. According to Baruch and Holtom (2008)a response rate of above 80% is adequate for social sciences. This study realized 100% questionnaire return rate as shown by table 4.1

4.3 Demographic Information of Respondents

This section presents the demographic information of the respondents. It includes general profile of the study respondents with regard to gender, age and duration for principals, heads of departments and science teachers in their current work station. It was necessary to take demographic information of the respondents so as to determine whether the study samples are obtained from experienced respondents who understood the real state of SMASE implementation in their schools regarding school based factors influencing implementation of SMASE programme in public secondary schools in the study area.

4.3.1 Demographic Information of Principals

The demographic information of principals was based on gender, age, the duration they had served as principals and highest academic qualification held. The study sought to establish the gender of the Principals and the results are as shown in Table 4.2

Table 4.2 Distribution of Principals by Gender

Principals' gender	Frequency (f)	Percentage (%)
Males	12	75
Females	4	25
Total	**16**	**100**

The results revealed that 75% of the principals were males while 25%of the principals were females. This shows that there were more male Principals than female Principals in

public secondary schools in Makueni Sub County. This distribution, 75% male Principals and 25% female Principals does not meet the constitutional gender requirement which states that for every public appointment, at least one third should be of either gender. This could mean that the TSC need to promote more women to head schools in Makueni Sub County to meet the gender balance. To establish the age of Principals, the researcher asked them to indicate their age. The results are shown in Table 4.3

Table 4.3 Distribution of Principals by Age

Age bracket	Frequency (f)	Percentage (%)
41 – 50 years	4	25
51 – 60 years	12	75
Total	**16**	**100**

The data in Table4.3 shows that, 25% of the Principals are aged between 41 - 50 years and 75% of the Principals are aged between 51 – 60 years. Therefore the Principals were deemed to be old enough to address the issues regarding implementation of SMASE in their schools since most of them have been Principals from the inception of SMASSE in 1998 in the then Makueni district. From this data it can be deduced that majority of the respondents were mature enough an indication that they had worked for long enough as Principals to understand better the factors influencing implementation of SMASE in schools.

The study also sought to find out the level of education of Principals. The researcher asked them to indicate their level of education and the results are shown in Figure 4.1

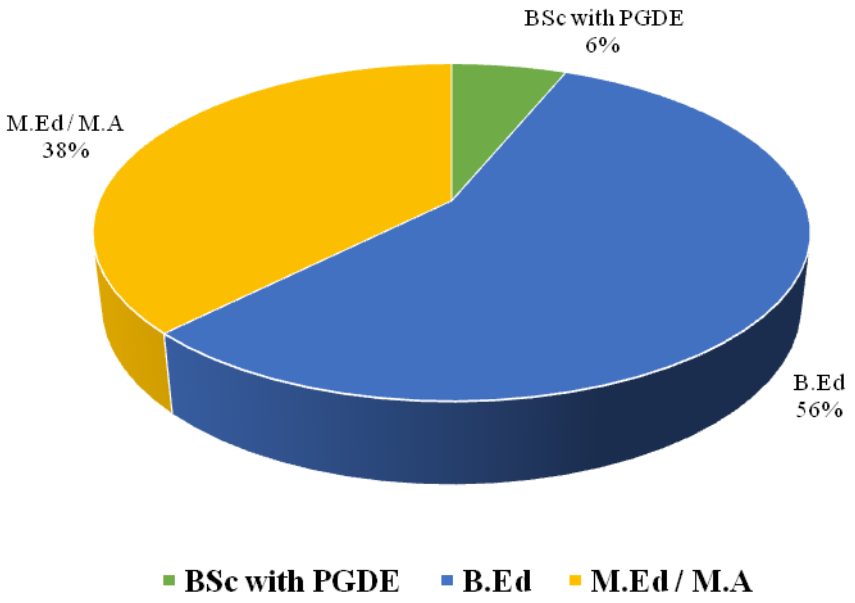

Figure 4.1 Highest level of Education reached

The findings in Figure 4.1 show that 6% of the principals hold Bachelor of Science (BSc) Degree with a Post Graduate Diploma in Education (PGDE), 56% Bachelors' Degree in Education (B.Ed) and 38% of the principals hold Master of Education (M.Ed) or Master of Arts (M.A) Degree. The implication is that principals had the required education qualification hence were in a position to understand school based factors that influence implementation of SMASE in their institutions.

The study sought to establish the length of service of Principals in their capacity as a Principal in the current station. The principals were asked to indicate the number of years they had served as principals in that school and their responses are shown in Table 4.4.

Table 4.4 Principals' Service in their Current Station

Years of service	Frequency (f)	Percentage (%)
1 – 3 years	5	31.3
4 – 6 years	6	37.5
10-12 years	1	6.2
Over 13 years	4	25.0
Total	**16**	**100**

Table 4.4 shows that most principals 68.7%had been principals in their current school for a considerable number of years at least four years hence were in a position to explore the school factors influencing implementation of SMASE in the schools. Only 31.3% of the principals had been in their current school for less than three years.

4.3.3 Demographic Information of Heads of Department

Demographic information of Heads of Department was based on gender, age, highest qualification and the duration they had served in that school. To establish the gender of Heads of Department (HoDs), the study asked them to indicate their gender and the results are as shown in Figure 4.2.

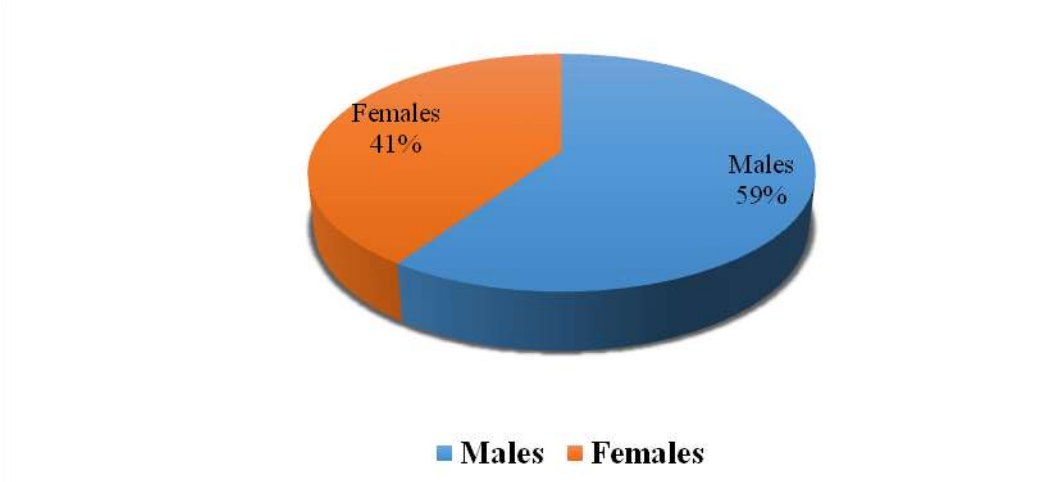

Fig 4.2 Distribution of Heads of Department by gender in percentages (n=32)

The results in Figure 4.2 revealed that 41% of the Heads of Department were ales, while 59% were male Heads of Departments. This distribution is however acceptable as it is in line with the two thirds majority rule as espoused in Kenya constitution and it shows that both genders were serving as heads of Mathematics and Science departments in public secondary schools in Makueni Sub County.

The study sought to establish the age of Heads of Department in the sampled schools. The HoDs were asked to indicate their age. The results are shown in Table 4.6

Table 4.6 Distribution of Heads of Department by Age

Age bracket	Frequency (f)	Percentage (%)
25 – 30 years	2	6.3
31 – 40 years	10	31.2
51 – 60 years	20	62.5
Total	**32**	**100**

The data in Table 4.6 shows that only 6.3% of the Heads of Department were aged between 25 - 30 years, 31.2% of the Heads of Department were aged between 31 – 40 years and majority, 62.5% of the Heads of Department were aged between 51 – 60 years. This means that the Heads of Departments in public secondary schools were mature enough and had served in the teaching profession for a considerable time span hence gained experience to qualify to be appointed as departmental heads. This implies the heads of departments have a wealth of experience on school based factors influencing implementation of SMASE program in their schools.

The study sought to establish the level of education of the Heads of department and the results are shown in Figure 4.3

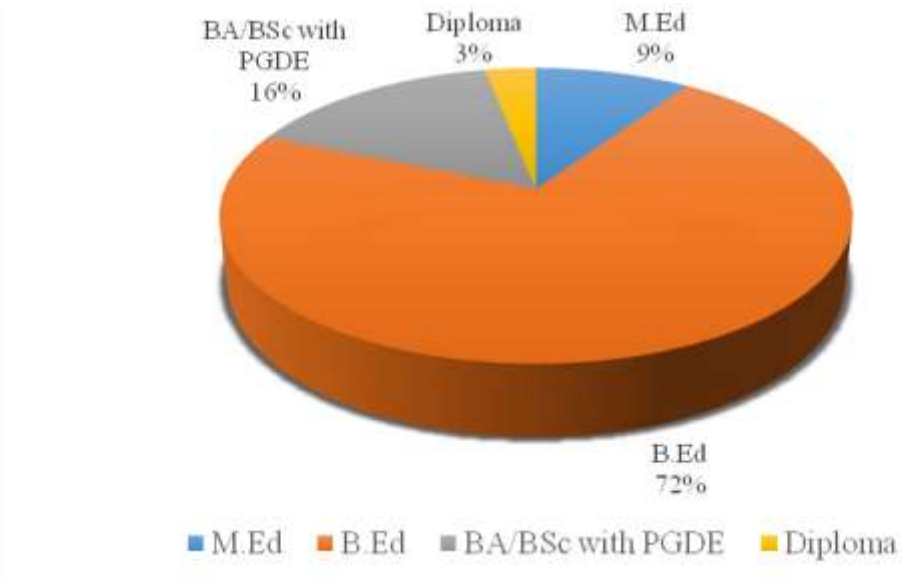

Figure 4.3 Distribution of Heads of Department by level of Education (n=32)

The results in Figure 4.3 show that 72% of the Heads of Department had Bachelor's Degree in education (B.Ed) while 16% had Bachelor of Arts (BA) or Bachelor of Science (BSc) degree with Post Graduate Diploma in Education (PGDE),9% of the heads of departments hold a Master's degree in Education (M.Ed) and the last budge of 3% of the HoDs hold a Diploma in Education. This implies that majority 97%of the heads of department are professional graduates with Bachelor's Degree and above hence could understand well the factors influencing implementation of SMASE.

Table 4.7 Duration of service of Heads of Department in the Teaching Profession

Years of service	Frequency (f)	Percentage (%)
1 – 2 years	4	12.5
3 – 4 years	11	34.4
5– 6 years	7	21.9
More than 7 years	10	31.2
Total	**32**	**100**

The results in Table 4.7 indicate that 12.5% of the HoDs served as HoDs for 1 - 2 years, those with a service length of 3 – 4 years were 34.4%, 5 – 6 years were 21.9% and those with more than 7 years were 31.2%.This implies that majority 87.5% of Heads of Department in Makueni Sub County have served as HoDs for a period of above 2 years and hence are capable of providing useful information on factors influencing implementation of SMASE.

4.3.4 Demographic Information of Science and Mathematics Teachers

The demographic information of science teachers was based on gender, age, highest qualification and the duration they had served in that school. To establish the gender of the Science and Mathematics teachers, the researcher asked them to indicate their gender and the results are as shown in Figure 4.5.

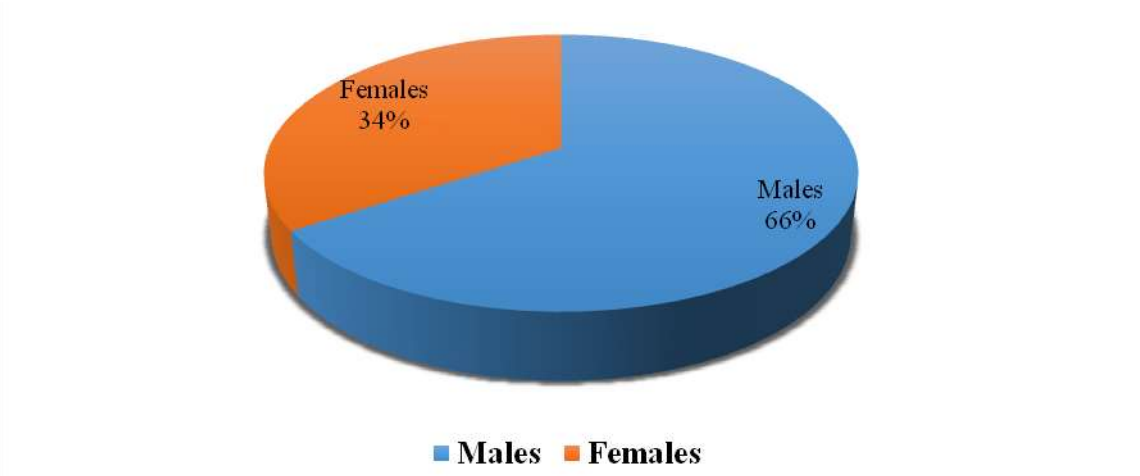

Fig 4.5 Distribution of Science and Mathematics Teachers by Gender (n=64)

The results in Figure 4.5 revealed that 34% of the Science and Mathematics teachers were females while majority 66% of the teachers were males. This shows that there were more male science and Mathematics teachers than females. While this distribution is was acceptable for the purposes of research, there was need for the Ministry of Education and education stakeholders including Principals of schools to encourage females to choose Science and Mathematics as their teaching subjects.

The study sought to establish the age of Science and Mathematics teachers in the sampled schools. The science and Mathematics teachers were asked to indicate their age. The results are shown in Table 4.8

Table 4.8 Distribution of Science and Mathematics Teachers by Age

Age bracket	Frequency (f)	Percentage (%)
25 – 30 years	18	26.1
31 – 40 years	36	56.3
41 – 50 years	7	10.9
51 – 60 years	3	4.7
Total	**64**	**100**

The data in Table 4.8 shows that majority of Science and Mathematics teachers 71.9% were aged between 31 and 60 years. This implies that they were mature enough and may have taught the subject long enough to understand and respond to factor that influence implementation of SMASE.

The study sought to establish the level of education of theScience and Mathematicsteachers and the results are shown in Figure 4.6

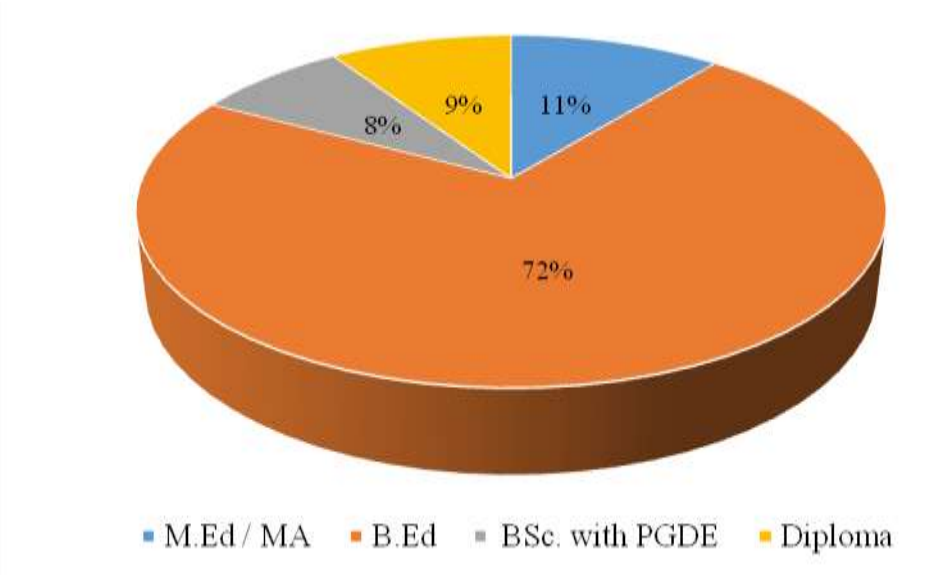

Figure 4.6 Distribution of Science and Mathematics Teachers by level of Education

The results in Figure 4.6 show that majority 72% of the Science and Mathematics teachers had Bachelor's Degree in education while 9% of the Science and Mathematics teachers had Diploma in Education, 8% of the Science and Mathematics teachers had Bachelor's Degree in Science with Post Graduate Diploma in Education (PGDE)and the last budge which included 11% of the Science and Mathematics teachers had Master's Degree in Education hence majority of the teachers had the right qualifications to teach Mathematics and Science.

The study sought to establish the length of service of Science and Mathematics teachers. The researcher asked them to indicate the duration they had been as Science and Mathematics teachers. Their responses are shown in Table 4.9.

Table 4.9 Science and Mathematics Teachers' Duration of Service in the Teaching Profession

Years of Service	Frequency (f)	Percentage (%)
Less than 1 year	2	3.1
1 – 2 years	19	29.7
3– 4 years	13	20.3
5- 6years	16	25.0
More than 7 years	14	21.9
Total	**64**	**100**

The results in Table 4.9 show that only 3.1% of the Science and mathematics Teachers had a service of less than 1 year, those with a service length of 1 – 2 years were 29.7%of the Science and mathematics Teachers, 3 – 4 years were 20.3%of the Science and mathematics Teachers, 5 – 6 years were 25%of the Science and mathematics Teachers and those with more than 7 years were 21.9%of the Science and mathematics Teachers. This means that majority, 67.1% of the Science and Mathematics teachers in Makueni Sub County have been in employment for more than 3 years hence could provide useful information about implementation of SMASE in their respective schools.

4.4 Teaching Resources and Implementation of SMASE Programme

The first objective of the study was to establish the influence of availability of teaching resources on implementation of SMASE programme in Public Secondary Schools in Makueni Sub County. The study posed questions to Principals, Heads of Department (Science and Mathematics) and Science and Mathematics teachers to establish the same. The questions included availability of key teaching resources namely science laboratories, computer laboratory, science apparatus, laboratory reagents, models and real objects and use of ASEI-PDSI. These were rated on three point likert scale of adequacy, inadequate and neutral. The respondents were asked to rate availability of each teaching resource enumerated as adequate, inadequate or neutral so as to find out whether

availability of each teaching resources and frequency of use of ASEI-PDSI had influence on implementation of SMASE programme.

4.4.1 Level of Availability of Science Laboratories

To study sought to establish whether science laboratories were adequately available by posing questions to the respondents. The results were as tabulated in Table 4.10

Table 4.10 Influence of Availability of Science Laboratories on Implementation of SMASE Programme.

Category of Respondent	Adequate		Inadequate		Neutral		Total	
	f	%	f	%	f	%	f	%
Principals	6	37.5	9	56.3	1	6.2	16	100
Heads of Department	7	21.9	24	75.0	1	3.1	32	100
Science Teachers	27	42.2	29	45.3	8	12.5	64	100

The results in Table 4.10 show that most Principals 56.3% indicated that laboratories were inadequate, while 37.5% of the principals said they were adequate and 6.2% of the principals were not sure whether they were adequate or inadequate. Majority of the HODs 75% said that laboratories were inadequate then 21.9% of the HODs indicated that they were adequate while 3.1% of the HODs did not know whether they were adequate or inadequate. When asked the same question 45.3% of science teachers indicated that they were inadequate while 42.2% of science teachers indicated that they were adequate and 12.5% of science teachers were not sure whether they were adequate or inadequate.

4.4.2Level of Adequacy of Computer Laboratories

The study sought to establish whether computer laboratories were available in Public Secondary Schools. The results are shown in Table 4.11

Table 4.11 Influence of Availability of Computer Laboratories on Implementation of SMASE Programme.

Category of respondent	Adequate		Inadequate		Neutral		Total	
	f	%	f	%	f	%	f	%
Principals	3	18.8	9	56.3	4	25.0	16	100
Heads of Department	4	12.5	15	46.9	13	40.6	32	100
Science & Math teachers	10	15.6	35	54.7	19	29.7	64	100

The results in Table 4.11 show that most Principals 56.3% indicated that computer laboratories were inadequate while 25% of the principals were not sure whether they were adequate or inadequate while 18.8% of the principals said they were adequate. 46.9% of Heads of Departments said computer laboratories were inadequate and 40.6% of the HODs were not sure whether the computer laboratories were adequate or inadequate while 12.5% of the HODs said they were adequate. When the same question was posed to Science and Mathematics teachers, majority 54.7% of Science and Mathematics teachers said that they were inadequate, 29.7% of Science and Mathematics teachers were not sure whether they were adequate or inadequate and 15.6% of Science and Mathematics teachers said they were adequate.

4.4.3 Adequacy of Science Apparatus and Implementation of SMASE

The study sought to establish whether science apparatus were adequate in Public Secondary schools. The results were as tabulated in Table 4.12.

Table 4.12 Influence of Availability of Science Apparatus on Implementation of SMASE Programme

Category of respondent	Adequate		Inadequate		Neutral		Total	
	f	%	f	%	f	%	f	%
Principals	9	56.3	7	43.7	0	0.0	16	100
Heads of Department	12	37.5	20	62.5	0	0.0	32	100
Science& Math Teachers	32	50.0	20	31.3	12	18.8	64	100

The results in Table 4.12 show that majority of the Principals 56.3% indicated that science apparatus were adequate, 43.7% of the principals said they were inadequate. Majority of HODs 62.5% said that they were inadequate while 37.5% of the HODs said they were adequate. When the same question was posed to science teachers majority 50% of science teachers indicated they were adequate while 31.3% of science teachers said that they were inadequate while 18.8% of the science teachers were not sure whether they were adequate or inadequate.

4.4.4Availability and adequacy of Laboratory Reagents and Implementation of SMASE Programme

The study sought to establish whether Science laboratory reagents were available in public secondary schools and adequate. The results were as tabulated in Table 4.13

Table 4.13 Influence of Availability of Laboratory Reagents on Implementation of SMASE Programme

Category of respondent	Adequate		Inadequate		Neutral		Total	
	f	%	f	%	f	%	f	%
Principals	8	50.0	8	50.0	0	0.0	16	100
Heads of Department	19	59.4	13	40.6	0	0.0	32	100
Science& Math Teachers	41	64.0	17	26.6	6	9.4	64	100

The results in Table 4.13 show that a half of the Principals 50% indicated that laboratory reagents were adequate while 50% of the principals indicated that they were inadequate. Majority of Heads of Department 59.4% said that the laboratory reagents were adequate while 40.6% of the HODs said they were inadequate. When the same question was posed to science teachers, majority 64% of the science teachers indicated that they were adequate, 26.6% of the science teachers said they were inadequate while 9.4% of the science teachers were not sure whether the reagents were adequate or inadequate.

4.4.5Availability and adequacy of Science and Mathematics Models and Implementation of SMASE Programme

The study sought to establish whether the Science and Mathematics models were available in their schools and whether they were adequate, and the results were as shown in Table 4.14.

Table 4.14 Influence of Availability of Science and Mathematics Models on Implementation of SMASE Programme

Category of respondent	Adequate		Inadequate		Neutral		Total	
	f	%	f	%	f	%	f	%
Principals	4	25.0	11	68.8	1	6.2	16	100
Heads of Department	11	34.3	18	56.3	3	9.4	32	100
Science& Math Teachers	27	42.2	29	45.3	8	12.5	64	100

The results in Table 4.14 show that most Principals 68.8% indicated that science and mathematics models were inadequate,25% of the principals indicated that they were adequate while 6.2% of the principals were not sure whether they were adequate or inadequate. Majority of Heads of Department 56.3% indicated the models were inadequate, 34.3% of the HODs said the models were adequate while 9.4% of the HODs were not sure whether the models were adequate or inadequate. When the same question was posed to science and mathematics teachers, majority 45.3% of science and mathematics teachers indicated that they were inadequate, 42.2% of science and mathematics teachers said the models were adequate while 12.5%of science and mathematics teachers were not sure whether the models were adequate or inadequate.

4.4.6 Availability of Real Objects and Implementation of SMASE Programme

The study sought to establish whether real objects for teaching mathematics and science were available in Public Secondary schools. The results are shown in Table 4.15.

Table 4.15Influence of Availability of Real Objects on Implementation of SMASE Programme.

Category of respondent	Adequate		Inadequate		Neutral		Total	
	f	%	f	%	f	%	f	%
Principals	4	25.0	9	56.3	3	18.7	16	100
Heads of Department	10	31.3	19	59.4	3	9.3	32	100
Science& Math Teachers	13	20.3	31	48.5	20	31.2	64	100

The results in Table 4.15 show that most Principals 56.3% said the real objects were inadequate,25% of the principals indicated that they were adequate, while 18.7% of the principals were not sure whether real objects were adequate or inadequate. Majority of Heads of Department 59.4% indicated that real objects were inadequate, 31.3% of the HODs said real objects were adequate while 9.3% of the HODs were not sure whether real objects were adequate or inadequate. When the same question was posed to science and mathematics teachers, majority 48.5% of science and mathematics teachers indicated real objects were inadequate, 20.3% of science and mathematics teachers said real objects were adequate and 31.2% of science and mathematics teachers were not sure whether real objects were adequate or inadequate.

4.4.7Principals' Response on Teachers' use of ASEI-PDSI in Schools.

The study sought to establish whether teachers use ASEI – PDSI while teaching Science and Mathematics in Public Secondary Schools. The results are shown in Table 4.16.

Table 4.16 Principals Response on Teachers' use of ASEI-PDSI

Activity	A		S		E		I		P		D		S		I	
Response	f	%	f	%	f	%	F	%	f	%	f	%	f	%	f	%
Always	10	62.5	11	68.8	6	37.5	4	25.0	10	62.5	11	68.8	11	68.8	12	75
Rarely	6	37.5	5	31.2	10	62.5	12	75.0	6	37.5	5	31.2	5	31.2	4	25
Never	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0
Total	**16**	**100**	**16**	**100**	**16**	**100**	**16**	**100**	**16**	**100**	**16**	**100**	**16**	**100**	**16**	**100**

Table 4.16 shows that, all the teachers in their schools use various aspects of SMASE. 62.5% of the Principals indicated that the teachers mostly give their students Activity (A) , 68.8% of the principals indicated that teachers use Student centered teaching (S), 62.5% of the principals indicated that teachers, Plan (P) their teaching, 68.8% of the principals said that teachers, guide the students to Do the work (D) 68.8% of the principals indicated that teachers help the learners to, See how it is working (S) and 75% of the principals said that teachers guide the students to Improve on their work (I). Majority of the principals 62.5% revealed that teachers rarely use experimentation and 75% of the principals indicated that teachers rarely used Improvisation of the available local resources (I)

4.4.8 Heads of Departments' response on teachers' use of ASEI-PDSI in schools.

The study sought to find out whether teachers use ASEI – PDSI while teaching Science and Mathematics in Public Secondary schools. ASEI-PDSI is an acronym for Activity (A), Student (S), Experimentation (E) and Improvisation (I)-Plan (P), Do (D), See (S), Improve (I). The results are shown in Table 4.17.

Table 4.17 Heads of Departments' (HODs) Response on Teachers' use of ASEI-PDSI

Activity	A		S		E		I		P		D		S		I	
Response	f	%	f	%	f	%	F	%	f	%	f	%	f	%	f	%
Always	9	28.1	12	37.5	9	28.1	12	37.5	11	34.4	12	37.5	13	40.6	13	40.6
Rarely	22	68.8	20	62.5	23	71.9	19	59.4	19	59.4	19	59.4	18	56.3	18	56.3
Never	1	3.1	0	0.0	0	0.0	1	3.1	2	6.2	1	3.1	1	3.1	1	3.1
Total	32	100	32	100	32	100	32	100	32	100	32	100	32	100	32	100

Table 4.17 shows HoDs responses on teachers' use of various aspects of SMASE. Majority 68.8% of the Heads of Department indicated that teachers rarely give their students Activity (A), 62.5% of the HODs revealed that teachers rarely use Student centered teaching (S), 71.9% of the HODs indicated that the teachers rarely Experiment (E) with their learners,59.4% of the HODs said that teachers rarely Improvise locally available resources (I),Plan their teaching (P) or guide their learners to Do work (D),56.3% of the HODs indicated that teachers rarely help their learners to See the work (S) and Improve (I).

According to the HODs, 28.1% of the teacher always give Activity (A) and do Experiment with the students (E), 37.5% of the HODs indicated that teachers always use Student centred teaching (S) and always Improvise locally available materials (I) and guide learners to Do their work (D), 34.4% of HODs said the teachers plan their work (P),40.6% of the HODs indicated that the teachers help the learners to see how Experiments are working (E) and guide them to Improve (I).

The study revealed that 3.1% of the HODs indicated that teachers never use Activities with their learners in teaching (A) neither did they Improvise locally available resources (I), nor help learners Do activities (D), nor help learners to See how things work (S) nor

help learners Improve on their activities (I).6.2% of the HODs indicated that teachers never Plan their work (P).

4.4.9 Science Teachers' Response on use of ASEI-PDSI in their Teaching.

The study sought to find out whether teachers use ASEI – PDSI while teaching Science and Mathematics in their schools. The results are shown in Table 4.18

Table 4.18 Science teachers' response on their use of ASEI-PDSI when teaching

Activity	A		S		E		I		P		D		S		I	
Response	f	%	f	%	f	%	F	%	f	%	f	%	f	%	f	%
Always	40	62.5	53	82.8	42	65.6	28	43.8	50	78.1	52	81.3	45	70.3	42	65.6
Rarely	24	37.5	11	17.2	22	34.4	36	56.3	14	21.9	12	18.8	19	29.7	22	34.4
Never	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0
Total	64	100	64	100	64	100	64	100	64	100	64	100	64	100	64	100

Table 4.18 shows that, all the Science and Mathematics teachers in the schools use various aspects of SMASE. The Science and Mathematics teachers indicated that, most (62.5%) of the teachers gave their students Activity (A), 82.8% of the teachers used Student centered teaching (S), 65.6% of the teachers, gave students Experiments (E),43.8% of the teachers, Improvised locally available resources (I), 78.1% of the teachers Plan (P) their teaching, 81.3% of the teachers guided their learners to Do work (D) ,70.3% of the teachers help learners to See how it is working (S) and 65.6% of the teachers help learners to Improve on their work (I).

The Science and Mathematics teachers also revealed that37.5% of teachers rarely use Activity (A) in teaching, 17.2% of the teachers rarely use student centred teaching (S), 34.4% of the teachers rarely use experiments in teaching (E), 56.3% of the teachers rarely Improvise locally available resources (I), 21.9% of teachers rarely plan their work (P), 18.8% of teachers rarely guide learners to Do the work (D), 29.7% of the teachers rarely help the learners to see how it is working (S),34.4% of teachers rarely help the learners to

Improve their work(I).The study revealed that all teachers at least apply a SMASE practice of ASEI-PDSI.

4.5 Teachers' Attitude and Implementation of SMASE Programme

The second objective of the study sought to establish the influence of teachers' attitude towards implementation of SMASE programme.The responses are as presented in Figure 4.7

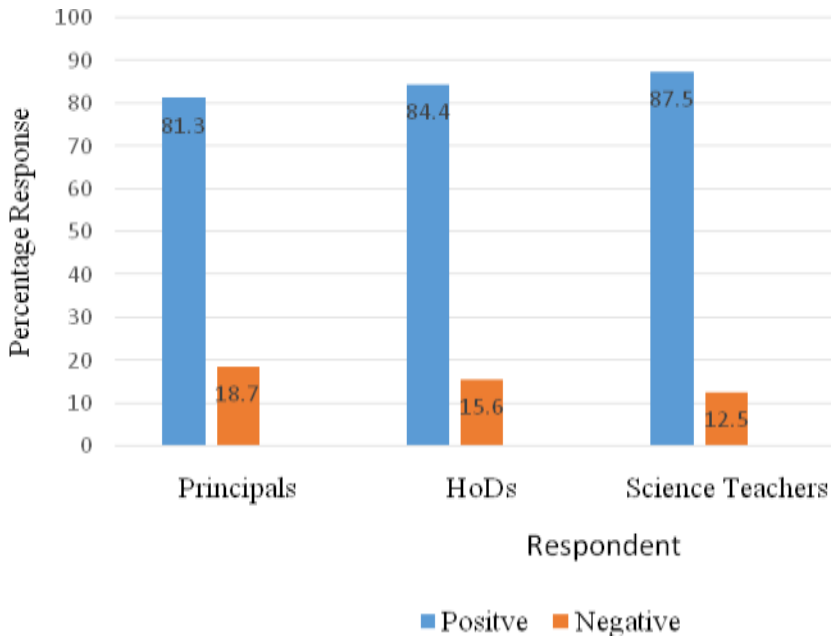

Figure 4.7 Principals', Heads of Department and Science and Mathematics Teachers' Response on Teachers' Attitude Towards Implementation of SMASE Programme.

The findings in Figure 4.7 show that all the respondents indicated that Science and Mathematics teachers have positive attitude towards implementation of SMASE programme. Majority of the Principals 81.3%,saidscience and mathematics teachers had a positive attitude towards the implementation of SMASE program while 18.7% of the

Principals indicated that science and mathematics teachers had a negative attitude towards implementation of SMASE programme. Majority of Heads of Department (84.4%) said the science and mathematics teachers had positive attitude towards implementation of SMASE programme,15.6% indicated that Science and Mathematics teachers had negative attitude towards implementation of SMASE programme. Majority 87.5% of the Science and Mathematics teachers themselves indicated a positive attitude towards implementation of the SMASE program while only a paltry 12.5% of the science and mathematics teachers registered a negative attitude toward implementation of SMASE programme.

4.5.2 How Teachers' Attitude influenced SMASE Implementation

The study sought to establish how teachers' attitude influenced implementation of SMASE Programme in their schools. Findings are explained below;

Majority of the Principals 68.8% said teachers' attitude had positively influenced implementation of SMASE programme since majority of the teachers always used the ASEI-PDSI when teaching science and mathematics subjects,30% of the principals said that teachers' attitude had negatively affected implementation of SMASE programme science they rarely used ASEI-PDSI when teaching science and mathematics while 1.2% of the principals were not sure whether teachers' attitude had positively or negatively influenced implementation of SMASE programme. Majority of Heads of Department 81.2% indicated teachers' attitude had positively influenced SMASE implementation since they apply ASEI-PDSI aspects when teaching science and mathematics subjects, 9.4% of the HoDs said that teachers' attitude had negatively influenced SMASE implementation since they rarely apply ASEI-PDSI aspects when teaching science and mathematics subjects while 9.4% of the HoDs were not sure whether teachers' attitude had negatively or positively influenced implementation of SMASE programme. When asked the same question, Majority, 87.5% of the science and mathematics teachers indicated that their attitude had positively influenced implementation of SMASE

programme since they always used ASEI-PDSI approaches when teaching science and mathematics 4.7% of the science and mathematics teachers said that their attitude had negatively influenced SMASE implementation since they rarely used the ASI-PDSI when teaching science and mathematics while 7.8% of the science and mathematics teachers were not sure whether their attitude toward SMASE programme had affected its implementation.

The principals and science and mathematics teachers were unanimous that the teachers attitude in public schools in Makueni Sub County was positive although the percentage of the principals who agreed that the teachers attitude was positive was lower than those of science and mathematics teachers that is 68.8% against 87.5%.This could be due to the fact that the teachers are the real implementers of ASEI/PDSI while the principals plays a supervisory role.

4.6 Principals' Response on Influence of Teacher Training on the Implementation of SMASE Programme

The third objective of the study was to determine the influence of teacher training in SMASE on the implementation of SMASE programme. The study sought information from the Principals, Heads of Department and Science and Mathematics Teachers as indicated in the Tables below.

4.6.1 Principals' Responses on Number of Mathematics and Science Teachers in their Schools.

The study sought to establish from Principals the number of Mathematics and Science teachers in their schools. Their responses are tabulated in Table 4.19.

Table 4.19 Principals' Response on Number of Mathematics and Science Teachers in their Schools

Number of Teachers	F	%
1 – 2	1	6.3
3 – 4	2	12.5
5 – 6	5	31.2
7 – 8	4	25.0
9 and above	4	25.0
Total	**16**	**100**

The results in Table 4.19 show that most of the schools 31.2% have 5 – 6 Mathematics and Science teachers while those with 7 – 8 teachers and 9 and above teachers tie at 25%. Only 12.5% of the schools have 3 – 4 and 6.3% of the schools have 1 – 2 Mathematics and Science teachers.

4.6.2 Principals' Response on Teachers who have Attended SMASE INSETS

The study sought to establish whether the Mathematics and Science teachers attend SMASE INSETS and how attendance of SMASE INSETS influences implementation of SMASE Programme. The responses were as shown in Figure 4.8.

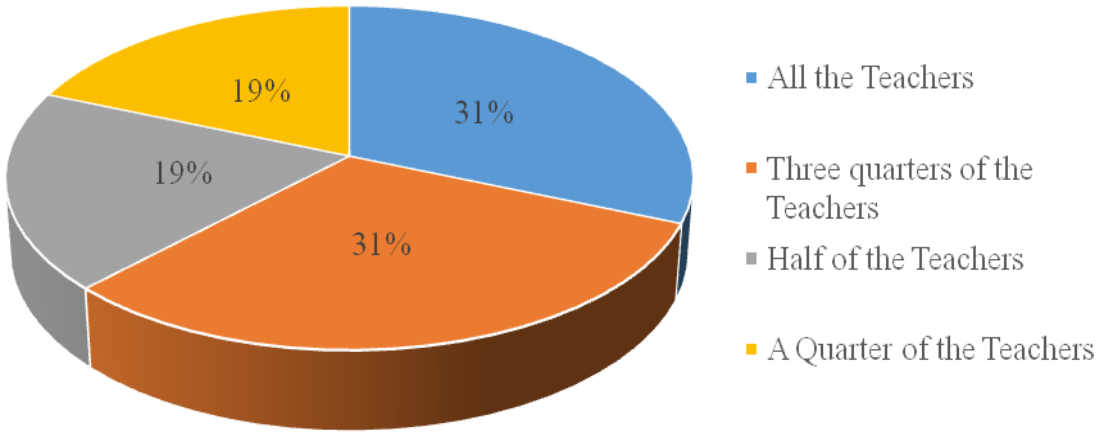

Figure 4.8 Principals' Responses on Teachers who have Attended SMASE INSET

Figure 4.8 shows that, 31% of the Principals indicated that all the Mathematics and Science teachers in their schools have attended SMASE INSETs, 31% of the Principals pointed out that three quarters of their teachers have attended SMASE INSET while the 19% of the Principals indicated that half of their teachers had attended SMASE INSET and 19% of the principals indicated that a quarter of the teachers have attended SMASE INSET.

4.6.3 Principals' Response on Impact of Training in SMASE on Teaching Approach of Mathematics and Science Teachers.

The study sought to establish how the training in SMASE has impacted on the Mathematics and Science teachers teaching approach in terms of ICT integration, Improvisation of teaching materials, peer teaching, SMASE Lesson planning and Lesson studying. The responses are as tabulated in Table 4.20.

Table 4.20 Principals' response on impact of SMASE training on teaching on teaching approaches

Category	Adequately		Inadequately		Not Sure		Total	
	f	%	f	%	f	%	f	%
ICT Integration	4	25.0	10	62.5	2	12.5	16	100
Improvisation t/m.	11	68.8	53	1.2	0	0.0	16	100
Peer teaching	7	43.8	8	50.0	1	6.2	16	100
Lesson Planning	7	43.8	8	50.0	1	6.2	16	100
Lesson Studying	3	18.8	10	62.5	3	18.8	16	100

Table 4.20 shows that,25% of the Principals indicated that ICT integration is adequately practiced in the schools, 62.5% of the principals said ICT integration is inadequately practiced while 12.5% of the Principals were not sure whether ICT integration is adequately or inadequately practiced. Majority of the principal 68.8%indicated that improvisation of teaching materials is adequately practiced,31.2% of the principals indicated that improvisation of teaching materials is inadequately practiced. 43.8%ofthe principals indicate that peer teaching and lesson planning is adequately practiced, 50% of the principals said that peer teaching and lesson planning is inadequately practiced, while 6.2% of the principals were not sure whether peer teaching ad lesson panning were adequately or inadequately practiced. 18.8% of the principals indicated that lesson studying was adequately practiced, a majority 62.5% of the principals indicated that lesson studying was inadequately practiced while 18.8% of the principals said that they were not sure whether lesson studying was adequately or inadequately practiced.

4.6.4Heads of Departments' Responses on Number of Mathematics and Science Teachers in each School's Department.

The study sought to establish from Heads of Department the number of mathematics and science teachers in their departments. Their responses are tabulated in Table 4.21

Table 4.21 Heads of Departments' Response on number of Mathematics and Science Teachers in their Departments

Number of Teachers	f	%
1 – 2	2	6.3
3 – 5	15	46.9
6 – 8	10	31.2
9 and above	5	15.6
Total	**32**	**100**

The results in Table 4.21 show that 6.3% of the HoDs indicated they have 1 – 2 teachers in the school department, 46.9% of the HODs indicated they have 3 – 5 teachers, 31.2% of the HODs indicated that they have 6 – 8 teachers and lastly 15.6% of the HODs said they have 9 teachers and above mathematics and science teachers.

4.6.5 Heads of Departments' Response on Teachers who have Attended SMASE INSET

This study sought to establish whether the Mathematics and Science teachers had attended SMASE INSET and whether attendance of SMASE INSET influences implementation of SMASE Programme. Figure 4.9 shows tabulation of HODs' responses on SMASE INSET attendance

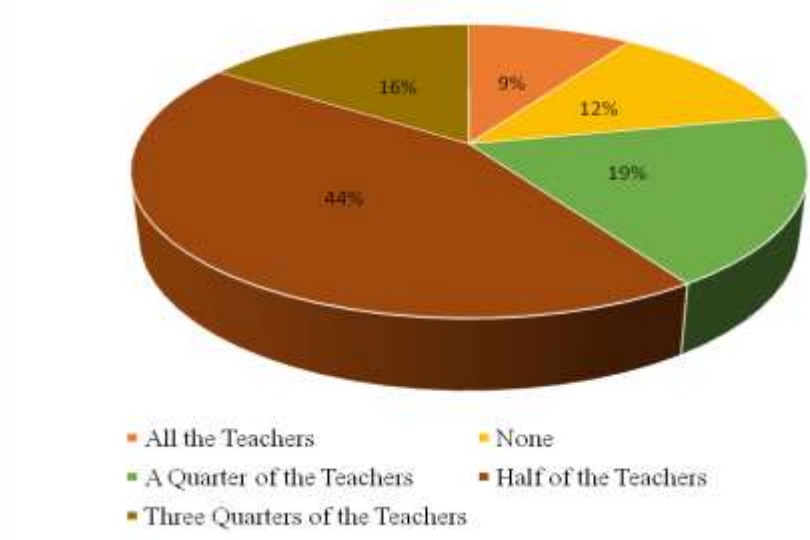

Figure 4.9 Departmental Heads Responses on Teachers who have Attended SMASE INSET (n=32)

Figure 4.9 shows that, 9% of the HoDs indicated that all the Mathematics and Science teachers in the schools had attended SMASE INSET, 16% of the HoDs pointed out that three quarters of the teachers had attended SMASE INSET, while most of the HoDs (44%) indicated that half of their teachers had attended SMASE INSETS and that a quarter of the teachers had attended according to 19% of the HODs. 12% of the HoDs indicated that none of their teachers had ever attended SMASE INSET.

4.6.6 Heads of Departments response on the impact of training in SMASE on teaching approach of mathematics and science teachers

The study sought to establish how the training in SMASE has impacted on the Mathematics and Science teachers teaching approach in terms of ICT integration, Improvisation of teaching materials, peer teaching, SMASE Lesson planning and Lesson studying. The responses were as tabulated in Table 4.22

Table4.22Departmental Heads' Responses on Impact of SMASE Training on teaching approaches

Category	Adequately		Inadequately		Not Sure		Total	
	f	%	f	%	f	%	f	%
ICT Integration	1	3.1	21	65.6	10	31.3	32	100
Improvisation t/m.	9	28.1	20	62.5	3	9.4	32	100
Peer teaching	11	34.4	16	50.0	5	15.6	32	100
Lesson Planning	19	59.4	11	34.4	2	6.2	32	100
Lesson Studying	10	31.3	17	53.1	5	15.6	32	100

The findings of Table 4.22 indicated that, majority 65.6% of the HODs said that ICT integration is inadequately practiced in teaching science and mathematics, 3.1% of the HoDs said that ICT is adequately integrated in teaching mathematics and science, while 31.3% of the HODs are not sure whether ICT is adequately or inadequately integrated in teaching mathematics and science.

Majority 62.5% of the HODs indicated that teachers improvised teaching materials, 28.1% of HODs said that teachers adequately improvised teaching materials while 9.4% of HODs were not sure whether teachers adequately or inadequately improvised teaching materials. Of the HODs who participated in the study, majority 50% said that peer teaching is inadequately practice, 34.4% of the HODs said that it is adequately practiced while 15.6% were not sure whether teachers adequately or inadequately practiced peer teaching. 59.4% of the HODs indicated that lesson planning is adequately practiced in teaching science and mathematics,34.4% of the HODs said lesson planning is inadequately practiced while 6.2% of the HODs were not sure whether lesson planning is adequately or inadequately practiced in teaching mathematics and science. 53.1% of the HODs indicated that lesson studying was inadequately practiced,31.3% of HODs said that lesson studying is adequately practiced while 15.6% of the HODs were not sure whether lesson studying was adequately or inadequately practiced by teachers in teaching science and mathematics in schools

4.6.7 Mathematics and Science Teachers Response on Attendance of SMASE INSETS (n=64)

The study sought to establish whether the Mathematics and Science teachers had attended SMASE INSETS and how attendance of SMASE INSETS influences implementation of SMASE programme. The results were tabulated in Figure 4.10.

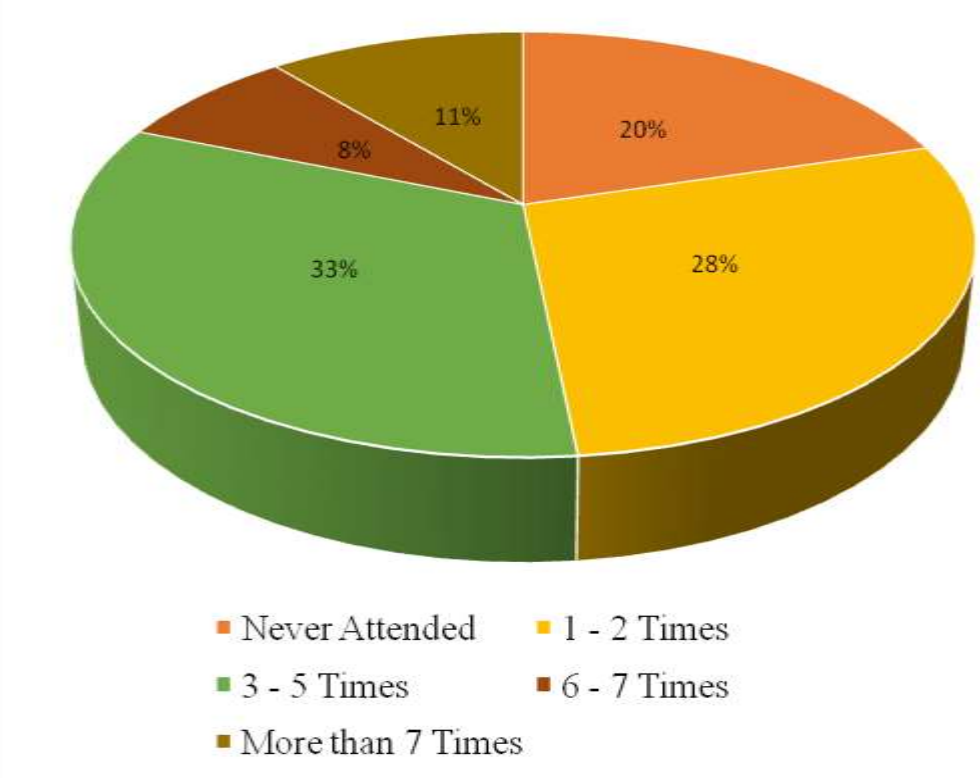

Figure 4.10 Mathematics and Science Teachers' Responses on Attendance of SMASE INSET (n=64)

Figure 4.10 shows that, 20% of the Mathematics and Science teachers indicated that they had never attended SMASE INSET, 28% of the teachers indicated that they had attended SMASE INSET 1 – 2 times, while most of the teachers 33% said they had attended 3 – 5 times, 8% of the teachers indicated that they had attended 6 – 7 times and 11% of the teachers indicated that they had attended more than 7 times.

4.6.8Mathematics and Science Teachers' Response on the Impact of Training in SMASE on Teaching Approach

The study sought to establish how the training in SMASE has impacted on the Mathematics and Science teachers teaching approach in terms of ICT integration, Improvisation of teaching materials, peer teaching, SMASE Lesson planning and Lesson studying. The responses are as tabulated in Table 4.23

Table 4.23 Mathematics and Science Teachers' Responses on Impact of SMASE Training on Teaching Approaches

Category	Adequately		Inadequately		Not Sure		Total	
	f	%	f	%	f	%	f	%
ICT Integration	31	48.4	24	37.5	9	14.1	64	100
Improvisation t/m.	40	62.5	23	35.9	1	1.6	64	100
Peer teaching	32	50.0	29	45.3	3	4.7	64	100
Lesson Planning	29	45.3	31	48.4	4	6.3	64	100
Lesson Studying	29	45.3	30	46.9	5	7.8	64	100

The findings of Table 4.23 shows that, 48.4% of the teachers indicated that ICT integration is adequately practiced in the schools, 37.5% of the teachers said ICT integration is inadequately practiced, while 14.1% of the teachers were not sure whether ICT integration is adequately or inadequately practiced. Majority of the teachers 62.5% indicated that improvisation of teaching materials is adequately done,35.9% of the teachers indicated that improvisation of teaching materials is inadequately done while 1.6% of the teachers were not sure whether improvisation of teaching materials was adequately or inadequately done. 50% of the teachers indicated that peer teaching is adequately practiced 45.3% of the teachers said that peer teaching is inadequately practiced, while 4.7% of the teachers were not sure whether peer teaching was adequately or inadequately practiced. 48.4% of the teachers indicated that lesson planning was inadequately practiced, 45.3% of the teachers said lesson planning is adequately practiced while 6.35 of the teachers were not sure whether lesson planning was adequately or inadequately practiced in schools. Majority 46.9% of the teachers indicated that lesson studying was inadequately practiced, 45.3% of the teachers indicated that lesson studying

was adequately practiced while 7.8% of the teachers said that they were not sure whether lesson studying was adequately or inadequately practiced.

4.7 Influence of Principals' Training in SMASE on Implementation of the SMASE Programme(n=16)

The study sought to establish how Principals' training in SMASE influences the implementation of the SMASE programme. Their responses are shown in Figure 4.11

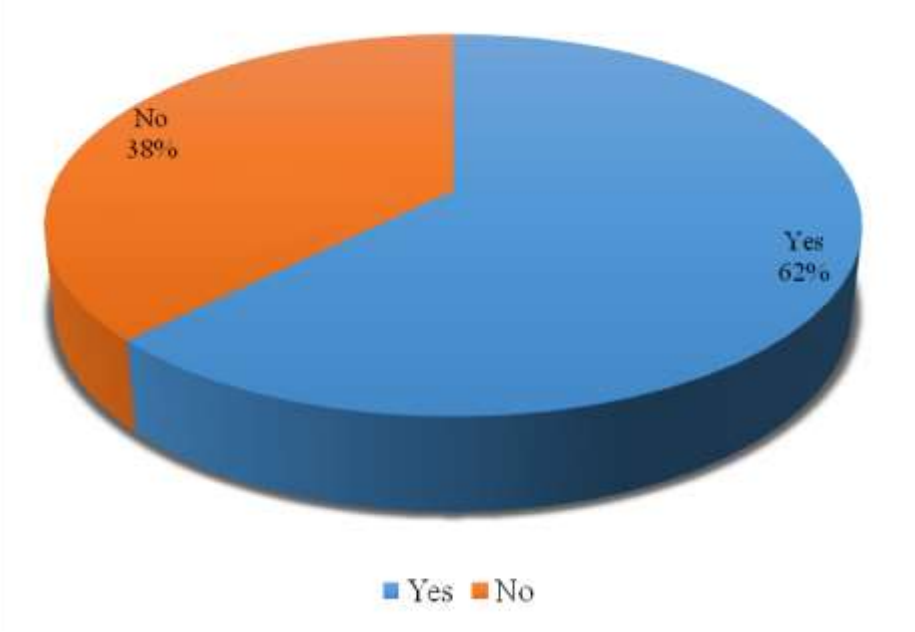

Figure 4.11Response of Principals on Attendance of SMASE Training

The results on Figure 4.11 show that 62% of the Principals indicated that they had attended SMASE training while 38% of the Principals indicated that they had never attended any SMASE Programme.

This study sought to establish the frequency at which Principals attended SMASE training. Their responses are presented in Table 4.24 shows the Principals' responses to the items.

Table 4.24 Principals Responses on Frequency of Attendance of SMASE Programmes

Number of Times per year	**f**	**%**
Once	6	37.5
Twice	3	18.8
Thrice	1	6.3
More than Thrice	2	12.5
Not Applicable	4	25.0
Total	**16**	**100**

Table 4.24 shows that, most of the Principals 37.5% had attended SMASE once, those who had attended twice and thrice 18.8% and 6.3% respectively. Principals who had attended more than thrice were 12.5%. Those who indicated not applicable were 25% representing that group which indicated no attendance in Part 1

The Principals were asked whether attendance of SMASE had helped in implementation of ASEI-PDSI. The responses were as indicated in Figure 4.12

Figure 4.12 Usefulness of SMASE Attendance for Principals in Implementation of ASEI-PDSI (n=16)

The results in Figure 4.12 show that, most Principals 69% indicated that attending SMASE Programme had helped in implementation of ASEI-PDSI while 31% of the Principals said that they would have implemented ASEI-PDSI even without having to attend SMASE INSETS.

The study also sought to establish from the principals how attendance of SMASE programmes had helped them in implementation of ASEI-PDSI. The results of their responses were presented in Table 4.25

Table 4.25 Principals' response on how attendance of SMASE had helped in the Implementation of ASEI-PDSI

Category	**f**	**%**
Has helped	2	12.5
Has helped to a greater extend	8	50.0
Not sure	1	6.3
Not applicable	5	31.2
Total	**16**	**100**

The results in Table 4.25 revealed that majority 62.5% of the Principals indicated that attending SMASE had helped in implementing ASEI-PDSI. Only 6.3% of the Principals who indicated that they were not sure whether it helps while 31.2% of the Principals indicated not applicable since they had not attended.

4.7.1 Heads of Departments' Response on Influence of Principals' Training in SMASE and Implementation of ASEI-PDSI

The study sought to establish from the HODs how Principals' training in SMASE influences the implementation of the SMASE programme. Their responses are shown in Figure 4.13

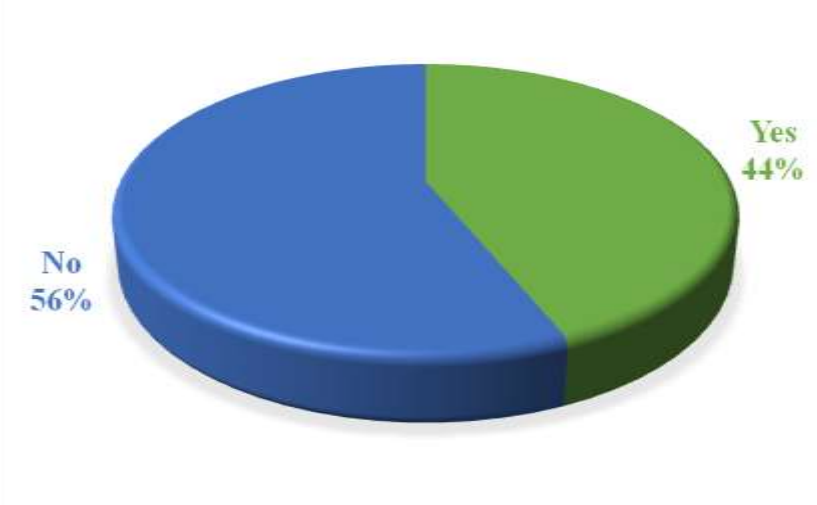

Figure 4.13 Response of Heads of Department on attendance of SMASE training by Principals (n=32)

The results on Figure 4.13 show that 44% of the Heads of Department indicated that their Principals attend SMASE training while 56% of HODs indicated that their principals had not attended SMASE training Programme.

This study further sought to establish from heads of departments the frequency at which Principals attended SMASSE trainings. The responses from HoDs are as shown in Table 4.26.

Table 4.26 Heads of Departments responses on frequency of attendance of SMASE training by the principal

Number of Times per year	**f**	**%**
Not Applicable	16	50.0
Always	5	15.6
Rarely	11	34.4
Total	**32**	**100**

Table 4.26 shows that, majority of the Heads of Department 50% indicated that the Principals never attend SMASE training,34.4% of the HODs indicated that their principals attend SMASE training but rarely while 15.6% of Heads of Department indicated that their principals always attended SMASE training.

The study sought to establish from heads of departments whether attendance of SMASE by Principals helped in implementation of ASEI-PDSI. The responses are as presented in Figure 4.14.

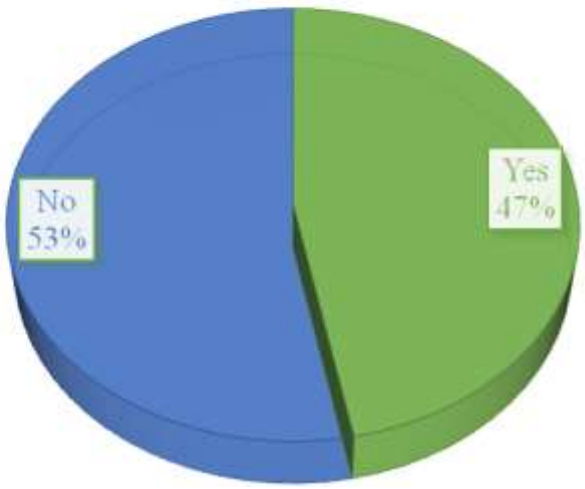

Figure 4.14 Heads of Departments Responses on Usefulness of SMASE Training for Principals on Implementation of ASEI-PDSI (n=32)

The results in Figure 4.14 show that, most Heads of Department 53% indicated that Principals' attendance of SMASE training had not helped in implementation of ASEI-PDSI but 47% of HODs indicated that attending SMASE training by their principals has helped in implementation of ASEI-PDSI. This is a good number bearing in mind that there are principals who had not attended SMASE training while others attend rarely.

The study also sought to establish from HODs how attendance of SMASE training by principals has helped the implementation of ASEI-PDSI by the principals. Their responses are presented in Table 4.27

Table 4.27 Heads of Departments' Responses on how Training in SMASE has helped Principals in Implementation of ASEI-PDSI

Category	**f**	**%**
No influence	2	6.3
Positive influence	15	46.9
Neutral	10	31.3
No comment	5	15.5
Total	**32**	**100**

The results in Table 4.27 revealed that majority 46.9% of the Departmental Heads indicated that training of Principals has positively influenced implementation of ASEI-PDSI, 6.3% of the HODs indicated that principals attendance of SMASE training had no influence on the implementation of ASEI-PDSI while 46.8% of the HoDs were not sure whether attending SMASE training by principals had any influence on the implementation of ASEI-PDSI.

4.7.2 Science Teachers' response on influence of Principals' Training in SMASE and Implementation of ASEI-PDSI

The study sought to establish from science and mathematics teachers how Principals' training in SMASE influenced the implementation of ASEI-PDSI. Their responses are shown in Figure 4.15

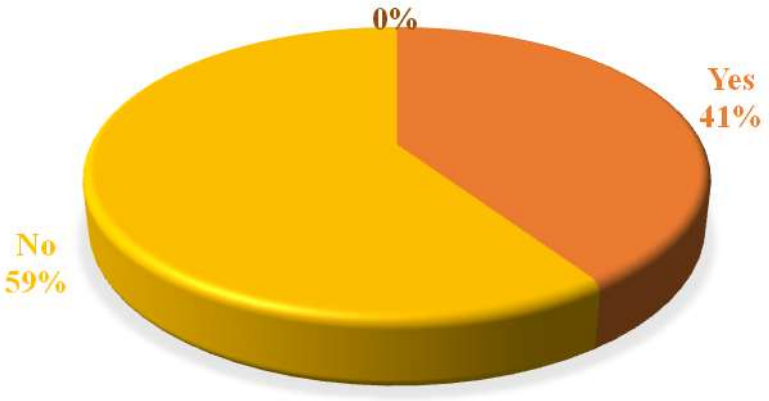

Figure 4.15Response of Science and Mathematics Teachers on Attendance of SMASE Training by Principals

The results on Figure 4.15 show that 41% of the Science and Mathematics teachers indicated that their Principals attend SMASE training while 59% of the Principals do not attend SMASE training programme.

The study sought to establish the frequency at which principals attended SMASE training. The Science and Mathematics teachers provided their responses which are tabulated in Table 4.28.

Table 4.28 Science and Mathematics Teachers' Responses on Frequency of Attendance of SMASE Training by the Principals

Number of Times per year	**f**	**%**
Not Applicable	40	62.5
Always	11	17.2
Rarely	13	20.3
Total	**64**	**100**

Table 4.28 shows that, most of the Science and Mathematics teachers 62.5% indicated not applicable for frequency of attending SMASE for principals. Few science and Mathematics teachers 17.2% indicated that their Principals always attend SMASE training. The rest 20.3% of Science and Mathematics teachers indicated that the Principals rarely attended SMASE training.

The study sought to establish from science and mathematics teachers whether attendance of SMASE training by principals has helped Principals in implementation of ASEI-PDSI. Their responses are presented in Figure 4.16

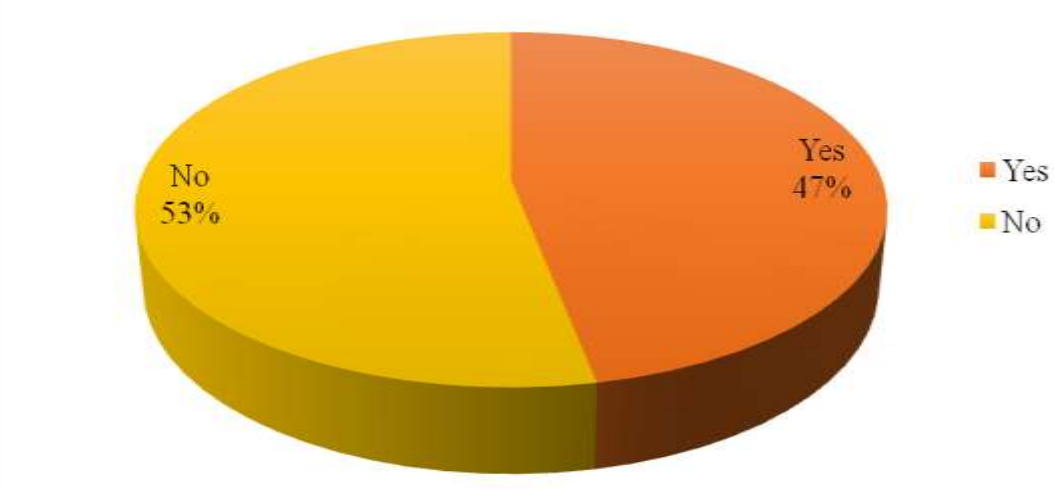

Figure 4.16 Science Teachers Responses on Usefulness of SMASE Training for Principals' ASEI - PDSI Implementation

The results in Figure 4.16 show that, majority of Science and Mathematics teachers53% indicated that Principals' attendance of SMASE training had not helped in implementation of ASEI-PDSI while 47% of the science and mathematics teachers indicated attending SMASE training by principals had helped them in implementation of SMASE programme.

The study also sought to establish from science and mathematics teachers how attendance of SMASE training has helped in implementation of ASEI-PDSI by the Principals. The results of their responses are presented in Table 4.29

Table 4.29 Science Teachers' Responses on how Training in SMASE has helped Principal in Implementation of ASEI-PDSI

Category	**f**	**%**
Not Applicable	30	46.9
Positive on implementation	28	43.8
Not Sure	6	9.3
Total	**64**	**100**

The results in Table 4.29 revealed that majority of Science and Mathematics teachers46.9% said that training of Principals has no influence on implementation of ASEI-PDSI hence not applicable while 43.8% of science and mathematics teachers said that there was positive influence in training of the Principals in implementation of ASEI-PDSI while 9.3% of the science and mathematics teachers were not sure whether training in SMASE for Principals had any influence on implementation of ASEI – PDSI.

CHAPTER FIVE

DISCUSSION AND INTERPRETATION OF RESEARCH FINDINGS

5.1 Introduction

This chapter consists of discussion and interpretation of research findings in line with the study objectives. The general objective of this study was to investigate the school based factors influencing implementation of SMASE Programme in Public Secondary Schools in Makueni Sub County, Makueni County, Kenya. To achieve this general objective, data was collected which sought to establish the influence of availability of teaching resources on implementation of SMASE programme in public secondary schools, the influence of teachers' attitude towards implementation of SMASE programme in public secondary schools, the influence of teacher training in SMASE on implementation of SMASE programme in public secondary schools and to determine the influence of Principals' training in SMASE on implementation of SMASE programme in public secondary schools in Makueni Sub County, Makueni County.

5.2 Teaching Resources and Implementation of SMASE

Results of study objective one indicated that 56.3% of the Principals and 75% of Heads of Department said that science laboratories were inadequate in public secondary school. However, 45.3% of science and mathematics teachers which was less that 50% said that science laboratories were inadequate in public secondary schools. Although 56.3% of the principals and 54.7% of science and mathematics teachers said that computer laboratories were inadequate, only 46.9 % of the HoDS said that computer laboratories were inadequate. This could be a contributor to the poor implementation of SMASE programme as reflected in the poor performance in Science and Mathematics given computer laboratories play an integral part of ICT integration in instruction

56.3% of the principals indicated that Science apparatus were adequate, 50 % of the science and mathematics teachers indicated that science apparatus were adequate,

however majority of the science and mathematics HODs 62.5% indicated that Science apparatus were inadequate. HODs play a multi-disciplinary supervisory role and therefore their indication that science apparatus are inadequate could be taken to have more weight, hence poor implementation of SMASE programme which is activity based.

Results of the study indicated from 50% of the principals, 59.4 % of HoDs and 64% science and mathematics teachers that laboratory reagents were adequate. This could explain why majority of the Science and Mathematics teachers were able to use the various aspects advocated by the SMASE programme. Science and Mathematics models were inadequate as indicated 68.8% of the principals and 56.3% of the HoDs. However, only 45.3 % of the science and mathematics teachers said that science and mathematics models were inadequate. This variation is attributed to the fact that the science and mathematics models may be adequate in some disciplines and inadequate in other subjects.

Real objects were inadequate as indicated by 56.3% of the Principals, 59.4% of the HODs and 48.5% of the science and mathematics teachers. This could have contributed to poor implementation of SMASE programme.

A study by Kearney and Carol(2000), on the use of apparatus in Australian schools concurs with the current study that each teacher requires a range of tools to draw upon in order to assist and support student learning. In this case of Makueni Sub County, this range of tools is inadequate as the results obtained have shown that science laboratories are inadequate since56.3% of the Principals, 75% of the Heads of Departments and 45.3% of the Science and Mathematics teachers pointed out in adequacy of science laboratories. Implementation of SMASE and ASEI-PDSI calls for science laboratories to be adequate for learner centered teaching. Inadequacy negatively influences the implementation. In the teaching of science and mathematics teaching resources include, models, science apparatus, chemicals and realia, (Kearney & Carol, 2000). Despite this, the results indicate that the science models and real objects were inadequate.

This study agrees with findings of a Study conducted in Australia by the Australian School Library Association, Australian Library and Information Association (2001) on the use of teaching resources in pedagogy which shows that the purpose of teaching resources is to provide a basis for learning experiences for students. Learning resources include not only textbooks, workbooks, and audio-visual teaching aids produced by the Education Department (ED) or other organizations but also web-based learning materials, IT software, the Internet, the media, resources in the natural environment, people and libraries. In this study area of Makueni Sub County, even the computer laboratories which could be utilized for IT software and internet for teaching and learning were inadequate as indicated by 56.3% of the Principals, 46.9% of the HoDs and 54.7% of the Science and Mathematics teachers. Since most learning resources are inadequate, it poses a challenge in implementation of SMASE programme in Public secondary schools and this could explain why public secondary schools in Makueni Sub County perform poorly in Science and Mathematics Department despite introduction of intervention initiatives such as the SMASE programme.

This study further agrees with the study of Orodho and Mutungwa (2013) on Resource Management Strategies and Learners Academic Performance in National Examinations in Public Secondary Schools in Makindu District, Makueni County, Kenya. The study found that, there was a positive and significant correlation between the effectiveness of resource management strategies and learners' academic performance in national examination. Some resources were however discovered to be adequate in public secondary schools of Makueni Sub County. This included teaching apparatus and laboratory reagents as indicated by the respondents; 50% of the Principals, 59.4% of the HoDs and 64% of the science and mathematics teachers. To a greater extend, this level of adequacy would positively influence implementation of SMASE in Makueni Sub County and positively influence performance in science and mathematics.

5.3 Attitude of Teachers and the Implementation of SMASE

The second objective sought to establish teachers' attitude on SMASE implementation. The results showed that 81.3% of the Principals, 81.3% of the Heads of Department and 87.5% of the science and mathematics teachers had positive attitude towards SMASE implementation. This means that SMASE programme has been embraced by science and mathematics teachers in Makueni Sub County. This could be interpreted to mean that the low performance is from other factors other than teachers' attitude towards implementation of SMASE programme. A study done by Nedelsky (2005) on graduate students in education for setting standards for examinations noted that, attitudes determine what each individual will see, hear, think and do. This concurs with research findings by Ballone and Czernik (2001) on an evaluation of ASEI-PDSI teaching approach in elementary schools which indicated that perception towards a certain behaviour is a strong determinant of teachers intention to engage in that specified behaviour. Since the teachers' attitude is positive, this means that the INSETs had been successful in imparting teachers' attitude.

According to a study done by Ngetuny, (2013), in Kenya on the effectiveness of SMASE in Bomet sub County, if a teacher has a negative attitude towards the use of ASEI/PDSI approaches, this would be evidenced by their tendency to move away from it, that is, avoid using the approaches. If on the other hand, a teacher had a positive attitude towards the use of ASEI/PDSI, this would be made evident by their tendency to use them when one has a choice to do so. It can be ascertained that teachers who have a negative attitude towards the use of ASEI/PDSI, it is predicted how they (teachers) are likely to behave if they are provided with the apparatus and chemicals to be used in classroom teaching. Since this study has revealed a positive attitude towards the SMASE programme implementation, the programme could be successfully implemented. On the influence of teachers' attitude on implementation of SMASE, 68.8% of the Principals, 81.2% of Heads of Departments and 87.5% of the teachers indicated positive influence. This could have been as a result of their teaching which involved the use of the SMASE values of ASEI-PDSI hence moving towards teaching the SMASE way leading to improved

performance in Science and Mathematics. Teachers' attitude has thus positively influenced implementation of SMASE programme.

5.4 Teacher Training in SMASE and the Implementation of SMASE Programme

Results from the third objective revealed that most teachers had been trained in SMASE and the training positively influences successful implementation of SMASE programme in the schools. The Principals indicated that, 31% of all teachers have attended SMASE training, ¾ of teachers have attended representing 31% of the schools and only 20% who have not attended SMASE according to the teachers. Since most of the teachers have attended SMASE training regularly, this has positively influenced implementation of SMASE tenets in the teaching of science and mathematics. 48.4% of the teaching use ICT integration while teaching, improvisation of teaching materials is done by 62.5% of the teachers, 75% of the teachers give students experiments, peer teaching is done by 50% of the teachers while lesson planning and lesson studying tie at 45.3%.

These findings are in line with studies done on teacher training and teaching methods in other countries. For instance a study by Jackson and Davis (2000), on educating adolescents in New York, which reported that teacher training, improved teaching skills and knowledge thus enhancing their content delivery. Another study by Gamoran (2006), in the University of Wisconsin, indicated that teacher training enhanced student learning through its effects on teaching practices like content delivery. In this respect, teacher training in SMASE has enabled the teachers in Makueni Sub County to be able to utilize the teaching resources available well and improvise what is lacking. The application of lesson study has led to pedagogical growth and use of learner centered methods.

A review of SMASE programme conducted in Burkina Faso (2011) concluded that, Improvement in teachers' pedagogical practices was observed using learner-centered approach in science and mathematics lessons at the secondary school level, through the results of monitoring and evaluation conducted by the Project. More than 97% of the pedagogical advisors and inspectors were trained by the Project, which contributed substantially to the realization of the national training sessions by Ministry of Basic

Education and Literacy. The Project developed all the lessons plans for science and mathematics of 6 grades in primary school level and it is in the process of the preparation for distributing the lesson plans to all the public schools. This contributed to further improvement in teachers' practice of ASEI-PDSI approach in class. The project has implemented planned activities, contributing to improvement in teachers' pedagogical practices in public secondary schools, and is expected to achieve the Project Purpose which is Teachers Training Improvement in Science and Mathematics at the secondary Level. Similarly, SMASE training aims at improving Technological, Pedagogical, Content, Knowledge (TPACK) of the teachers hence the teachers willingly attend SMASE due to the benefits of professional development attributed to the SMASE training. This agrees with the findings of the current study which shows that the influence of SMASE training on teaching approach is positive since all the SMASE teaching approach aspects selected were being practiced by science and mathematics teachers in every school.

5.5 Principals' Training in SMASE and Implementation of SMASE Programme

The findings on the fourth objective revealed that Principals' training in SMASE programme could positively influence successful implementation of the SMASE programme in Public secondary schools in Makueni sub county. The responses showed that majority of the Principals 62% indicated that they had attended SMASE training, 69% of the Principals indicated that attending SMASE training has helped them in implementation of SMASE programme in their schools. 50% of the Principals indicated that training in SMASE has helped them to a greater extend since they provide chemicals, apparatus and any teaching – learning materials required by the teachers in teaching and learning for supporting experiment by students. Principals also acknowledge the efforts of the teacher in applying SMASE skills in the teaching process.

The HoDs concurred with the Principals and the Science and mathematics teachers that attendance of SMASE training by Principals positively influences implementation of SMASE programme. The attendance in SMASE for Principals can be attributed to the

initiative of the Centre for Mathematics, Science and Technology Education in Africa (CEMASTEA) that organizes and conducts sensitization workshops for various stakeholders with a view to build their capability to support the implementation of training activities with the objective of sensitizing stakeholders on CEMASTEA's Strengthening of Mathematics and Science Education (SMASE) activities. Principals of secondary schools are among key stakeholders sensitized through such workshops (CEMASTEA, 2013). This is because Principals play a critical role in the supervision of classroom practices on implementation of learner-centred lessons and provide pedagogical leadership in the school.

According to Ngetuny (2013), in a study in Bomet Sub County, Principals of secondary schools play a key role in the supervision and providing pedagogical leadership for quality curriculum implementation at the school level. CEMASTEA's TNA 2015 report indicated that 19% of serving Principals were newly appointed hence required capacity development in pedagogical leadership. Principals of schools play key role in the success of SMASE for they are the Chief Executive Officers in their schools. Their decisions in the prioritization of initiatives in schools, for instance, purchase of basic apparatus, equipment and chemicals to be used in the teaching of mathematics and science, significantly affect results in these subjects and hence the success of SMASE (Ngetuny, 2013). These studies carried out by Maccini and Gagnon(2000), in the United States and by Ngetuny (2013), in Bomet Sub County, Kenya emphasized on the need for Principals' training but did not establish the influence of Principals' training on SMASE and the effective implementation of the programme. Hence the data collected showed 62% of the Principals had attended SMASE training possibly due to the CEMASTEA initiative after carrying out Training Needs Assessment (TNA) for principals. Of the Principals who attended, 69% of the principals indicated the training was helpful in implementation of SMASE programme by sensitizing them on stocking schools with reagents, science apparatus, models and real objects. It is safe to say that there is a positive influence between training Principals in SMASE and its successful implementation.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter discusses the summary of the findings, conclusions, and recommendations from the study and suggestions for further research.

6.2 Summary of Findings

From the first objective of the study which sought to establish the influence of availability of teaching resources on implementation of SMASE programme in public secondary schools, the study established that most Principals 56.3% 75% of the Heads of Department and 45.3% of science and mathematics teachers indicated that science laboratories were inadequate meaning unavailable in public secondary schools in Makueni Sub County which negatively influenced implementation of SMASE programme. Only a few Principals 37.5%, 21.9% of Heads of Departments and 42.2% of Science and mathematics teachers had indicated that science laboratories were adequate hence available. Similarly, most respondents indicated that computer laboratories were inadequate. Teaching apparatus and Laboratory reagents were adequate while science and mathematics models and real objects were on the list of inadequacy. This came out clearly that, the schools that had adequate teaching resources also had higher percentage of teachers practicing ASEI – PDSI and enthusiastically attending SMASE training.

The second objective of this study was to establish the influence of teachers' attitude towards implementation of SMASE programme. The study established that there was a strong positive influence between teachers' attitude and implementation of the SMASE programme in their schools as displayed by Figure 4.8 which shows that 81.3% of the Principals, 81.3% of the Heads of Department and 87.5% of the science and mathematics teachers affirmed positive attitude towards SMASE implementation by the teachers is an impetus to the implementation process. The implication is that SMASE programme

implementation is likely to raise performance of students and shift teaching style from teacher centered to student centered when embraced by science and mathematics teachers in Makueni Sub County consequently resulting in positive attitude of the fresh teachers being employed to attend SMASE training hence institutionalization of SMASE.

The third objective of the study sought to determine the influence of teacher training in SMASE on implementation of SMASE programme. The study established that there was a strong positive influence of teacher training in SMASE on the implementation of the SMASE programme in the schools of study. The Principals provided data in figure 4.10 that, of the 31% of all science and mathematics teachers who had attended SMASE training, ¾ of teachers had attended representing 31% of the schools and only 20%of science and mathematics teachers who have not attended SMASE according to the teachers possibly because they were newly employed as indicated in table 4.7 that 26.1% of the teachers are aged between 25 – 30 years hence are likely to be newly employed and table 4.8 on teachers' duration of service that 32.8% of the teachers had served for two years and below in the station and hence no training held within that period. Since most of the teachers have attended SMASE training regularly, this has positively influenced implementation because Table 4.22 on use of SMASE methods indicate that, most are adequately done.48.4% of the teachers use ICT integration while teaching, improvisation of teaching materials is done by 62.5% of the teachers, 75% of the teachers give students experiments, peer teaching is done by 50% of the teachers while lesson planning and lesson studying tie at 45.3%. This shows that teacher training in SMASE effectively enhances implementation of SMASE programme.

The fourth objective of the study was to determine the influence of Principals' training in SMASE on implementation of SMASE programme. The findings revealed that Principals' attendance of SMASE training positively influenced implementation of SMASE programme. The responses showed that majority of the Principals 62% indicated that they had attended SMASE training and even a good number 12.5% of the principals had attended the training more than three times. Most Principals 69% also indicated that

attending SMASE training had helped them in implementation of SMASE programme in their schools. 50% of the Principals indicated that training in SMASE had helped them to a greater extend since they provide chemicals, apparatus and any teaching – learning materials required by the teachers in teaching and learning for supporting experiment by students. Principals also acknowledge the efforts of the teacher in applying SMASE skills in the teaching process.

6.3 Conclusions

The study found out that, availability of teaching resources positively influence implementation of SMASE programme because the teachers will have all they need to apply ASEI-PDSI in teaching and learning process hence in Makueni Sub County, the Principals have purchased teaching materials though in most schools, the materials are available but inadequate. The study therefore concludes that inadequacy of teaching material, science and ICT laboratories in most schools limits application of ASEI-PDSI leading to poor performance in mathematics and sciences.

The study also found out that teachers' attitude towards SMASE influences the implementation process. The study found out that, science and mathematics teachers in Makueni Sub County have positive attitude towards SMASE which positively influences implementation of SMASE. The study therefore concludes that the positive attitudes of the teachers is useful in making sure that SMASE is implemented effectively.

On teacher training in SMASE, the study found out that when teachers are trained they get the urge to practice what they have learned and consequently institutionalize SMASE. The study found out that most teachers in Makueni Sub County have undergone SMASE training and the few that have not been trained in SMASE are willing to undergo the training when the opportunity arises. Therefore the study concludes the teachers are willing to be trained and implement SMASE.

Finally the study found out that not all principals attend SMASE training. However most Principals in Makueni Sub County have undergone training in SMASE and they indicated

that it was helpful in implementation of SMASE. The study concludes that all principals should attend SMASE training regardless of their teaching subjects because this will enable them in creating an enabling environment for the implementation of SMASE teaching approaches. Principals who attended SMASE training found it useful and hence could implement SMASE well in their schools.

6.4 Recommendations

From the study findings and conclusions, the study makes the following recommendations as per study objectives;

On the first objective about availability of teaching resources and implementation of SMASE programme the study recommends that;

i) The government should construct adequate science laboratories in all public secondary schools in line with student population to enhance teaching of science subjects like Biology, Chemistry and Physics.

ii) The government and the Boards of Management should construct and equip computer laboratories to be used in the teaching of Science subjects and Mathematics.

iii) The Principals and boards of management should ensure that laboratories are equipped with chemicals, reagents,realia and apparatus to enhance teaching of science subjects such as Biology, Chemistry and Physics.

Concerning the second objective on teachers' attitude and implementation of SMASE programme, the study recommends that;

i) Since the teachers' attitude towards implementation of SMASE programme is positive, the Principals should continuously support teachers to embrace what SMASE advocates for.

ii) The subject teacher can be authorized within some limits to acquire the right materials for teaching and a refund assured so as to feel motivated and avoid scarcity of some rare resources.

From the third objective on teacher training in implementation of SMASE program, the study recommends that;

i) The TSC should consider providing incentives such as salary increments and promotion to higher grades to teachers who have attended SMASE INSETS as a way of motivating them. This will go a long way in encouraging all Science and Mathematics teachers to attend the INSETS now that the study revealed that some teachers are yet to attend the SMASE trainings.

ii) The Principals should ensure that all Science and Mathematics teachers in their respective schools attend SMASE INSETS as part of their curriculum supervision role.

On the fourth and last objective on Principals' training in SMASE on implementation of SMASE programme, the study recommends that;

i) All Principals should attend training because CEMASTEA offers training specifically tailored for Principals regardless of their teaching subjects to equip them with skills and capacity build them for management and implementation of SMASE. This can be made mandatory for all Principals since some Principals indicated they failed to attend SMASE training since they teach non Science and Mathematics subjects.

ii) The TSC should recognize SMASE INSET certificates as an added advantage to Principals attending interviews on promotion.

iii) The MOE and the county education office should encourage all principals to attend SMASE

6.5 Suggestions for Further Research

The study makes the following suggestions for further research;

i) Research needs to be done by MOE policy formulators to establish why only the science and mathematics teachers are constantly trained on SMASE in-service training and the improvement in the same subjects is dismal while some other subjects arts and humanities perform better without constant training on the teachers.

ii) There is need for research on other factors that influence implementation of SMASE in secondary schools which were not part of this study.

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APPENDICES

APPENDIX I

LETTER OF INTRODUCTION

Janet M Kavisi
South Eastern Kenya University
PO BOX 170-90200
Kitui-Kenya.

Dear Sir/Madam,

RE: PERMISSION TO COLLECT RESEARCH DATA

I am a MASTER of Education Degree finalist at the South Eastern Kenya University specializing in Educational Administration. I am currently undertaking research as a requirement for the award of the Degree. The research is on '**School Based Factors Influencing Implementation of SMASE Programme in Public Secondary Schools in Makueni Sub County'.** Your school has been sampled to participate in the study. I wish to therefore seek your participation in the study, your HODs for Mathematics and Sciences and the Mathematics and Science teachers. The data collected will be used for the current study only and will be held in confidence. Thank you for your cooperation.

Yours Faithfully,

Janet Mutiwa Kavisi
E55/WTE/20614/2015

APPENDIX II

PRINCIPALS' QUESTIONNAIRE

This questionnaire is intended to collect data on school based factors influencing implementation of SMASE programme in public secondary schools in Makueni Sub County. Kindly read the questions below carefully and give the responses by either ticking (√) where appropriate or by giving information in the spaces provided. This study is purely for academic purposes and all information given shall be treated with utmost confidentiality.

Section A: Personal Information

1. Gender: (Tick as appropriate) Male ( ) Female ( )
2. Age in years(Tick as Appropriate)

   25-30 ( ) 31-40 ( ) 41-50 ( ) 51-60 ( )

3. State your highest professional qualification: (Tick as appropriate)

Ph.D ( ) M.Ed/MA ( ) Graduate (B/ED) ( ) BSC with PGDE ( ) Diploma( )

4. How many years have you been a Principal in this school?_____

Section B: Implementation of SMASE Programme

a) Availability of Teaching and Learning Resources.

5. The following resources are used in implementation of SMASE programme, state the level of adequacy of the resources in your school by ticking in the appropriate box..

6

Resource	**Adequate**	**Inadequate**	**Neutral**
Science Laboratories			
Computer laboratory			
Science Apparatus			
Reagents			
Models			
Real Objects			

7. SMASE programme advocates for ASEI-PDSI (Activity, Student Centred Experiment and Improvisation- Plan Do See and Improve).

    i) To what extent do teachers in your school use the following student centred activities in the teaching of Science and Mathematics?

Approach	**Always**	**Rarely**	**Never**
Activity			
Student Centred			
Experiment			
Improvisation			
Plan			
Do			
See			
Improve			

b) Teachers' attitude towards implementation of the SMASE programme

8. What is the attitude of teachers in your school towards implementation of the SMASE programme? Positive ( ) Negative ( ) (Please tick as appropriate).

9. Briefly explain how the teachers' attitude has influenced the implementation of SMASE.

_____

_____

_____

_____

c) Influence of teacher training in SMASE on the effective implementation of the programme.

10. How many teachers of mathematics and science are in your school?_____

11. How many have attend SMASE insets?_____

12. How has the training impacted on their teaching approach in terms of?

INSET Objectives	**Adequately**	**Inadequately**	**Not Sure**
ICT integration			
Improvisation of teaching materials			
Peer Teaching			
SMASE lesson planning			
Lesson Studying			

d) Influence of principals' training in SMASE on the implementation of the programme.

13. Have you ever attended SMASE inset since becoming Principal? Yes( )no( )

14. If yes, how often?_____

15. Has the SMASE INSET helped you in implementing the ASEI-PDSI approach to teaching in your school? Yes ( ) no ( ). Please explain_____

_____

_____

Thank you

APPENDIX III

HEAD OF DEPARTMENTS' QUESTIONNAIRE

This questionnaire is intended to collect data on school based factors influencing implementation of SMASE programme in public secondary schools in Makueni Sub County. Kindly read the questions below carefully and give the responses by either ticking (√) where appropriate or by giving information in the spaces provided. This study is purely for academic purposes and all information given shall be treated with utmost confidentiality.

Section A: Personal Information

1. Gender: (Tick as appropriate) Male ( ) Female ( )
2. Age in years(Tick as Appropriate)

   25-30 ( ) 31-40 ( ) 41-50 ( ) 51-60 ( )
3. State your highest professional qualification: (Tick as appropriate)

   Ph.D ( ) M.Ed/MA ( )Graduate (B/ED) ( ) BSC with PGDE ( ) Diploma( )
4. How many years have you been a HOD in this school?_____

Section B: Implementation of SMASE Programme

a) Availability of Teaching and Learning Resources

5. The following resources are used in implementation of SMASE program, state the level of adequacy of the resources in your school by ticking in the appropriate box.

Resource	Adequate	Inadequate	Neutral
Science Laboratories			
Computer laboratory			
Science Apparatus			
Reagents			
Models			
Real Objects			

6. SMASE programme advocates for ASEI-PDSI (Activity, Student Centred Experiment and Improvisation- Plan Do See and Improve).

ii) To what extent do teachers in your Department use the following student centred activities in the teaching of Science and Mathematics?

Approach	**Always**	**Rarely**	**Never**
Activity			
Student Centred			
Experiment			
Improvisation			
Plan			
Do			
See			
Improve			

b) Teachers' attitude towards implementation of the SMASE programme

7. What is the attitude of teachers in your department towards implementation of the SMASE programme? Positive ( ) Negative ( ) (Please tick as appropriate).

8. Briefly explain how the teachers' attitude has influenced the implementation of SMASE_____

_____

_____

c) Influence of teacher training in SMASE on the effective implementation of the programme.

9. How many teachers are in your department? _____

10. How many have attend SMASE insets?_____

11. How has the training impacted on their teaching approach in terms of?

INSET Objectives	**Adequately**	**Inadequately**	**Not Sure**
ICT integration			
Improvisation of teaching materials			
Peer Teaching			
SMASE lesson planning			
Lesson Studying			

d) Influence of principals' training in SMASE on the implementation of the programme.

12. Does your Principal attend SMASE training ?Yes()No()

13. If yes, how often?_____

14. Has the SMASE INSET helped the principal in influencing the implementation of the ASEI-PDSI approach to teaching in your school? Yes ( ) No ( ). Please explain_____

_____

_____

Thank you

APPENDIX IV

SCIENCE/ MATHEMATICS TEACHERS' QUESTIONNAIRE

This questionnaire is intended to collect data on school based factors influencing implementation of SMASE programme in public secondary schools in Makueni Sub County. Kindly read the questions below carefully and give the responses by either ticking (√) where appropriate or by giving information in the spaces provided. This study is purely for academic purposes and all information given shall be treated with utmost confidentiality.

Section A: Personal Information

1. Gender: (Tick as appropriate) Male ( ) Female ( )
2. Age in years(Tick as Appropriate)

   25-30 ( ) 31-40 ( ) 41-50 ( ) 51-60 ( )
3. State your highest professional qualification: (Tick as appropriate)

   Ph.D ( ) M.Ed/MA ( ) Graduate (B/ED) ( ) BSC with PGDE ( ) Diploma( )
4. How many years have you been a teacher in this school?_____

Section B: Implementation of SMASE Programme

a) Availability of Teaching and Learning Resources

5. The following resources are used in implementation of SMASE program, state the level of adequacy of the resources in your school by ticking in the appropriate box.

Resource	Adequate	Inadequate	Neutral
Science Laboratories			
Computer laboratory			
Science Apparatus			
Reagents			
Models			
Real Objects			

6. SMASE programme advocates for ASEI-PDSI (Activity, Student Centred Experiment and Improvisation- Plan Do See and Improve).

i) To what extent do you use the following student centred activities in the teaching?

Approach	Always	Rarely	Never
Activity			
Student Centred			
Experiment			
Improvisation			
Plan			
Do			
See			
Improve			

b) Teachers' attitude towards implementation of the SMASE programme

7. What is your attitude towards implementation of the SMASE programme? Positive ( ) Negative ( ) (Please tick as appropriate).

8. Briefly explain how your attitude has influenced the implementation of SMASE. _____

_____

_____

c) Influence of teacher training in SMASE on the effective implementation of the programme.

9. How many times have you attended SMASE insets?_____

10. How has the training impacted on your teaching approach in terms of?

INSET Objectives	**Adequately**	**Inadequately**	**Not Sure**
ICT integration			
Improvisation of teaching materials			
Peer Teaching			
SMASE lesson planning			
Lesson Studying			

d) Influence of principals' training in SMASE on the implementation of the programme.

11. Does your Principal attend SMASE training ?Yes( ) No( )

12. If yes, how often?_____

13. Has the SMASE INSET helped the principal in influencing the implementation of the ASEI-PDSI approach to teaching in your school? Yes ( ) No ( ). Please explain_____

_____

_____

_____

Thank you

SOUTH EASTERN KENYA UNIVERSITY

OFFICE OF THE DIRECTOR

BOARD OF POST GRADUATE STUDIES

P.O. BOX 170-90200
KITUI, KENYA
Email. info@seku.ac.ke

TEL. 020-4213859 (KITUI)
Email. directorbps@seku.ac.ke

Our Ref: E55/WTE/20614/2015

DATE: 15th November 2018

Janet Mutiwa Kavisi
Re g. No. E55/WTE/20614/2015
Masters of Education in Educational Administration and Planning
C/O Dean, School of Education, Humanities and Social Sciences

Dear Kavisi

RE: PERMISSION TO PROCEED FOR DATA COLLECTION

This is to acknowledge receipt of your Master in Educational Administration and Planning Proposal document titled: *"School Based Factors Influencing Implementation of Strengthening of Mathematics and Science Education (SMASE) Programme in Public Secondary Schools in Makueni Sub County"*.

Following a successful presentation of your Masters Proposal, the School of Education in conjunction with the Directorate, Board of Postgraduate Studies (BPS) have approved that you proceed on and carry out research data collection in accordance with your approved proposal.

During your research work, you will be closely supervised by Dr. Janet Mulwa and Dr. Selpher K. Cheloti. You should ensure that you liase with your supervisors at all times. In addition, you are required to fill in a Progress Report *(SEKU/ARSA/BPS/F-02)* which can be downloaded from the University Website.

The Board of Postgraduate Studies wishes you well and a successful research data collection exercise as a critical stage in your Master of Education in Educational Administration and Planning.

Prof. Felix Ngunzo Kioli
Director, Board of Postgraduate Studies

Copy to:
Deputy Vice Chancellor, Academic, Research and Students Affairs
Dean, School of Education, Humanities and Social Sciences
Chairman, Department of Education Administration and Planning
Director, Machakos Campus
Dr. Janet Mulwa
Dr. Selpher K. Cheloti
BPS Office - To file

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471,
2241349,3310571,2219420
Fax:+254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref. No. **NACOSTI/P/19/72620/28376**

Date: **12th March, 2019**

Janet Mutiwa Kavisi
South Eastern Kenya University
P.O. BOX 170-90200
KITUI

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"School based factors influencing implementation of Strengthening of Mathematics and Science Education (SMASE) programme in public secondary schools in Makueni Sub County, Kenya"*** I am pleased to inform you that you have been authorized to undertake research in **Makueni County** for the period ending **12th March, 2020.**

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

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Makueni County.

The County Director of Education
Makueni County.

THIS IS TO CERTIFY THAT:
MS. JANET MUTIWA KAVISI
of SOUTH EASTERN KENYA UNIVERSITY , 29-90300 MAKUENI,has been permitted to conduct research in *Makueni County*

Permit No : NACOSTI/P/19/72620/28376
Date Of Issue : 12th March,2019
Fee Recieved :Ksh 1000

on the topic: ***SCHOOL BASED FACTORS INFLUENCING IMPLEMENTATION OF STRENGTHENING OF MATHEMATICS AND SCIENCE EDUCATION (SMASE) PROGRAMME IN PUBLIC SECONDARY SCHOOLS IN MAKUENI SUB COUNTY, KENYA***

for the period ending:
12th March,2020

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014.

CONDITIONS

1. The License is valid for the proposed research, location and specified period.
2. The License and any rights thereunder are non-transferable.
3. The Licensee shall inform the County Governor before commencement of the research.
4. Excavation, filming and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
5. The License does not give authority to transfer research materials.
6. NACOSTI may monitor and evaluate the licensed research project.
7. The Licensee shall submit one hard copy and upload a soft copy of their final report within one year of completion of the research.
8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice.

National Commission for Science, Technology and innovation
P.O. Box 30623 – 00100, Nairobi, Kenya
TEL: 020 400 7000, 0713 788787, 0735 404245
Email: dg@nacosti.go.ke, registry@nacosti.go.ke
Website: www.nacosti.go.ke

REPUBLIC OF KENYA

NACOSTI

National Commission for Science, Technology and Innovation

RESEARCH LICENSE

Serial No.A 23545

CONDITIONS: see back page

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

Telegram:
Telephone: 0743-987-177
Fax:
Email: *cc.makueni@interior.go.ke*

COUNTY COMMISSIONER
MAKUENI COUNTY
P.O. Box 1-90300
MAKUENI

Ref: MKN/CC/ADM.6/1 VOL.III/156

13th March, 2019

Janet Mutiwa Kavisi
SOUTH EASTERN KENYA UNIVERSITY

RE: RESEARCH AUTHORIZATION

Reference is made to Director General National Commission for Science Technology and Innovation Research License **Ref. No. NACOSTI/P/19/72620/28376 dated** 12th March, 2019 on the above subject.

You are hereby authorized to undertake research on **"School based factors influencing implementation of strengthening of Mathematics and Science Education (SMASE) programme in public secondary schools in Makueni Sub County, Kenya"** for a period ending ***12th March, 2020.***

By a copy of this letter the Deputy County Commissioner, Makueni Sub County is requested to give you the necessary assistance.

B. K. NICHOLAS
FOR: COUNTY COMMISSIONER
MAKUENI

c.c.
County Director of Education
MAKUENI COUNTY

Deputy County Commissioner
MAKUENI SUB COUNTY

REPUBLIC OF KENYA
MINISTRY OF EDUCATION
STATE DEPARTMENT OF EARLY LEARNING AND BASIC EDUCATION
Email:cdemakueni@gmail.com
When replying please quote

County Education Office
P.O. Box 41
MAKUENI

MKN/C/ED/5/33/ VOLII/56

10th December, 2020

Janet Mutiwa Kavisi
South Eastern Kenya University
P. O BOX 29-90300
MAKUENI

RESEARCH AUTHORISATION FOR JANET MUTIWA KAVISI

This office is in receipt of a letter from the Director General, National Commission for Science Technology and Innovation dated 12th March, 2019 Ref. NACOSTI/P/19/72620/28376 on **"School Based factors influencing implementation of Strengthening of Mathematics and Science Education (SMASE) programme in public Secondary Schools in Makueni Sub County -Kenya"** for the period ending **12th March, 2020**.

Following this authorization, you are allowed to proceed with your research as requested.

Gachungi J. Muriithi
County Director of Education
MAKUENI

Cc

Sub County Director of Education- **Makueni**