INFLUENCE OF ASEI-PDSI PEDAGOGY ON PUPILS' PERFORMANCE IN KCPE MATHEMATICS IN PUBLIC PRIMARY SCHOOLS IN KAJIADO NORTH SUB COUNTY, KENYA

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DECLARATION

I declare that this document and the research it describes are my original work and that they have not been presented in any other university for academic work

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This research was conducted under our supervision and is submitted with our approval as University supervisors

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DEDICATION

This work is dedicated to all primary school administrators and Mathematics teachers

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May God shower you all with limitless blessings.

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LIST OF ABBREVIATIONS AND ACRONYMS

AEO	Area Education Officer
ASEI	Activity, Students, Experiment, and Improvisation
CEMASTEA	Centre for Mathematics, Science and Technology in Africa
CSO	Curriculum Support Officers
DEO	District Education Officer
FPE	Free Primary Education
ICADETA	Institute for Capacity Development of Teachers in Africa.
INSET	In-service Education and Training.
JICA	Japanese International Co-operation Agency
KCPE	Kenya Certificate of Primary of Education
KEPSHA	Kenya Primary Schools Heads Association.
KESSHA	Kenya Secondary Schools Heads Association.
KNUT	Kenya National Union Of Teachers
KCSE	Kenya Certificate of Secondary Education
KUPPET	Kenya Union of Post Primary Teachers
LATF	Local Authority Transfer Fund
MOE	Ministry of Education
MOEST	Ministry of Education Science and Technology
NACOSTI	National Council for Science Technology and Innovation
PDSI	Plan, Do, See and Improve
QASOs	Quality Assurance and Standards Officers
SMASSE	Strengthening of Teaching Mathematics and Science in
SCEO	Sub County Education Officer
SPSS	Statistical Package for Social Science.
TIVET	Technical Industrial Vocational and Entrepreneurship Training
TSC	Teachers Service Commission
WECSA	Western Eastern Central and Southern Africa

OPERATIONAL DEFINITION OF TERMS

ASEI-PDSI approaches refer to lesson delivery that focuses on activities that are student–centred, experimentation or practical work, and improvisation in teaching and learning.

Do refers to the teacher acting as a facilitator, carrying out instructional activities as planned in an innovative, interesting way, ensuring active learner participation, reinforcing learning , dealing with learners questions and misconceptions

Experimentation refers to a scientific test that is done to study what happens and gain knowledge

Improve refers to the teacher reflecting on the performance, evaluation and effectiveness of the lesson objectives. It should enable the teacher to take note of the strengths, weaknesses of the lesson and address them accordingly

Improvise refers to doing something with whatever is available or use similar versions when standard approaches or equipment are insufficient or unavailable

INSET cycle refers to a 10-day SMASSE INSET per year for mathematics teachers

Pedagogy refers to all teaching and learning processes, including what is taught, how teaching takes place and how what is taught is learnt

Performance refers to the outcome of pupils ability in KCPE measured in terms of mean score or grades.

Plan refers to the careful preparation and trying out of activities which will enable learners to understand individual concepts and connect them, get rationale/value of lesson, retain the learning and apply it to real life situations, get rid of misconceptions and have interest in the lesson

Principals' support refers to the ability to mobilize mathematics teaching and learning resources, promote mathematics, encourage mathematics teacher collaboration, supervise the adoption of the ASEI-PDSI approach and monitor student progress

See refers to a teacher‟s evaluation of the teaching and learning process during and after the lesson using various techniques and feedback from students and colleagues. It should enable the teacher to note good practices and mistakes to be addressed, be more open to evaluation students, peers and seniors

Student-centred refers to the shift of activity from teacher to student; it includes active learning, cooperative learning, inductive teaching and learning, explicit skill instruction, encourages students to reflect on what is learnt and how it is learnt, gives students some control over the learning and encourages collaboration

Teachers' attitude refers to a predisposition or a tendency to respond positively or negatively towards SMASE project.

ABSTRACT

Learner-centred pedagogy is the hallmark of the ASEI-PDSI approach. The SMASSE/SMASE ASEI-PDSI pedagogy is an innovative approach that aims at shifting classroom practices from content based to activity-focused teaching and from teacher centered to learner-centered. Despite the use of the innovative approach, the KCPE grades in mathematics have remained persistently below average among public primary schools in Kajiado North Sub County. The purpose of the study was to examine the influence of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics in public primary schools in Kajiado North Sub County, Kenya. The study specifically aimed at assessing the influence of teachers' use of ASEI-PDSI pedagogy, head teachers' supervision of teachers' use of ASEI-PDSI pedagogy, and teachers' attitude towards the use of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics in public primary schools in Kajiado Sub County. The study was anchored on Brunner theory of constructivism. The study adopted cross-sectional survey research design. The study targeted 14 head teachers and 39 mathematics teachers. Through census sampling technique, all the 14 head teachers were sampled while simple random sampling was used to sample 28 mathematics teachers. Data were collected through teachers' questionnaires, head teachers' interview schedule, and mathematics lesson observation rating scale. Pilot testing involved teachers and head teachers from the neighbouring Kajiado East Sub County. The content and construct validity of the data collection instruments was ascertained by presenting the instruments for scrutiny by the researcher's two university supervisors. By computing Cronbach's alpha coefficient, the reliability of the teachers' questionnaire was estimated and found to be sufficient. Data were analysed by both descriptive and inferential statistics. Descriptive statistics involved frequencies, means, standard deviations and percentages. The three null hypotheses of the study were tested using multiple regression analysis. The study found that despite the SMASE training, most of the teachers hardly used ASEI-PDSI approach, while head teachers supervision of ASEI-PDSI pedagogy was almost none existence. However, most of the teachers had positive attitude towards the ASEI-PDSI pedagogy. The study found that independent variables contributed 62.7 % of variance in pupils' KCPE performance in mathematics (R^2 = 0.627). Mathematics teachers' use of ASEI-PDSI pedagogy had the most significant relative influence to the prediction of pupils' KCPE performance in mathematics (β = 0.458, $p < 0.05$) followed by the head teachers' supervision of ASEI-PDSI pedagogy implementation (β = 0.413, $p < 0.05$) while the teachers' attitude towards ASEI-PDSI pedagogy had the least and insignificant influence (β = 0.118, p = 0.017). The study findings would be significant to teachers, head teachers, CSOs, SMASE management and MOE, as they explore on how to improve and sustain quality grades in primary mathematics. The study recommended that, MOE entrench ASEI-PDSI pedagogy in mathematics and science in teachers training curriculum to ensure continuity of the novel approach.

CHAPTER ONE

INTRODUCTION AND BACKGROUND INFORMATION

1.1 Introduction

Chapter one gives the background of the study in which the origin of SMASSE/SMASE is traced. The chapter also contains the statement of the problem, the purpose of the study, the objectives of the study, research questions, and the study hypotheses. Further, significance of the study, scope, delimitations, limitations and assumptions of the study are explained. The chapter closes with an explanation of the study theoretical framework and conceptual framework.

1.2 Background of the Study

Mathematics is an essential discipline which is recognized worldwide. However, it requires to be augmented in education in order to equip students with necessary skills for achieving higher education, personal fulfilment and career aspirations. According to Fraser and Gilan (1992) as cited in Muthomi and Mbugua (2014), mathematics is the base for all technologies in the world since it is employed as a key instrument in a diversity of fields such as engineering, medicine, natural science, physical science, social science, commerce and business. Owing to its significance, learners at all levels are increasingly under pressure to succeed in mathematics more than in any other subject (Muthomi & Mbugua, 2014).

Costello (1991) cited in Amadalo, Wasike and Wambui (2011) conceives mathematics as a subject that deals with measurement, numbers, shapes, algebra, and a variety of other more specialized topics which give the subject its flavor. It involves some memory capacity skills such as the ability to acquire and retain knowledge, conceptual structures identification, problem- solving and acquisition of proper attitudes concerning

mathematics and learning of new facts and skills (Costello, 1992). Due to its use and importance in the learning of other subjects and its application in industry and real life situations, mathematics has been one of compulsory subjects at elementary educational level all over the world including Kenya.

Despite the significance attached to mathematics, performance in the subject has been worrying in many countries. According to Costello (1992), there has been anxiety about the standards of achievement in school mathematics in Britain for many years. He observes that complaints of declining standards have been regularly made in the press and by government organizations. In Africa, the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ III), ranked Namibia below other Southern and Eastern African countries in terms of learners' competencies in mathematics (Wasanga, Ogle & Wambua, 2011). This report showed that Namibian learners scored 430/1000 in mathematics compared to other Southern African countries.

In Kenya, poor performance in mathematics at Kenya Certificate of Primary Education (KCPE) has been and still is a subject of much debate among politicians, teachers, parents, educational specialists and other stakeholders (Wasanga et al., 2011). In the year 2005, 671, 417 pupils sat for KCPE in Kenya and the mathematics raw mean was 53.94%, while in the year 2007, 698, 364 pupils did the exam and obtained a percentage raw mean of 49.24 (Ministry of Education, 2010). These poor results called for urgent need in determining the causes of poor performance and offering effective solution if Kenya is to achieve scientific and technological advancements and actualize vision 2030.

In cognizance of the deteriorating performance in science and mathematics at secondary level, the Kenyan Government undertook the countrywide in service training of teachers

through Strengthening of Mathematics and Science in Secondary Education (SMASSE) project in 1998 (Animata, 2015). The initiative was a joint venture between the Kenya Government through the Ministry of Education (MOE) and the Government of Japan through the Japanese International Cooperation Agency (JICA). SMASSE aim was to raise the quality of teaching mathematics and science in secondary schools through In-Service Education and Training (INSET). The project was divided into three phases. The first phase (1998-2003), SMASSE Project was launched in 1998 on a pilot basis in 9 districts. In the second phase, the project was then scaled up to all districts in the country in 2003. It was during the second phase that 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 SMASSE – WECSA (Western, Eastern, Central and Southern Africa) members. In the third phase, JICA's assistance was expanded to primary education as initiation of the project for Strengthening of Mathematics and Science Education (SMASE), while maintaining the intervention for secondary education to some extent and for other African countries (Republic of Kenya, 2015).

In order to establish the specific issues in mathematics and sciences that needed intervention and to come up with strategic plan of operation, the SMASSE team conducted a baseline survey of nine pilot districts in 1998. The major stake holders that were interviewed included teachers, head teachers, students, laboratory assistants and parents. In addition, data was collected by administering questionnaires to students and teachers, lesson observation and video recording of lessons for further observations. The survey findings showed that there were numerous problems in mathematics and science education (CEMASTEA, 2011). Among these were those problems within the scope of SMASSE

Operations and others beyond the scope of the initiative. Some of the problems considered to be within the scope of SMASSE included: attitude towards science and mathematics; students' attitude was generally found to be negative. This was attributed to low marks at admission, belief that the subjects are difficult, lack of facilities, peer influence, harsh teachers and theoretical approach to teaching.

The teachers' attitude was generally neutral but their approaches in mathematics were mainly teacher centred and that were reluctant to perform experiment especially in chemistry which were deemed dangerous. Teacher demonstrations dominated the lessons. The head teachers' attitude was found to be neutral to negative as reflected by their development priorities which ranked textbooks, laboratories and laboratory equipment as low. The parents' attitude was neutral. Most parents were not keen in their children's performance, least of all in mathematics and science. Progress reports were not a matter of concern and many were only keen in paying school fees (CEMASTEA, 2011).

The baseline survey further established that most teachers had low mastery of content, hardly ventured to other examples apart from those given in the text books, hardly involved students in the lesson activities and improvisation was nonexistence. Moreover, teachers had no interactive forum to share the challenges and success in the field of mathematics and sciences. It was in view of this background that SMASSE embarked on improvement of mathematics and science education through In-Service Education and Training (INSET) for teachers with innovative approach. The SMASSE/SMASE intervention strategy was a pedagogical shift, coined as the *Activity-focused, Student-Centered, Experimenting and Improvisation (ASEI) through Plan, Do, See and Improve (PDSI) approach* (SMASSE, 2006; 2008).

ASEI aims at assisting Mathematics and science teachers to shift classroom practices from content based to activity-focused teaching, from teacher centered to learner-centered, lecture method/theoretical approach to experiment and research-based approaches, from large-scale experiments to scaled-down experiments and improvisation. ASEI classroom practices also attempt to place more responsibility on the student during teaching/learning situations while the teachers take up a mediation and guidance role. PDSI on the other hand, emphasizes careful planning of the lessons before teaching and implementation of those plans in class, hence the acronym Plan, Do, See and Improve (SMASSE, 2006; 2008).

In order to strengthen the school based INSET activities in phase 3, head teachers and Quality Assurance Officers (QASOs) also underwent training. Head teachers are expected to play a key role in the success of SMASE for apart from supervision of implementation of ASEI-PDSI pedagogy by teachers, their decisions in the prioritization of acquisition of the required resources determines the success of the projects.

According to CEMASTEA (2013), SMASSE/SMASE projects had a number of achievements namely: establishment of a sustainable teachers' INSET programme for both secondary and primary education in Kenya, capacity building of Kenyan education managers for both primary and secondary education in Kenya. Further, there was an establishment of SMASE-WECSA network on mathematics and science education with other African countries.

A SMASSE Impact Assessment Survey (SPIAS) conducted from 2004 till 2008 analyzed how the participation in the INSET affected the student's performance (Muta & Sasaki, 2009). The survey found that there was a marginal but significant improvement in academic performance in mathematics and biology. Teachers' attitude towards the teaching

of mathematics and sciences was found to have improved appreciably. However, Ngetuny (2013) study found that though there were some schools which posted improved grades, low performance in mathematics and sciences persisted in majority of schools. The study found that though teachers, head teachers had a positive attitude towards teaching and learning of mathematics and sciences, the monitoring of implementation of the SMASSE initiative by head teachers and QASOs was minimal. In addition, there was a growing dissent among teachers since the INSET took place during school holidays when teachers considered as the time to rest and accomplish personal projects.

Just like other Sub counties in Kenya, teachers, head teachers and QASOs in Kajiado Sub County attended the SMASE INSETs. Mathematics and science teachers teaching in classes' six to eight were introduced and trained on the ASEI-PDSI approach in teaching. However, the heavy investment in funds and man-hours notwithstanding, the KCPE mean performance in mathematics has remained almost static at below 50%. Thus, the much anticipated improvement in academic performance as a result of the adoption of ASEI-PDSI pedagogical approach has not been realized. Table 1.1 shows the Kajiado Sub County public primary schools KCPE mean performance in mathematics.

Table1.1: Kajiado North Sub County Public Primary Schools KCPE Mathematics Results

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
KCPE Math Mean Mark	**45.9**	**46.2**	**44.8**	**47.2**	**45.5**	**46.9**	**45.4**	**47.5**	**43.7**	**46.5**	**46.8**

Source: Kajiado North Sub County Education Office

It is evident from Table 1.1 that the mean performance has stagnated at around 44 to 47 percent. Since the SMASE INSET started in 2009 for most teachers in Kajiado North Sub

County, its influence on the KCPE result was expected to be felt from 2011 to date. It is however, instructive to note that some schools have consistently maintained a relatively higher mean than the Sub County average. The persistent low performance (below average) in KCPE in mathematics in Kajiado North Sub County casts some aspersions on the extent to which teachers implement ASEI-PDSI approach in mathematics, the head teacher supervision and the teachers attitude towards the approach.

1.3 Statement of the Problem

The SMASSE/SMASE ASEI-PDSI pedagogy is an innovative approach that aims at shifting classroom practices from content based to activity-focused teaching and from teacher centered to learner-centered. ASEI-PDSI classroom practices places more responsibility on the student during teaching/learning situations while the teachers take up a mediation and guidance role. The approach also emphasizes careful planning of the lessons, learners doing the planned tasks through experiments using the available items and improvising to cater for the unavailable items resulting to improvement.

Despite the colossal amount of funds spent by the government of Kenya in conjunction with Japan (CEMASTEA, 2013) in capacity building of teachers through SMASE projects, reports from various studies show varied outcomes. A series of studies conducted by CEMASTEA indicate that there has been a marginal improvement in KCPE performance in mathematics nationally (CEMASTEA, 2013). However, regional studies by Ngetuny (2013), Onchong'a (2013), Mwelese and Atwoto (2014), Manyara (2014) and Aminata (2015) decried the consistent low performance in mathematics.

The analyzed KCPE mathematics results for public primary schools in Kajiado North Sub County (Table 1.1) shows that there has been no marked improvement despite the implementation of ASEI-PDSI pedagogy since 2009. However, owing to the fact that some schools in the same region had registered a steady improvement in mathematics mean mark (Appendix IV), it was incumbent to conduct a study to examine some of the factors that could have influenced not only the overall dismal performance in the Sub County but also the noted performance differentials. The current study endevoured to examine the extent to which teachers in various public primary schools in Kajiado North Sub County have been implementing the ASEI-PDSI pedagogy, the extent to which head teachers supervise the implementation of the new approach and the attitude of teachers towards the ASEI-PDSI pedagogy. Most of the studies that have been conducted in the past to examine the achievement of SMASSE project, concentrated in secondary mathematics and sciences (Gachuhi, 2014; Aminata, 2015; Ngetuny, 2013; Sikolia & Sikolia, 2016; Abong'o (2013), relegating the achievements of SMASSE project in primary school mathematics to oblivion. The identified lacuna also spurred the undertaking of the current study.

1.4 Purpose of the Study

The purpose of the study was to examine the influence of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics in public primary schools in Kajiado North Sub County, Kenya.

1.5 Objectives of the Study

The study objectives will be:

(a) To assess the influence of the level of teachers' use of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics in public primary schools in Kajiado North Sub County

(b) To examine the influence of the head teachers' supervision of teachers' use of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics in public primary schools in Kajiado Sub County

(c) To establish the influence of teachers' attitude towards the use of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics in public primary schools in Kajiado Sub County.

1.6 Null Hypotheses

The following null hypotheses were tested at 95% confidence level

H_o1: The level of teachers' use of ASEI-PDSI approach has no statistically significant influence on the pupils' performance in KCPE mathematics in public primary schools in Kajiado North Sub County.

H_o2: Head teacher's supervision of teachers' use of ASEI-PDSI pedagogy has no statistically significant influence on pupils' performance in KCPE mathematics in public primary schools in Kajiado North Sub County.

H_o3: Teachers' attitude towards the use of ASEI-PDSI pedagogy has no statistically significant influence on pupils' performance in KCPE mathematics in public primary schools in Kajiado North Sub County.

1.7 Significance of the Study

Significance of a study shows how the research benefits or impacts others in part or whole (Simon & Goes, 2013). The study findings may be important to head teachers, teachers, parents, MOE policy makers, CEMASTEA, researchers and other stakeholders in education.

The study findings on the extent to which teachers' use of the ASEI-PDSI pedagogy might inform the head teachers and QASOs supervision strategies and areas of emphases. Furthermore the findings may provide an insight to CEMASTEA and MOE on the possible causes of lack of meaningful improvement in mathematics performance in most schools. The findings may also form the basis for teachers' self-appraisal in regard to the extent they are practicing the SMASE espoused activity based, student centred teaching. In addition, the teachers' established shortcomings might also be the basis of soliciting more funds from the government and other funders for acquisition of the essential mathematical teaching resources such as three dimensional kits. By doing so, teachers' might ensure that every topic in mathematics is approached from the learners' exploration and discovery point of view.

The study findings on the influence of head teachers' supervision of the teachers' use of ASEI-PDSI pedagogy may be used as head teachers' self-appraisal in regard to one of their key tasks as school internal quality assurers. The findings may also guide the QASOs in their head teachers' appraisal reports and form the basis for future INSETs. The findings on the mathematics teachers' attitude towards ASEI-PDSI pedagogy may be an eye opener in regard to their planning, preparation for activity oriented lessons and their propensity to initiate improvisation- all being the crucial ingredients for success in ASEI-PDSI pedagogy. Overall, the findings may guide the formulation of new policies at school, sub county and national levels in addressing the identified hindrances to actualization of ASEI-PDSI pedagogy and subsequently dismal performance in mathematics in Kajiado North Sub County.

1.8 Scope of the Study

According to Marylin and Goes (2013), scope of study refers to the geographical area, population, research methodology, and theoretical framework within which the study is done. The proposed study involved all public primary schools in Kajiado North Sub County in Kajiado County. The site was selected due to the persistent low performance in KCPE mathematics despite the implementation of the SMASE ASEI-PDSI pedagogy. Mathematics teachers and head teachers were involved. The study adopted a cross-sectional survey research design, implying that there was no manipulation of variables and that data was taken at one point in time. Any change to variables after data collection was not considered by the current study.

1.9 Delimitation of the Study

Delimitations are the definitions one sets as the limits of their own thesis (Brooks, 2013). Also according to Simon and Goes (2013), study delimitations are those features which arise from limitations of the study as well as the sensible exclusionary and inclusionary choices made during the development of the research plan. Delimitations are set so that the study goals do not become impossibly large to complete. The ASEI-PDSI pedagogy is meant to be applied for both sciences and mathematics, however, the study was confined to mathematics. Although there may be many factors that could influence pupils' performance in KCPE mathematics, such as pupil related factors, the proposed study was delimited to teachers and head teachers' related factors.

1.10 Limitations of the Study

Limitations are possible short comings or influences that can affect the study and are not under control of the researcher. They limit the extent to which a study can go and may

affect the end results of the study (Simon & Goes, 2013). The teachers' questionnaire comprised of sections where teachers' rated extent to which they had implemented the ASEI-PDSI pedagogy. According to Sharma (2008), individuals tend to over-rate themselves on desirable traits and under-rate themselves on undesirable traits. However, to mitigate againist such a tendency, a lesson observation schedule was employed to triangulate the information. In addition, head teachers through interviews were expected to furnish more information on teachers' use of ASEI-PDSI pedagogy. Being an academic based study, the research employed a cross sectional survey design which enabled the researcher to collect data at one point from a sample selected to describe some large population at that time. Thus, the researcher was not be able to undertake a longitudinal study that involves observing the teachers and the pupils' lessons over a period of time in order to trace the transformation process of the ASEI-PDSI classroom practice to its maturation and performance of KCPE.

1.11 Assumptions of the Study

According to Simon (2011), assumptions of the study are things that are somewhat out of the researchers' control but if they are not present, the study would become irrelevant. Reichardt and Cook (2009) define assumptions in research as facts assumed to be correct but not really verified. It was assumed that all the teachers who took part in the study attended the four cycles of SMASE training. It was also assumed that, all the head teachers attended the workshops conducted by SMASE specifically for the school managers, education officers and QASOs.

1.12 Theoretical Framework

The research study was premised on constructivist learning theory by Jerome Bruner (1966). According to the constructivist learning theory, learning is an active process in which learners construct new ideas or concepts based upon their past and current knowledge. The learner selects and transforms information, hypothesizes and makes decisions relying on a cognitive structure.

In practice, the teacher should encourage students to discover principles by themselves and also the teacher should engage learners in an active dialogue like inquiry approach. The theory advocates for active participation of learners in learning process rather than being passive receivers of knowledge. Learners should be involved in physical action, hands-on experience which engages mind. The learner is allowed to make mistakes and learn from them. Learning is more meaningful if the child is allowed to experiment on his own rather than listening to the lecture. The teacher should present learners with materials, situations that allow them to discover new learning. In this case the teacher becomes a facilitator of knowledge that is he guides and stimulates the learners.

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. The weaknesses of constructivism theory is that it removes grading in the traditional way and instead places more value on students evaluating their own progress which may lead to students falling behind. Without standardized grading and evaluation,

the teacher may not know that the learner is struggling. The other disadvantage is that, it can easily lead to students' confusion and frustration 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. Despite these problems, the theory is based on construction of learners' own perspective of the world through individual experiences and schema.

Constructivist theory was found appropriate for the current study because SMASE programme advocates for learner-centred approaches and learners being active participants in learning process. The ASEI-PDSI pedagogy encourages teachers to plan their lesson, putting in mind learners prior knowledge and experiences in order to build new concepts on it.

1.13 Conceptual Framework

A conceptual framework is a tool that assists the researcher to elaborate knowledge and perception of the condition under examination and to communicate this. When evidently expressed, a conceptual framework has a potential value as a tool to assist a researcher to make meaning of successive findings. It forms part of the scrutinized plan for negotiation and it is reviewed and improved as a result of investigation (Gregory, Lumpkin & Marley, 2005). Figure 1.1 shows the proposed study conceptual framework.

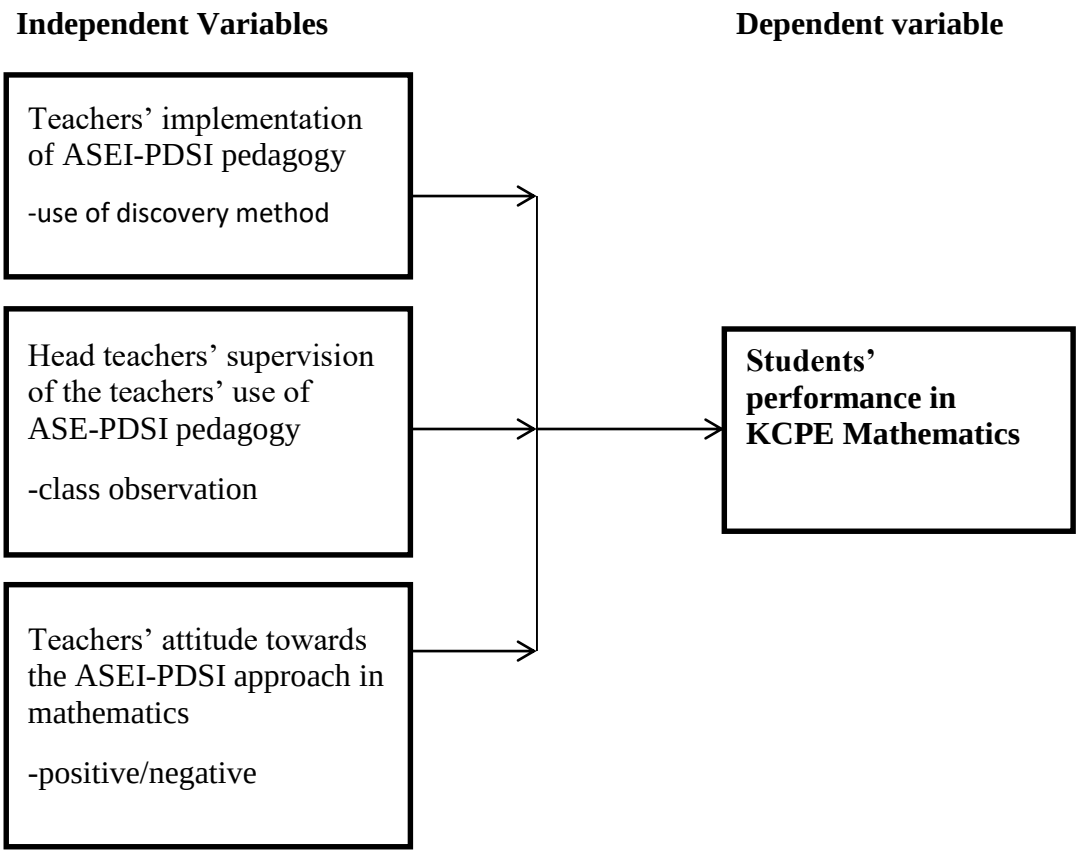

Figure 1.1: Conceptual Framework Showing the Presumed Factors that Influence the Pupils' Performance in KCPE Mathematics

Figure 1.1 shows the three independent variables were conceptualized to influence pupils' performance in KCPE mathematics in public primary schools in Kajiado North Sub County. The first independent variable is the teachers ASEI-PDSI classroom practices that entice learners to participate in activities geared towards removing obstacles that lead to poor performance in mathematics. Though all teachers may be well trained in ASEI-PDSI approach, its application is likely to vary from one teacher to another depending on many other factors such as motivation and availability of essential resources and the level of supervision by the head teacher. Teachers' attitude towards the pedagogy is also a major determinant of the teachers' pro activeness and creativity in conducting an ASEI-PDSI

oriented lesson. The independent variables are expected to influence the hands on participation of pupils as advocated by Brunner constructivist theory where pupils using cognitive structures discover concepts and construct knowledge by working independently to solve real problems. This will lead to improved capability in mathematics where pupils are able to apply the knowledge taught in their day to day lives and hence improved KCPE performance.

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CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter presents the review of the relevant literature in view of the research problem. The chapter is organized according to the study objectives. The review was undertaken in order to eliminate duplication of what has been done and provide a clear understanding of existing knowledge base in the problem area. The literature review is based on authoritative, recent, and original sources such as journals, books, thesis and dissertations. Specifically, the chapter reviews literature on the influence of teachers' use of ASEI-PDSI pedagogy, head teachers' supervision teachers' use of ASEI-PDSI pedagogy and the teachers' attitude towards the ASEI-PDSI approach in teaching mathematics. The chapter closes with the summary of the reviewed literature and research gaps.

2.2 Teachers' use of ASEI-PDSI Pedagogy and Pupils' Performance in Mathematics

Chapuis (2003) as cited in Aminata (2015) regards pedagogy as a science of teaching that requires a combination of knowledge and skills to enable students make a difference in the intellectual and social development. According to Kuzu (2007), the traditional pedagogy was based on the view that teachers were to serve as the source of knowledge while learners were passive receivers. This idea corresponds to Scrivener (2005) simile which likens traditional teaching to jug and mug– the knowledge being poured from one receptacle into an empty one. Thus, the traditional methodology puts the responsibility for teaching and learning mainly on the teacher and assumes that if students are present in the lesson and are attentive to the instructor's examples and explanations is enough to ensure that learning takes place.

Unlike traditional pedagogy, Richards (2008) argues that progressive pedagogy is much more student-centred the teacher's main role is to facilitate learning to happen. Learners should be allowed to work at their own speed, by not giving long explanations, but rather encouraging them to talk, participate, interact and do things. As an example of a progressive pedagogy, the ASEI-PDSI pedagogy is an innovative approach of teaching championed by the SMASE INSET programme. Onchong'a (2013) notes that innovation is a type of change in which something new is added to an existing phenomenon and stresses that it should be simple enough to be understood and utilized. Daft (2004) considers innovation as a deliberate attempt to improve practice in relation to certain desired objectives. However, as Daft (2004) observes, implementation of change is often the most difficult part of the change process.

According to Oluoch (1982) as cited in Onchong'a (2013), an effective implementation of innovation involves among other things, persuading a variety of people to accept the innovation, keeping the general public informed, training the teachers, provision of necessary facilities, supply of materials and equipment, actual practice of the innovation, and providing continuous support for teachers. In this regard, the SMASE project had the support of MOEST, teachers' trade unions (KNUT and KUPPET), head teachers associations and County administration (CEMASTEA, 2013).

Training of teachers is however, the most fundamental component of the innovation. Teachers are required to have an adequate understanding of the approach and its elements. The SMASSE/SMASE intervention strategy was a pedagogical shift, coined as the *Activity-focused, Student-Centered, Experimenting and Improvisation (ASEI) through Plan, Do, See and Improve (PDSI) approach* (SMASSE, 2006; 2008).

The approach entails **Activity** focused teaching and learning, which means the teacher should plan for how the learner should actively participate right from the beginning of the lesson. The **Student-centred** teaching and learning, can be accomplished through encouraging students to give their prior experiences and explaining their ideas related to the content (known to unknown concept). In addition, learners are encouraged to give their own predictions/hypotheses and helped to discuss how they differed from those held by others.

Through **Experiments,** learners can verify their hypothesis and which can also lead to more discoveries. Learners are encouraged to observe and record what they see and at the same time discuss with their peers as well as the teacher their findings. Experiments will enhance understanding of the various concepts learned. In order to arouse interest, curiosity and sustain learners' motivation, the teacher is expected to be creative and innovative to **Improvise** and use the materials in the immediate environment. Improvisation is a welcome strategy for schools without the expensive conventional instruments and makes it possible for conduct of simplified/modified experiments. Further, improvisation provokes learners to extend their experimenting initiative to their homes-a practice that led to famous discoveries in the world.

In order to actualize the principles of ASEI which are: activity-based teaching as opposed to knowledge-based teaching; student-centred learning instead of teacher-centred teaching; experiment and research-based approaches as opposed to the traditional lecture approach; and Improvisation and small-scale experiments to replace large-scale experiments, the teacher is expected to adopt PDSI (Plan, Do, See, Improve) approach which in practice should be employed in tandem with ASEI (SMASSE, 2009). **Planning** entails the

preparation of schemes of work, lesson plan, the tools and apparatus to conduct experiments and improvisation of materials essential for learner centred activities. **Doing** is concerned with lesson delivery; the instructional process based on the lesson plan-introduction of the lesson should incorporate previous knowledge, skills and everyday experience and linked the topic; the introduction should be clear on what the teacher wants the students to learn besides being stimulating enough to arouse the interest and curiosity of the students. The teacher should deal with students' questions, misconceptions and reinforce learning at each step; lesson should encourage active participation of students as much as possible in the main teaching steps.

Seeing involves evaluation of the lesson at all stages of its development. The teacher should supervise learners as they attend to the class work. This will require the teacher to move around the class sometimes responding to individual learners' needs. Furthermore, the teacher should strive to have eye contact with students to monitor their feelings. The teacher should also invite questions from students; and the teacher should ask questions to check quality of understanding. Evaluation need also be done by teacher's colleagues who may be invited to observe the lessons and offer feedback. In regard to **Improvement,** this involves making appropriate improvements during the development of the lesson and/or in the subsequent lessons based on the feedback obtained in the See component of this approach. This is evidenced by the teacher rephrasing questions or instructional statements as necessary; teacher interjecting rightly and calling to attention from students; teacher giving further guidance to students on lesson activities; and the teacher making appropriate adjustments in the conduct of the lesson (SMASSE, 2008, 2009).

Animata (2015) notes that there are a number of attempts to evaluate the extent of teachers' implementation of ASEI-PDSI. For instance, the nationwide SMASSE project impact assessment survey conducted in 2004 among other things established that teachers who had been exposed to the ASEI-PDSI approach were more confident, planned better and more consistently, attended to students' needs better, were more open to teamwork, tried out new methods of teaching, and were more proactive in using improvised materials. Additionally, students handled by such teachers were more positive towards activity based learning and especially in mathematics. However, according to Onchong'a (2013) it is instructive to note that the series of SMASSE surveys that give favourable assessment are internally done and there was a possibility to justify the continued allocation of resources into the programme.

A study by Sifuna and Kaime (2007) to establish the impact of SMASSE Programme on Classroom Interaction, found out that while teachers perceived the SMASSE INSET programme as having been effective in exposing them to a student-centred approach, this was not reflected in their classroom practices which were largely teacher-dominated. This was partly attributed to large classes, the use of English as second language, and pressure to cover the syllabuses in preparation of the national examinations.

Barasa (2015) conducted a study to establish the influence of strengthening mathematics and science education on pupils' science performance in public primary schools in Samia Sub-County, Kenya. The study found that half of the teacher respondents did improvise teaching and learning resources. Regarding the teachers' attitude, the study revealed that more than 75 % percent of teachers found ASEI/PDSI lesson plan difficult to prepare. Barasa (2015) eventually concluded that ASEI/PDSI approach has not been fully

implemented by science teachers as expected after the SMASE in-service training and recommended that MOE, KICD in conjunction with CEMASTEA should provide prepared ASEI/PDSI lesson plans for teachers.

However, Barasa (2015) study had two major weaknesses in that the researcher used questionnaires and interview guides and omitted the crucial lesson observation schedule. Secondly, the questionnaire items meant to cater for both science and mathematics issues were very general, and thus failed to capture specifically what goes on in a mathematics class. The current study not only focussed on implementation of ASEI-PDSI pedagogy specifically in mathematics but also used the lesson observation schedule to document the details as the lesson unfolded. Studies by Abong'o (2013), Ngetuny (2013), and Gachuhi (2013) also examined the efficacy of ASEI-PDSI pedagogy but were mainly focused on secondary level science and mathematics. While most of secondary schools have fairy equipped laboratories in Kajiado North Sub County, public primary schools do not have such facility. The current study aimed at establishing the students and teachers innovations in such deprived conditions in a bid to enhance performance in mathematics.

2.3 Head Teachers' Supervision of Teachers' use of ASEI-PDSI Pedagogy and Pupils Academic Performance in Mathematics

According to Wanzare (2013) the school head teacher instructional supervision entails monitoring teachers' instruction-related duties, providing teachers with teaching resources, visiting classrooms to observe lessons, and providing assistance and support to help teachers do their work effectively. Osman and Mukuna (2013) asserts that instructional supervision roles performed by head teachers include; monitoring of teachers' attendance during lessons. Wanzare (2012) proffer that effective principals are expected to be effective

instructional leaders. To be an effective instructional leader, the principal must be knowledgeable about curriculum development, staff development, clinical supervision, and teacher evaluation. A similar view is advanced by Quattlebaum (2013) and adds that the principal must be active and should collaborate with teachers in order to actualize the shared goals.

Fullan (1994) cited in Osman and Mukuna (2013) aver that schools managed by principals regarded by their teachers to be strong instructional leaders, do exhibit to a large extent better scores in reading and mathematics than did the schools operated by average and weak instructional leaders. Ololube and Major (2014) maintains that for an effective instructional leadership, the head teacher should also be a practicing teacher and who interacts with learners in class quite often. This observation is supported by Popham (2010) who found that the most important thing contributing to principals' instructional leadership in the United Kingdom was the fact that all continued to teach for an average of about 20% of the week.

From the fore going discussion, it is expected that head teachers in Kajiado North public primary schools should lead by example and apply ASEI-PDSI approach when handling their lessons. In doing so, they will have the moral authority to observe, identify and discuss with teachers the areas that will need intervention in order to improve pupils KCPE performance in mathematics. By checking the schemes of work and lesson plan, the head teacher should be able to deduce the extent to which a teacher will be ASEI-PDSI approach compliant. Starting with the lesson objectives, the supervisor is expected to scrutinize the planned pupils' activities, apparatus to be used and the expected results. Makokha (2017) found a significant relationship between head teachers level of support and the teachers of

use instructional improvised materials. It was found that head teachers who encouraged teachers and learners to explore on ways of using the materials in their environment, offered funds for the necessary modifications and allowed time to gather the materials, reported improved performance in mathematics and science subjects.

Aminata (2015) aimed at establishing relationship between principals' rating of their support for the adoption of the ASEI – PDSI approach in teaching Mathematics and girls' achievement in KCSE Mathematics among Nairobi County secondary schools. The study found that although most principals provided high level of support the adoption of ASEI-PDSI pedagogy by providing teaching and learning resources as well as allowing mathematics teachers to attend INSETS, monitoring and evaluation of the implementation of the approach was hardly done. Thus in some schools teachers reverted back to the examination based teaching. The study, however, apart from being conducted among secondary schools where the SMASSE project has lasted longer than in the primary schools sector, it targeted the case of girls only. The current study focussed on implementation of ASEI-PDSI pedagogy in public primary schools in regard to pupils' performance in mathematics regardless of gender.

2.4 Teachers' Attitude towards ASEI-PDSI Pedagogy and Pupils' Performance in Mathematics

Attitudes are feelings and beliefs that to a large extent influences how one perceives their environment, commit themselves to the intended actions and ultimately behave (Newstrom & Davis, 2002). According to Lenga (2001) cited in Barasa (2015), in everything a person does, success is determined by the attitude with which the person appreciates it. Thus, it

follows that teachers' attitude towards the innovations and readiness to implement resolutions in class will largely determine the success in their profession.

Khochen and Radford (2012) regards the term attitude as the sum total of man's inclination and feelings, pre-conceived notions, prejudice or bias, fears, ideals, threats, and convictions about specific topic. Thus, attitude is a personal disposition that impels an individual to react to an object, situation or proposition in favourable or unfavourable way. Coles and Scior (2012) emphasizes that an attitude is an organized and consistent manner of thinking, feeling and reacting to people, groups, social issues or more generally to any event in the environment. From the various definitions of attitude, it implies that the mathematics teacher attitude towards ASEI-PDSI pedagogy will to a large extent determine the planning of students' activities, the apparatus to be used, improvisation where conventional materials are lacking, and consistency in lesson evaluation.

Marete (2004) explicates that attitudes consist of three components. These are; cognitive, affective and behavioural components. The cognitive component is related to thoughts and beliefs, the affective relates to emotions or feelings, and the behavioural components relates to action. These three components of attitude interact with each other and an attitude is formed. When the three components are so interacted, specific feelings and reaction tendencies become consistently associated with the attitude object.

Attitudes influence teachers' thinking, behavior, and motivation and as such the strength of teachers' attitudes helps determine how much effort they will expend on an activity, how long they will persevere when confronted with obstacles, and how resilient they will be when faced with adversity (Van Hoorn, Nourot, Scales & Alward, 2011).

Teachers are the most important personnel in the implementation of any school programme. Wanzare (2013) postulates that the actions of individual teachers in their classrooms are instrumental in determining the success or failure of implementation or improvement of a programme regardless of the school manager's talents and expertise. The teachers' action mainly depends on the attitude they possess towards the programme. However, it is instructive to note that the teachers' action arising from the favourable disposition towards the ASEI-PDSI pedagogy can be thwarted by several school based factors such as lack of basic resources and weak administrative and monitoring structures.

A study by Ngetuny (2013) on factors affecting the success of SEMASE initiative in secondary schools In Koibatek Sub – County, Baringo County, found that on average 53 % of mathematics and science teachers had positive attitude towards SMASE whereas 47 % had neither positive nor negative attitude towards the same. These findings implied that half of the teachers were yet to acquire attitude change.

In a similar study, Mwelese and Atwoto (2014) conducted a study to determine the effects of the ASEI – PDSI approach on students' achievement in mathematics and the effect of ASEI-PDSI approach on students' views and attitudes towards the learning and teaching of mathematics among seconday schools in Vihiga County. Using a true experimental research design based on Solomon four-fold design, 152 students were randomly assigned to four groups. The control group was kept under a control condition by providing traditional competitive situation in class while the experimental group was provided with the ASEI-PDSI approach as treatment. The study findings showed students who went through ASEI-PDSI pedagogy performed better in geometry than the other group. In addition, students taught through the ASEI-PDSI approach had a better view and attitude

towards mathematics than those taught through the traditional approaches. The study targeted secondary students and did not seek views on teachers' attitude on the approach. The current study sought to establish the influence of teachers' attitude on learners KCPE performance in mathematics.

Gachahi, Kimani, Njagi and Ngaruiya (2014) conducted a study to investigate the headteachers' and teachers' perceptions towards SMASE programme and primary school pupils' mathematics and science achievement in Murang'a County. Among other findings the study found that both teachers and head teachers had a negative attitude towards SMASE programme and that teachers and head teachers' attitudes had no statistically significant relationship with pupils' grades in mathematics and science. Gachahi et al., (2014) postulate that pupils were performing well in sciences and mathematics regardless of their teachers' attitude towards SEMASE programme due to the intensive examination oriented drill methods employed by teachers. The study consequently noted that, failure to embrace activity based student centred learning at primary level especially in sciences and mathematics sets a stage for great difficulties and poor performance at secondary level.

It is therefore, evident that the various studies conducted in different regions on teachers and head teachers attitude towards the SMASE programme, implementation of ASEI-PDSI pedagogy and their influence on learners academic performance have varied results. It was therefore incumbent to establish the attitude of teachers' and the overarching dynamics which influence pupils' performance in mathematics in a specific region with a view to improve the performance.

2.5 Summary of Reviewed Literature and Information Gaps

The literature reviewed has revealed that apart from CEMASTEA there are also a number of researchers (Abong'o, 2013; Gachahi et al., 2014; Mwelese & Atwoto, 2014; Ngetuny, 2013) and others who have investigated the effectiveness of SMASSE programme in improving learners' performance in sciences and mathematics, and changing the teachers and students attitudes towards these subjects. Apart from conflicting findings from these studies most of them targeted the secondary schools. In addition, most of the studies did not do a comprehensive lesson observation in order to establish to what extent they were ASEI-PDSI compliant. Further, most studies investigated the implementation of ASEI-PDSI generally in both science and mathematics and thus failed to delve into specific pertinent issues in mathematics. Thus, while most studies were focused on the success and attitude towards SMASSE/SMASE programmes in general, the current study specifically sought to establish the influence of ASEI-PDSI pedagogy on KCPE performance in mathematics.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter explains and outlines the methodology that was used in achieving the objectives of the study. The chapter consists of the following subsections; research design, research site, target population, sample size and sampling techniques, data collection measures, pilot testing, validity and reliability of data collection instruments, data processing and analysis, and legal and ethical considerations.

3.2 Research Design

Creswell (2012) defines a research design as the scheme, outline or plan that is used to generate answers to research problem. It constitutes the blue print for the collection of measurement and analysis of data (Kothari, 2008). This study adopted a cross sectional survey design. In a cross sectional survey, data are collected at one point from a sample selected to describe some large population at that time. Such survey can be used not only for purposes of description but also for determination of relationships between variables at that time of study (Orodho, 2012). The cross sectional survey design was found appropriate since the researcher conducted a class observation once in each sampled school in order to witness and establish the degree to which the ASEI-PDSI approach was understood and practiced by mathematics teachers.

3.3 Research Site

Research site defines the area to which the study will be conducted and is vital as it influences the importance of the outcome produced (Kombo & Tromp, 2006). The study was carried out in Kajiado North Sub County, in Kajiado County. Kajiado Sub County has

two educational zones; Ngong and Ongata Rongai. The two zones have 14 public primary schools (MOE, 2018). The site was selected due to the persistent low performance in KCPE mathematics despite the implementation of the SMASE ASEI-PDSI pedagogy.

3.4 Target Population

Gall, Borg & Gall (1996), define population as all the members of a real or hypothetical set of people, events or objects to which a researcher wishes to generalize the results of the study. According to Kajiado County education office, there are14 public primary schools in Kajiado North Sub County. The study targeted 14 head teachers and all class seven and eight mathematics teachers in all the 14 public primary schools in Kajiado North Sub County. Class seven and eight mathematics teachers were targeted because apart from the fact that most have gone through SMASE INSET, they are more involved in preparing pupils for KCPE mathematics. The head teachers were targeted since being the school managers, they were responsible in providing teaching resources crucial in teaching and learning mathematics and above all they were entrusted in teachers' supervision.

3.5 Sample and Sampling Techniques

A sample is a subgroup of the target population which is used to generate the required data for the study (Creswell, 2014). According to Orodho (2012) when the target population is small, the researcher can sample the entire population. Scheaffer, Mendenhall, Ott and Gerow (2011) aver that census survey is the approach where the population is equal to the sample. Thus, the researcher used census sampling technique to sample all the 14 head teachers for interview while two teachers (class seven and class eight teachers) from each school were sampled. Some schools had several streams and thus, more than one

mathematics teachers in classes seven and eight. In such a situation, simple random sampling was used to select one teacher. Table 3.1 shows the study sample frame.

Table 3.1: The Study Sample Frame

Category	Population	Sample	Percentage	Sampling Technique
Teachers	39	28	71.8%	simple random
Head teachers	14	14	100 %	Census
Total	**53**	**42**	**79.2 %**	

3.6 Data Collection Measures

The study employed three data collection instruments: Mathematics Teachers' Questionnaire (MTQ), head teachers interview schedule and class observation schedule.

3.6.1 Mathematics Teachers' Questionnaire (MTQ)

Kothari (2008) considers questionnaires as the heart of a survey operation. Use of questionnaires allows greater uniformity in the way questions are asked and hence ensuring greater comparability in the process. The Mathematics Teachers' Questionnaire (MTQ) was semi-structured. It consisted of open ended questions where respondents expressed their views in their own words and closed ended questions where factual responses were captured. MTQ was made of sections A, B, C and D. Section A gathered demographic information, section B sought information on the mathematics teachers' implementation of ASEI-PDSI pedagogy, section C was geared to collect data on head teachers' supervision of the implementation of ASEI-PDSI pedagogy, while section D sought information in regard to teachers' attitude towards ASEI-PDSI pedagogy.

3.6.2 Head teachers' Interview Schedule

According to Orodho (2012), to interview is to collect information in the form of oral-verbal responses and answers regarding oral-verbal questions. The advantage of the interview method is that it allows an in-depth response from the respondent and enables the interviewer to probe the respondents. Scheaffer et al., (2011) proffer that interview method of collecting data is often seen as superior than other instruments in that it creates rapport between the respondent and the researcher. The study used unstructured interview schedule to gather views from head teachers in regard to teachers' use of ASEI-PDSI pedagogy. Additionally, it was also used to assess the extent to which head teacher supervise and support teachers as they exploit the innovative approach to enhance performance in KCPE mathematics.

3.6.3 Mathematics Lesson Observation Rating Scale

Observation procedure can record naturally occurring behaviour and avoid some of the disadvantages associated with the questionnaires and interview guides (Kombo & Tromp, 2009). The researcher used the mathematics lesson observation rating scale (Appendix IV) to rate the extent to which teachers had implemented ASEI-PDSI pedagogy. The scale comprised of several sections namely: introduction, lesson development, conclusion and use of instructional materials. According to Kamindo (2008), a well-prepared professional documents do not translate to effective teaching in class and as such, the researcher aimed at witnessing the actual use of the prepared documents. In addition, the sufficiency of work given to students, assessment, teacher/student interaction, methodology and teaching strategies was also noted.

3.7 Pilot Testing of Research Instruments

Creswell (2012) observes that it is vital for a researcher to test tools before using them to ensure their validity, reliability and practicability. Therefore, piloting was done in order to ascertain the credibility of the tools by testing clarity of language, time taken to respond, procedure of administering, length and layout of tools. Piloting involved two head teachers and 10 mathematics teachers from two public primary schools in the neighboring Kajiado East Sub County but with similar characteristics with those who participated in the actual study. The participants were encouraged to comment and make suggestions which were later used to improve various items. The main aim of the pilot study was to enhance validity and reliability of the data collection instruments (Creswell, 2014; Mugenda & Mugenda, 2009).

3.8 Validity of Instruments

Validity refers to the correctness, meaningfulness of inferences and soundness of outcomes of conclusion, which are based on the research findings (Kothari, 2008; Mugenda & Mugenda, 2009). The researcher sought the expert opinion on content and construct validity. The questionnaire was availed to the two supervisors assigned to the researcher in order to review the instruments. Comments solicited from them were used to enhance the research instruments before commencing data collection. Moreover, the instruments was piloted to improve questions, formats and scales. The results from the piloting together with the comments from the supervisors were incorporated in the final instrument revisions to ensure its validity.

3.9 Reliability of Instruments

Reliability is a measure of a degree to which a research instrument yields consistent results or data after repeated trials (Kombo & Tromp, 2006). Reliability of quantitative items in the questionnaires was established by computing Cronbach's alpha coefficient which is an estimate of internal consistency. It is suitable for items that do not have right or wrong answers such as in a Likert scale. A coefficient of 0.82 was obtained. According to Creswell (2012), in social sciences, a reliability coefficient of 0.6 and above is satisfactory for any research instrument while Bowling (2002) considers an alpha index of 0.5 or higher as a sign of acceptable internal consistency.

However, according to Creswell (2009); Cohen, Manion and Morrison (2007), the reliability of research instruments in qualitative data (MTQ open ended questions and head teacher interview data) focuses on the researcher for being the instrument itself. In qualitative research, both validity and reliability of research instruments are treated together. The trustworthiness of a researcher therefore involves credibility, transferability, dependability and confirmability. According to Lincoln and Guba (1985) as cited in Kamindo (2008), credibility (truth value) refers to confidence in the findings from informants and the context in which the study was undertaken. In this study, the researcher allowed respondents to consent to participate in the study, the right to withdraw and encouraged them to be frank.

3.10 Data Processing and Analysis

Upon completion of the data collection, the data collection instruments were checked for completeness and numbered as a form of identity during the data entry. Responses in all the questions were assigned numeric values to be used when entering the data. Data was

then entered in the International Business Machines Statistical Package for Social Sciences (IBM SPSS) version 22, cleaned or checked for any mistakes in entry, before the data analysis. Both descriptive and inferential statistics were used to analyze the data. Descriptive statistics such as percentages, means, bar graphs, pie charts and frequencies were used to report the data. The study three formulated hypotheses were tested by use of multiple regression analysis. Qualitative data generated from the head teachers' interview and Mathematics Teachers Questionnaire open ended questions were put into simple narratives for easier discussion and interpretation. However, verbatim quotations and excerpts from note book were also used in a bid to retain the respondent original message.

3.11 Legal and Ethical Considerations

The researcher followed ethical guidelines to ensure that all the participants of the study were treated with respect and consideration. Before proceeding with data collection and analysis, approval was sought from Africa Nazarene University, the Kenya National Commission for Science, Technology and Innovation (NACOSTI) and the Kajiado North Sub County Education Officer. Additionally, permission to interact with teachers was sought from the administrative personnel of the participating schools. The participants were informed (transmittal letter) of the nature and purpose of the study. Additionally, respondents were made aware that their participation was voluntary and that they had the right to withdraw from the study at any time. Every effort was made to ensure the confidentiality and anonymity of the participants, including removal of names and details from quotes and descriptions that might have revealed the identity of an individual, and by using numeric labels when quoting the participants' statements.

CHAPTER FOUR

RESULTS AND ANALYSIS

4.1 Introduction

This chapter presents the results and analysis of the data collected in this study. The purpose of the study was to examine the influence of ASEI-PDSI pedagogy on pupils' performance in mathematics in public primary schools in Kajiado North Sub County, Kenya. The study objectives were: to assess the influence of the level of teachers' use of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics, to examine the influence of the head teachers' supervision of teachers' use of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics, and to establish the influence of teachers' attitude towards the use of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics in public primary schools in Kajiado Sub County. Data were collected through mathematics teachers' questionnaire, head teachers' interview schedule and mathematics lesson observation rating scale. Both quantitative and qualitative data were collected. Data were analyzed as per the research objectives. The three null hypotheses of the study were tested using multiple regression analysis at a significance level of 0.05. Qualitative data from the head teachers' interviews were analysed concurrently with the quantitative data.

4.2 Response Rate

The study sampled 28 mathematics teachers and 14 head teachers. All mathematics teachers and 12 head teachers took part in the study. Thus, the response rates for mathematics teachers, and head teachers' were 100% and 85.7% respectively. Babbie (2014) postulates that a response rate of more than 70 per cent is considered sufficient for a study.

4.3 Demographic Information

The study found it necessary to analyze the demographic information of respondents, which formed the basis under which some of the interpretations were made. The demographic information sought included: gender, age bracket, highest professional level attained in teacher education, teaching experience, teaching load and attendance of SMASSE INSETS.

4.3.1 Gender of Respondents

The researcher sought to establish the gender distribution of the respondents. Table 4.1 depicts the finding.

Table 4.1: Gender Distribution of Respondents

Gender		Frequency	Percentage
Mathematics Teachers	Male	18	**64.3**
	Female	10	**35.7**
	Total	**28**	**100.0**
Head teachers	Male	6	**33.3**
	Female	6	**66.7**
	Total	**12**	**100.0**

Table 4.1 shows that 18 teachers constituting 64.3% were male while 10 teachers constituting 35.7% were female. This showed male teachers dominated the teaching of mathematics in classes 7 and 8 in public primary schools in Kajiado Sub County. There was, however, gender parity in headship.

4.3.2 Age Bracket of Respondents

The researcher sought to establish the respondents' age bracket distribution. Table 4.2 depicts the finding.

Table 4.2: Respondents' Age Bracket Distribution

Age in years	Category			
	Mathematics Teachers		Head Teachers	
	f	%	f	%
< 30	3	10.7	0	0.0
30-40	5	17.9	1	8.3
41-50	12	42.9	6	50.0
>50	8	28.6	5	41.7
Total	**28**	**100.0**	**12**	**100.0**

As shown in Table 4.2, eight mathematics teachers constituting 28.6 % were 40 years and below, 42.9 % were in the bracket of 41 to 50 while eight were above 50 years of age. Thus, over 70.0 % of teachers were over 40 years of age implying that SMASSE training should continue training more teachers as the trained teachers continue to exit after attaining the retirement age. Similarly, over 40 % of head teachers were above 50 years and their exit should be planned by ensuring more ASEI-PDSI trained head teachers would take the mantle in future.

4.3.3 Mathematical Teachers' Highest Level of Professional Training

The study also sought to establish the mathematics teachers' highest level of professional training. More exposure to mathematics education can help a teacher to be more proactive and innovative in preparing more learner centred lessons. Figure 4.1 shows the findings.

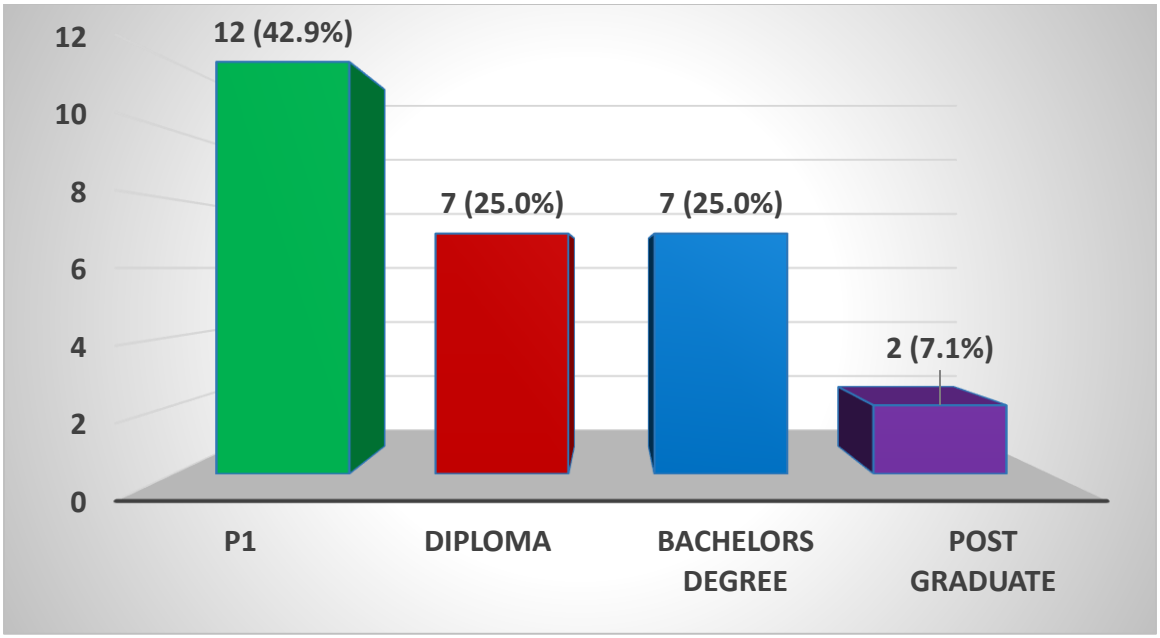

Figure 4.1: Mathematics Teachers highest level of Professional Training

In reference to Figure 4.1, most of the sampled class teachers (42.9 %) had P1 certificates while only two (7.1%) had post graduate education. This meant that all the sampled mathematics teachers were trained in pedagogy and they could easily adapt to ASEI-PDSI pedagogy.

4.3.4 Mathematics Teachers' Teaching Experience

The study also sought to establish teachers' teaching experience. Figure 4.2 shows the distribution of teaching experience.

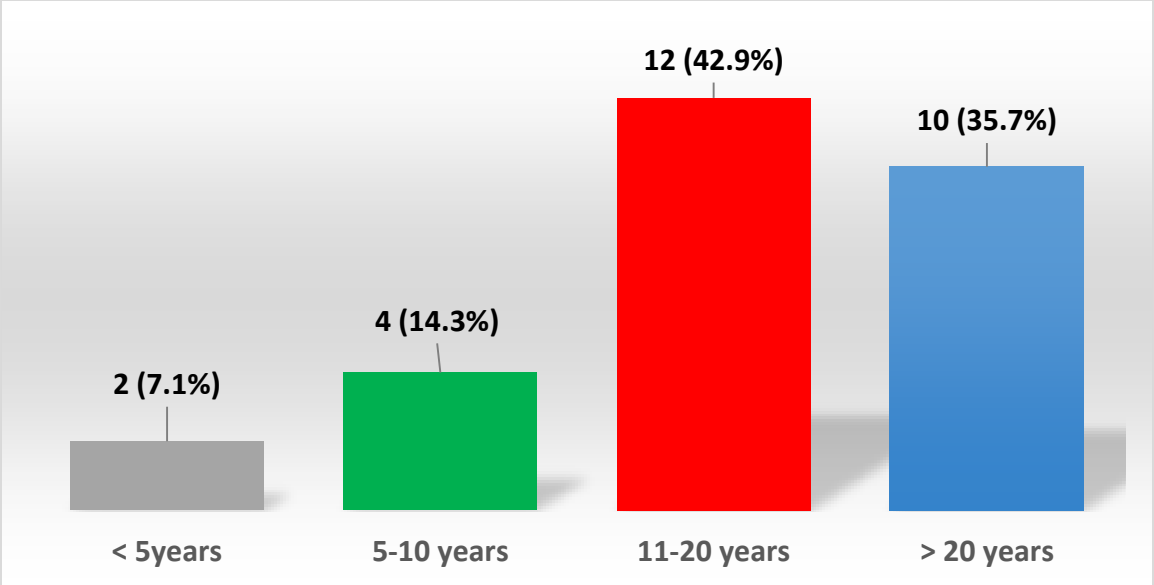

Figure 4.2: Mathematics Teachers' Teaching Experience

As evident from Figure 4.2, only two (7.1%) mathematics teachers had an experience of less than five years. As high as 78.6% of teachers had an experience of 11 years and above. This meant that most of the teachers were highly experienced and most are aware of the locally available materials that could be used to improvise the required mathematical apparatus.

4.3.5 Mathematics Teachers' Teaching Load

The study sought to establish the mathematics teachers teaching load. The use of ASEI-PDSI pedagogy being a pedagogical shift of classroom practices from content based to activity-focused teaching, requires a teachers to have ample time for planning the class activities. Thus, a mathematics teacher teaching load was significant factor in determining the success in use of ASEI-PDSI pedagogy. Figure 4.3 depicts the distribution of mathematics teachers' workload (number of lessons per week).

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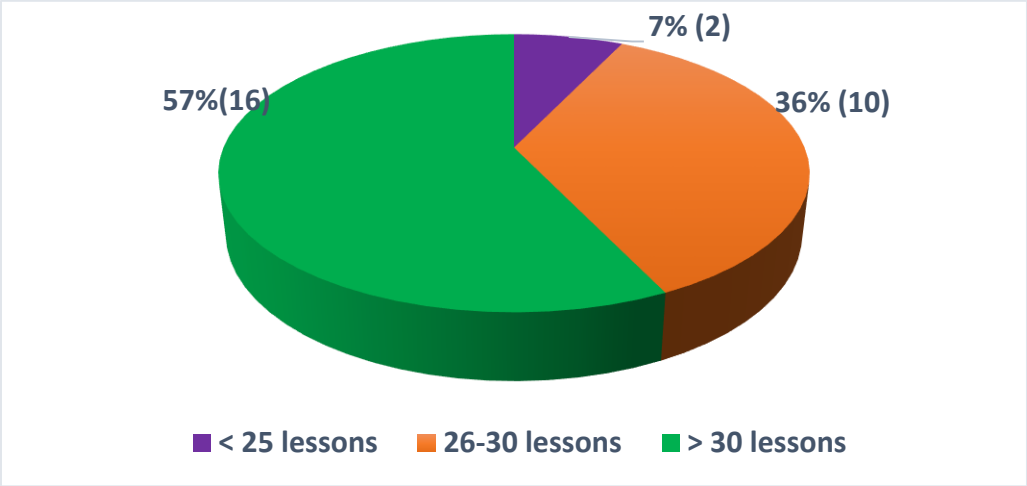

Figure 4.3: Mathematics Teachers Work Load

As evident from Figure 4.3, majority of teachers (57%) had very high work load of over 30 lessons per week which translated to an average of over six lessons per day. The high work load must have brought a big burden to mathematics teachers as they implemented the ASEI-PDSI pedagogy.

4.3.6 Attendance of SMASE INSET

The study sought to establish the mathematics teachers who had attended SMASE INSET. Out of the sampled 28 teachers, 25 teachers constituting 89.3% indicated that they had attended the INSET. This implied that almost all the teachers under study were conversant with ASEI-PDSI pedagogy and therefore could respond to the questionnaire with ease.

4.4 Mathematics Teachers' Implementation of ASEI-PDSI Pedagogy and Pupils' Academic Performance

The first objective of the study was to assess the influence of the teachers' use of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics in public primary schools in Kajiado Sub County. To achieve the objective, the study analyzed quantitative and

qualitative data from mathematics teachers' questionnaire and the head teachers' interview schedule. The mathematics teachers' questionnaire had a set of statements in form of a likert scale where teachers indicated the extent to which they implemented the ASEI-PDSI pedagogy. The questionnaire responses were coded such that to 'very large extent' was rated number 4; to 'large extent' number 3; to 'small extent' number 2; while 'to no extent' number one. The mathematics teachers' mean responses were computed such that: 1 to 2.5 was considered as to a 'small extent' while 2.6 to 4 was considered as to a 'large extent'. Table 4.3 shows the analyzed data in means and standard deviations (SD).

Table 4.3: Mathematics Teachers Mean Response on the Implementation of ASEI-PDSI Pedagogy

Statement	Mean	SD
My lessons are normally activity based and student centred	2.6	1.0
My lesson plans are done in accordance with ASEI-PDSI approach	2.6	0.8
I do plan and gather teaching aids long before the lesson	3.1	0.7
I do improvise and use locally available materials	2.8	0.5
I involve my pupils in gathering locally available teaching resources	3.2	0.4
I often use experimental/discovery method in derivation of formulas such as $C = 2\pi r$ and $S = 2\pi r^2 + 2\pi rh$	2.7	1.1
I do encourage views from pupils on how to improve my content delivery	3.4	0.5
I sometimes give research based mathematical problems	2.3	0.9
I have divided my class into discussion groups	2.9	0.6
I do invite my colleagues to evaluate my lesson as recommended by SMASE INSET, for further improvement	2.2	0.8
Aggregate Score	**2.8**	**0.7**

n = 28

As noted in Table 4.3, most of the teachers indicated that their lessons were normally activity based and student centred (Mean = 2.6, SD = 1.0). Further, their lesson plans were done in accordance with ASEI-PDSI approach (mean =2.6, SD = 0.8). Similarly, most of

the teachers affirmed the use of most of the recommended practices in ASEI-PDSI approach such as planning and gathering teaching aids long before the lesson (Mean = 3.1, SD = 0.7), improvising and using the locally available materials (Mean = 2.8, SD = 0.5), involving pupils in gathering locally available teaching resources and making use of experimental/discovery method in derivation of formulas such as $C = 2\pi r$ and $S = 2\pi r^2 + 2\pi rh$ (mean = 2.7, SD =1.1). However, the relatively high standard deviation was a manifest of the great variation in teachers' response. Some teachers were categorical that they could not apply ASEI-PDSI approach with fidelity since they could not finish the mathematics syllabus. One of the teacher wrote in the open ended section of the questionnaire, thus:

> To me ASEI-PDSI is an theoretical idea whose actual practice cannot be attained…I have 29 lessons a week, I am expected to gather various materials to facilitate practical approach in my mathematics lessons and if possible carry out an experiment in advance…this time is practically not there…I therefore, most often teach students how to answer and succeed in the KCPE. (Teacher 10)

A head teacher had similar sentiments as exemplified by the following comment:

> Before I became the head teacher, I had attended a number of SMASE INSETS…I did apply ASEI-PDSI approach in my class for some time with notable results… however, due to pressure of inadequate time for preparation and implementation and lack essential materials, I reverted to teacher centred teaching approaches…ASEI-PDSI approach requires commitment, resilience and an innovative mind. (H 7).

Further, when head teachers were requested to rate and comment on the teachers' accomplishment of SMASE objectives of cultivating a positive attitude and adoption of activity based student centred learning, they had varied responses. Some of the responses were as follows:

> I would rate the teachers' implementation of ASEI-PDSI pedagogy as good since there has been an improvement in KCPE mean performance. If all the mathematics and science teachers get a chance to get SMASE training, our pupils would experience tremendous improvement. (Head teacher 7).

> When the SMASE INSET was being conducted twice per year, I would rate mathematics teachers at 80%, but with the current trend where teachers have lacked commitment, the gains are fading…some teachers hardly attend the INSET for two hours…they spend almost the whole day attending to their personal issues and thus gain very little. The organizers should be stricter on the attendance and actual participation. Though our pupils seem more excited when preparing learning materials, their grades have remained static. (Head teacher 11).

> I would rate it as 4/10 even though it is not going on. I agree that teacher have been taught activity based and more practical oriented approach of teaching mathematical concepts…but am yet to see teaching carrying anything extra apart from the text book as they go to class…..furthermore our pupils grades in KCPE mathematics are on the downward trend (Head teacher 1).

Some of the head teachers, however, confessed to have known very little in regard to what was taught during SMASE INSETS and thus, were not in a position to competently rate their teachers. The following are some comments from head teachers:

> Honestly, I have never attended SMASE INSET or get trained on ASEI-PDSI pedagogy. I have gathered some information from my mathematics teachers that the emphasis is usually on the students' practical activities as they pursue discovery method in learning various concepts…I only hope my teachers are keen in implementing the new approach. We have almost everything in regard to mathematics teaching aids…in fact we have a special mathematics room where instruments are kept and simple repairs are done. (Head teacher 12).

> Though, I know very little about ASEI-PDSI, I am in support of its implementation, since I have realized pupils have developed a lot of interest in mathematics resulting to improved grades. Some teachers are however, skeptical of the time spent by pupils in constructing models as they accomplish their assignments. Teachers fear that pupils might ignore other and equally significant subjects…but for me, improvement in mathematics grades can lead to great improvement in overall school results. (Head teacher 6).

The fore mentioned sentiments from head teachers was a clear indicator that some head teachers knew little about ASEI-PDSI pedagogy and it was upon the mathematics to do their best in implementation of pedagogy without any supervision. It then follows that the level of teacher's self-motivation, attitude and commitment would be critical in enhancing pupils' performance in KCPE.

Most of the mathematics teachers, indicated that they give research based mathematical problems to a small extent (mean = 2.3, SD = 0.9). This meant that teachers hardly gave research based mathematical problems. One of the interviewed head teachers commented in regard to research based mathematics assignment, thus:

> Although SMASE INSETS encourages research based mathematical assignments for standard 6,7and 8, teachers are normally under pressure to drill learners for high grades…as such they give facts and formulas where necessary and most concepts are taught in as abstract manner. That is why our hope is in the new curriculum in which the focus will shift from teaching to pass exam to understanding of concepts. (H 10)

Similarly, teachers' did invite colleagues to evaluate their lessons as recommended by SMASE INSET to a small extent (mean =2.2, SD = 0.8). Although most of the interviewed head teachers supported collegial form of supervision in which teachers within a certain department could support each other through class observation, they expressed frustrations due to lack of teacher cooperation. Some of the head teachers had the following comments, thus:

> Most of the teachers are still not comfortable when their class teaching is being observed… I think the phobia of fault finding associated with inspection is deep rooted in them. When I visit some of the classes, some teachers appear very uncomfortable and I could tell that the planned objectives are not achieved. We had once planned for head of mathematics department to ensure collegial teaching is practiced as taught during SMASE INSETs but never took off. (Head teacher 3).

> The SMASE trainers are very particular on teachers supporting each other in perfecting the art of implementing the PDSI-ASEI approach…when I attended one of the INSETS, we spent the whole day peer teaching. In so doing. Teachers were able to point out the gaps as their colleagues taught the topics of their choice. I belief the same should often be practiced in our school among the mathematics teachers. For instance teachers should assist each other on the best way to demonstrate using open and closed cans how volume of different shapes can be determined farther using the established formulas. (Head teacher 8)
> In my school, the lead teacher, initiated the induction of new teachers and who had no training in ASEI-PDSI pedagogy. The move has enabled the teachers to make maximum use of the teaching aids. Learning the mathematics concepts through practical approach has enabled our pupils to score relatively good marks than

> before. I witnessed one of the sessions and I also came to discover how some the formulas that seemed complicated were derived from the basic simple formulas and that one can easily derive them when forhgotten. (Head teacher 5)

Overall, teachers indicated that they use the ASE-PDSI pedagogy to a 'large extent' (mean =2.8, 0.7). In order to ascertain the internal validity of this finding, the researcher employed a mathematics lesson observation tool. The next Section 4.4.1 expounds on mathematics lesson observation findings.

4.4.1 Data Analysis from Mathematics Lesson Observation Rating Scale (MLORS)

In order to triangulate information collected from the mathematics teachers' questionnaire (MTQ) in regard to use of ASEI-PDSI pedagogy, the researcher used the Mathematics lesson observation rating scale (MLORS) (Appendix IV). To accomplish the objective, the researcher rated the lesson introduction, development, conclusion and use of instructional materials. The rating was done such that: 'Not done' was rated number 1; 'Fair' number 2; 'Good' number 3; 'Very good' number 4. The mean rating were computed such that, 1 to 2.4 was considered as 'below average", 2.5 as 'average while 2.6 to 4.0 was considered as 'good or above average'. Table 4.4 shows the mean rating and corresponding standard deviations (SD).

Table 4.4: Mathematics Lesson Observation Mean Rating

S/N	Indicator of ASEI-PDSI Pedagogy Implementation	Mean Rating	SD	Comment
	Introduction			
1.	Incorporates previous knowledge/skills/everyday experience	2.5	1.0	A
2.	Is clear on what the teacher wanted students to learn	2.8	0.5	AA
3.	Is stimulating enough to arouse the interest and curiosity of learners	2.5	0.9	A
	Lesson development			
4.	Lesson encourages learners to give their prior experiences	3.0	0.8	AA
5.	Learners give their own hypotheses/predictions	2.4	0.6	BA
6.	Lesson encourages learners to give their own observations/results in experiments	2.1	0.9	BA
7.	Lesson facilitates process skills such as observing and measuring	2.2	1.0	BA
8.	Teacher deals with students' misconceptions and reinforces learning at every step	2.4	0.9	BA
9.	Active participation of students in main teaching steps	3.2	0.7	BA
10.	Teacher conducts the lesson taking into account the individual differences in student capability	2.4	1.0	BA
	Conclusion			
11.	Lesson encourages learners to draw conclusions	2.8	0.9	AA
12.	Teacher summarizes lesson and gave follow-up activities	3.0	0.6	AA
13.	Teacher checks accuracy, correctness and depth of content through question and answer technique	2.5	1.1	A
14.	Lesson encourages learners to view content in relation to what they come across in the society.	2.4	1.0	BA
	Use of Instructional Materials			
15.	Teacher made effective use of the teaching/learning materials and media	2.2	0.5	BA
16.	Teacher supervised class work	2.9	0.8	AA
17.	Students were effectively encouraged to give their own hypotheses/predictions	2.1	0.6	BA
18.	Students were effectively encouraged to give their own results/ observations in experiments	2.3	0.7	BA
19.	Students were able to make deductions from practical work	2.0	0.5	BA
20.	Teacher produced and or utilized improvised Materials	2.4	0.9	BA
21.	Students were able to use improvised materials effectively	2.3	0.8	BA

Key: BA-below average; A- average; AA-above average

As evident from table 4.4, in regard to introduction, most of the teachers incorporation of the previous knowledge/skills/everyday experience was rated as average (Mean = 2.5, SD = 1.0). While some teachers started their lesson from known to unknown (Mean = 2.8, SD = 0.5, some introduced the new content pronto. Most of the teachers were, however, clear on what they wanted students to learn and they managed to arouse some moderate interest and curiosity among learners (Mean = 2.5, SD = 0.9).

The second and the most crucial aspect to be observed was the lesson development. Most of the teachers encouraged learners to give their prior experiences (Mean = 3.0, SD = 0.8) but failed to adequately encourage learners to give their own observations/results in experiments (Mean = 2.1, SD = 0.9). Pupils' failure to give their own observations and deductions failed to promote the objectives of ASEI-PDSI pedagogy. The lessons were mearnt to be learner centred, where learners should be given priority to make give what they see after doing. Further, most Lessons were rated below average in facilitation of process skills such as observing and measuring. Most of the teachers seemed to be in a hurry while some seemed to be mentally planning of their next lesson. As noted in section 4.3.5, majority of teachers (57%) had very high work load of over 30 lessons per week which translated to an average of over six lessons per day. The high work load must have brought a big burden to mathematics teachers as they implemented the ASEI-PDSI pedagogy. In addition, most teachers also failed to adequately deal with students' misconceptions at each learning step. Nonetheless, there was active participation of students in main teaching steps in most of the lessons observed (Mean = 3.2, SD = 0.7). Finally, in regard to conducting the lesson taking into account the individual differences in student capability, most of the teachers scored below average (Mean = 2.4, SD = 1.0).

However, the relatively high standard deviation shows that there were also teachers who scored highly in this aspect.

In regard to the lesson conclusion, most teachers encouraged learners to draw conclusions. Most of the teachers also, scored above average in summarizing and giving follow-up activities (Mean = 3.0, SD = 0.6). However, the aspect of checking accuracy, correctness and depth of content through question and answer technique was dismally performed by most of the teachers (Mean = 2.5, SD = 1.1). In addition, the conclusion made by most of the mathematics teachers, did little to encourage learners to view content in relation to what they come across in the society.

In regard to use of instructional materials, most of the teachers scored below average in most of the aspects observed. Teachers were scored below average in the effective use of the teaching/learning materials and media, in encouraging students effectively to give their own hypotheses/predictions, in giving their own results/ observations in experiments, in enabling students to make deductions from practical work, in producing and utilizing improvised Materials, and in enabling learners to use improvised materials effectively.

4.5 Head teachers' Supervision of the Implementation of ASEI-PDSI Pedagogy

The second objective of the study was to examine the influence of the head teachers' supervision of teachers' use of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics in public primary schools in Kajiado Sub County. To achieve the objective, the study analyzed quantitative and qualitative data from mathematics teachers' questionnaire and the head teachers' interview schedule. The mathematics teachers' questionnaire had a set of statements in form of a likert scale where teachers indicated the

extent to which the head teachers supervised the ASEI-PDSI implementation. The questionnaire responses were coded such that to ‘very large extent’ was rated number 4; to ‘large extent’ number 3; to ‘small extent’ number 2; while ‘to no extent’ number one. The mathematics teachers’ mean responses were computed such that: 1 to 2.5 was considered as to a ‘small extent’ while 2.6 to 4 was considered as to a ‘large extent’. Table 4.5 shows the analyzed data in means and standard deviations.

Table 4.5: Head teachers’ Supervision of ASEI-PDSI Pedagogy Implementation

Statement	**Mean**	**SD**
Head teacher observes my lessons occasionally	2.1	0.6
Head teacher encourages me to use ASEI-PDSI approach	2.2	0.8
Head teacher checks my professional documents (schemes of work, lesson plans, record of work, progress reports)	2.8	0.8
Head teacher is keen in providing the necessary materials for ASEI-PDSI approach	2.7	0.9
Head teacher supports the improvisation of materials	3.0	1.0
Head teachers encourages collegial supervision	2.3	0.7
Head teacher is supportive in ensuring pupils are attending to given assignments	2.4	0.6
Head teacher monitors my class performance in mathematics	2.5	0.9
Head teachers enquires about the remedial work for weak pupils	2.1	0.7
Head teacher encourages mathematics INSET attendance	3.3	0.8
Aggregate Score	**2.5**	**0.8**

n = 28

As evident from Table 4.5, most of the teachers indicated that the head teacher mathematics lesson observation was to a small extent (Mean = 2.1, SD = 0.6). This meant that head teachers hardly supervised the ASEI-PDSI implementation. While some head teachers agreed that they hardly did class observation others' felt that their occasional spot check for all classes was adequate. The following comments were made by several head teachers, thus:

> I do visit each class at least once in a term for general observation, and not specifically on SMASE approach…for me I have never attended any SMASE INSET but from what I have gathered from my trained colleagues, teachers are expected to make use of teaching aids, be ready with all the professional documents such as lesson plan, schemes of work and teaching notes just like the usual practice. Therefore, I am normally keen to find out the extent a teacher has conformed to the standards and give counsel depending on the accomplishment of the set objectives. (Head teacher 3).

> Class observation is an essential part of my duties as a head teacher, however, I am always engaged meetings and other school administrative duties…I occasionally do spot check instead of a full class observation. Thus, I hardly get to know whether mathematics teachers involve learners in their demonstrations and experiments as recommended in ASEI-PDSI approach. Nevertheless, our mean mark in KCPE mathematics has been on upward trend and I attribute the improvement to SMASE training (Head teacher 7).

> Our Sub County Education Officer has been encouraging to support SMASE training by observing teachers as they implement ASEI-PDSI in science and mathematics classes. For me, I have only been able to observe two of my teachers and I was impressed of what and how they presented their content matter. I hope they have been presenting and interacting with learners the way they did. (Head teacher 8)

The gathered information from interviewed head teachers shows that, most of the head teachers did not manage to do thorough class observation as one of their roles in teaching staff management. Some managed spot check supervision and occasionally inspected teachers' professional development as well. Lack of consistency in teachers' supervision may result to some teachers abandoning the good practices as espoused in ASEI-PDSI approach.

Most of the teachers also indicated that the extent to which the head teacher encouraged them to use ASEI-PDSI approach, was to a small extent. Similarly, the head teachers encouragement of collegial supervision, support in ensuring pupils are attending to given assignments, and enquiry about the remedial work for weak pupils were all done to a small extent (Mean < 2.6). Most of the head teachers were also found to have hardly monitored the performance in mathematics (Mean = 2.5, SD = 0.9). This implied that most of the head teachers showed no special attention to how pupils were taught and performed in mathematics despite the dismal performance in KCPE. The following comments exemplifies head teachers' little concern in regard to the actual teacher-learners class activities in class.

> To be honest, I have not been paying much attention to the expected change in learners performance in mathematics and sciences as teachers embark on implementation of ASEI-PDSI pedagogy…it is however my conviction that, if there is any gainful change in learners' interest and understanding, the performance in KCPE will be the testimony. (Head teacher 2)
>
> Due to my busy schedule as I execute my administrative duties, I rarely get time to monitor learners' day to day progress… I have rather delegated the responsibility to my deputy and the senior teacher. Unfortunately, they also get overwhelmed by the various school administrative tasks and we get to know of teachers' shoddy work in mathematics when it is rather late. Last year I had a class which sat for their KCPE examination though they had hardly covered class eight and seven syllabi. (Head teacher 12)
>
> My teachers are responsible and I belief they are implementing the ASEI-PDSI pedagogy as required. However, we are yet to realize improved results in KCPE mathematics. My hope is on the newly posted relatively younger teachers who might adapt the new pedagogy as opposed to the elder teachers… (Head teacher 9).

It was evident from the comments from the interviewed head teachers that most of the head teachers had abdicated their duty of supervising teachers' class performance. Through constant supervision, lack of syllabus coverage should be identified early enough in order to take remedial measures. As noted in section 4.3.2, over 70.0 % of teachers were over 40

years of age and there might be a tendency to continue with the usual teaching approach. Thus supervision becomes paramount in a bid to ascertain the extent to which teachers have adopted ASEI-PDSI pedagogy.

Nevertheless, most teachers rated the head teacher highly in regard to checking their professional documents (schemes of work, lesson plans, record of work, progress reports) (mean = 2.8). Additionally, most of the head teachers were found to be keen in providing the necessary materials for ASEI-PDSI approach (Mean =2.7) and that they did support the improvisation of materials (mean = 3.0). Finally, most of the teachers indicated strongly that their head teachers encouraged mathematics INSET attendance (Mean = 3.3, SD =0.8). Overall, the head teachers' supervision of ASEI-PDSI pedagogy implementation was rated as 'to a small extent' (Mean = 2.5, SD = 0.8).

4.6 Teachers' Attitude towards ASEI-PDSI Pedagogy

The third objective of the study was to establish the influence of teachers' attitude towards the use of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics in public primary schools in Kajiado Sub County. To achieve the objective, the study analyzed quantitative and qualitative data from mathematics teachers' questionnaire and the head teachers' interview schedule. The questionnaire responses were coded such that 'Strongly Agree' was rated number 4; 'Agree' number 3; 'Disagree' number 2; while 'Strongly Disagree' number one. The mathematics teachers' mean responses were computed such that: 1 to 2.5 was considered as 'Disagree' or negative while 2.6 to 4 was considered as 'Agree' or positive. Table 4.6 shows the analyzed data in means and standard deviations.

Table 4.6: Mean Responses on Teachers' Attitude towards ASEI-PDSI Pedagogy

Statement	Mean	SD
I enjoy using ASEI-PDSI approach in my lessons	3.5	0.6
ASEI-PDSI approach will lead to improved KCPE mathematics performance	3.4	0.5
Through ASEI-PDSI approach pupils understand the concepts better	3.0	0.8
All lessons should in cooperate learners discovery part	2.5	1.0
Teachers should have a one day/two for a refresher workshop on ASEI-PDSI approach every term	2.9	0.6
ASEI-PDSI pedagogy stimulates enough to arouse the interest and curiosity of learners	2.7	0.6
Use of ASEI-PDSI approach makes pupils' have a more positive attitude towards mathematics	3.2	0.9
Through ASEI-PDSI, teacher and students are better in identifying and using improvised materials in their immediate environment	2.9	0.4
ASEI-PDSI pedagogy emphasis on method and procedures as opposed to rote learning/answer method, will make pupils better learners in mathematics	3.4	0.7
I have a better understanding of some concepts through ASEI-PDSI approach	2.7	1.0
Aggregate Score	**3.0**	**0.7**

n = 28

As noted in Table 4.6, most of the teachers strongly felt that they enjoyed using ASEI-PDSI approach in teaching mathematics (Mean = 3.5, SD = 0.6). That implied that were likely expend their time and energy in ensuring that their teaching is learner centred and activity oriented. Most teachers also believed that ASEI-PDSI approach would lead to improved KCPE mathematics performance (Mean = 3.4, SD = 0.5). Additionally, teachers strongly indicated that use of ASEI-PDSI approach enable pupils' have a more positive

attitude towards mathematics. Further, teachers indicated that ASEI-PDSI pedagogy emphasis on method and procedures as opposed to rote learning/answer method, would make pupils better learners in mathematics (Mean = 3.4, SD = 0.7). In concurrence, the interviewed head teachers underscored the new initiative to improve performance in mathematics and sciences. Their support for the initiative was evident from their comments, thus:

> The ASEI-PDSI approach in mathematics and sciences has enabled our pupils to understand various concepts as opposed to rote learning. We recently held an educational day where our class eight pupils made us proud through their outstanding display in mathematics and sciences. I attribute their prowess to application of ASEI-PDSI approach in their learning. I plead with the government to ensure that teachers are continuously engaged in SMASE INSET. (Head teacher 9).

> SMASE INSET has brought a new awakening in our mathematics teachers and pupils. Pupils can be seen all over the school compound with manila papers cutting and making various shapes in mathematics. It is very inspiring and it is my hope that the heightened activities will eventually culminate to improved grades. I will consequently use the improved performance to solicit more educational resources for ASEI-PDSI oriented activities. (Head teacher 5).

However, most of the teachers 'disagreed' to the statement that 'all lessons should incorporate learners discovery part' (Mean = 2.5, SD = 1.0). Similarly, most of the teachers disagreed that they have a better understanding of some concepts through ASEI-PDSI approach (Mean =2.5, SD = 1.0). It was, however, noteworthy that although the mean response for the two issues was negative, the standard deviation was relatively high showing that there were also teachers who strongly agreed to these statements. Most of the teachers were also moderately positive in regard to the statement that 'teachers should have a one day/two for a refresher workshop on ASEI-PDSI approach every term', and that ASEI-PDSI pedagogy stimulates enough to arouse the interest and curiosity of learners.

The interviewed head teachers, had varied views in regard to the teachers' attitude towards ASEI-PDSI pedagogy and its implications on the pupils' performance in KCPE mathematics. Some of them indicated that while some teachers were positive, some teachers viewed SMASE as unnecessary burden at primary school level. One of the head teacher commented:

> Our school had six teachers who have been attending SMASE INSET. Of the six two teachers seem enthusiastic and positive of the new approaches in teaching and learning. However, the other four teachers argue that SMASE training content could be of more use at secondary schools level to which, I also concur…the mathematics concepts at primary level are very elementary and do not require much experimenting, demonstrations and use of improvised materials. The KCPE mathematics examination is a multiple choice type and many a time's pupils can work out the correct answers from the given choices. Furthermore...i consider the normal drill they undergo adequate without much of ASE-PDSI stuff... (Head teacher 5).

Such sentiments from head teachers and teachers accounted for the persistent negative attitude among a certain section of teachers and which is manifested in their erratic attendance of INSET. I have a better understanding of some concepts through ASEI-PDSI approach Overall, mathematics teachers were found to have a positive attitude towards the use of ASEI-PDSI pedagogy in public primary schools in Kajiado North Sub County (Mean = 3.0, SD = 0.7).

4.7 Hypotheses Testing

The study applied multiple regression analysis to ascertain both the composite and relative influence of the three independent variables in this study on the dependent variable (KCPE performance in mathematics). The mean values associated with the study three variables (teachers' use of ASE-PDSI pedagogy, head teachers' supervision of the teachers' use of ASEI-PDSI pedagogy, and teachers' attitude towards the ASEI-PDSI approach in

mathematics) were regressed against students' KCPE mean performance in mathematics (Appendix V). Tables 4.7, 4.8 and 4.9 depict the summary of multiple regression analysis.

Table 4.7: Multiple Regression Model Summary

Model	R	R^2	Adjusted R^2	Standard error of the estimate
1	0.792	0.627	0.601	0.2431

Predictors: (constant), Teachers' use of ASEI-PDSI pedagogy, Head teachers' supervision of the implementation of ASEI-PDSI pedagogy, Mathematics teachers' attitude towards ASEI-PDSI pedagogy
Dependent variable: Pupils KCPE performance in Mathematics

Table 4.7, shows that the multiple correlation coefficient *R* and which is the correlation between the observed values of dependent variable and the values predicted by the multiple regression model, had a value of 0.792. This meant that there was a very strong correlation between the predicted and observed values of pupils' KCPE performance in mathematics.

The coefficient of determination R^2 which is the proportion of variance in the dependent variable that can be explained by the independent variables was found to be 0.627 implying that 62.7 % of variance in pupils' KCPE performance in mathematics was explained by the extent of teachers' use of ASEI-PDSI pedagogy, level of head teachers' supervision of ASE-PDSI implementation and teachers' attitude towards ASEI-PDSI pedagogy. Other variables not included in this model may have accounted for the remaining 37.3 % variance. The significance of the multi regression model was determined by analysis of variance as shown in Table 4.8.

Table 4.8: Multiple Regression Model Significance (ANOVA)

	Model	**Sum of Squares**	**df***	**Mean Square**	***F***	**Sig.**
1	Regression	14.712	3	4.904	26.58	0.002
	Residual	4.427	24	0.1845		
	Total	**19.139**	**27**			

df*- degrees of freedom.

Table 4.8 shows the analysis of variance (ANOVA) output. The *F*-ratio in the ANOVA table tests whether the overall regression model is a good fit for the data. That is, the ANOVA shows whether the model, overall, results in a significantly good degree of prediction of the outcome variable. The table shows that the joint independent variables statistically significantly predict the dependent variable, F (3, 24) = 26.58, $p < 0.05$. Thus, the regression model was a good fit for the data. Further, the relative influence of each of the independent variables were determined by considering the multiple regression model coefficients as depicted in Table 4.9.

Table 4.9: Summary of Multiple Regression Model Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		Beta	**Std. Error**	**Beta**	**t**	**Sig. value**
1	(Constant)	.218	0.223		2.14	0.132
	Teachers' use of ASEI-PDSI pedagogy	.472	0.120	0.458	4.362	0.007
	Head teachers' supervision of Implementation of ASEI-PDSI pedagogy	.425	0.111	0.413	3.421	0.004
	Mathematics teachers' attitude towards ASEI-PDSI pedagogy	.207	0.123	0.118	2.241	0.017

Dependent variable: Pupils' KCPE Performance in Mathematics

Table 4.9 reveals the relative contribution of the three independent variables to the dependent variable, expressed as beta weights. The positive value of the influence of mathematics teachers' use of ASE-PDSI pedagogy, head teachers' supervision of ASEI-PDSI pedagogy, and the mathematics teachers' attitude towards ASEI-PDSI pedagogy, implies that the pupils' KCPE performance in mathematics was actually determined by positive reinforcement of these three variables. The regression model capturing the hypothesized relationship was given as: $Y= \beta_0+ \beta_{1x1}+\beta_{2x2}+ \beta_{3x3} +\varepsilon$ and where y = pupils' KCPE performance in mathematics, x_1= level of teachers' use of ASEI-PDSI pedagogy, x_2= head teachers' supervision of implementation of ASEI-PDSI pedagogy, x_3 = mathematics teachers' attitude towards ASEI-PDSI pedagogy while ε is the error term.

Assuming the error term ε to be zero and substituting the unstandardized coefficients β values, the estimated multiple regression equation becomes: $y = 0.218 + 0.472\ x_1 + 0.425\ x_2 + 0.207x_3$.

The β values indicate the individual contribution of each predictor to the model if the effects of all other predictors are held constant. Thus, when the mathematics teachers' use of ASEI-PDSI pedagogy increases positively by one unit, pupils' KCPE performance in mathematics increases by 0.472 units (β = 0.472) while holding the other factors constant. Similarly, when the head teachers' supervision of ASEI-PDSI implementation improves by one unit the pupils' KCPE performance in mathematics increases by 0.425 units (β = 0.425) while holding the other factors constant and so on.

In order to have direct comparison and better insight into the importance of predictors, the standardized β values that do not depend on the units of measurement of variables were used. The standardized beta values give the number of standard deviation that pupils' KCPE performance in mathematics would change as a result of one standard deviation change in the predictor. Accordingly, Table 4.9 shows that mathematics teachers' use of ASEI-PDSI pedagogy had the most significant relative contribution to the prediction of pupils' KCPE performance in mathematics (β = 0.458) followed by the head teachers' supervision of ASEI-PDSI pedagogy implementation (β = 0.413) while the teachers' attitude towards ASEI-PDSI pedagogy had the least influence (β = 0.118).

In order to test the study's three formulated hypotheses, the *t* statistic that tests whether a *B* value is significantly different from zero (H_0: β =o) was considered (refer to Table 4.9).

H_O1: The level of teachers' use of ASEI-PDSI approach has no statistically significant influence on the pupils' performance in KCPE mathematics in public primary schools in Kajiado North Sub County

As shown in Table 4.9, the unstandardized beta value for the level of teachers' use of ASEI-PDSI pedagogy was significantly greater than zero (β = 0.472, t (27) = 4.362, $p < 0.05$). Subsequently, the null hypothesis was rejected, hence, the mathematics teachers' use of ASEI-PDSI pedagogy had a significant influence on pupils' KCPE performance in mathematics in public primary schools in Kajiado Sub County. This implied that schools where teachers were keen in use of ASE-PDSI pedagogy, pupils' performed better in KCPE mathematics.

H_O2: Head teacher's supervision of teachers' use of ASEI-PDSI pedagogy has no statistically significant influence on pupils' performance in KCPE mathematics in public primary schools in Kajiado North Sub County

In reference to Table 4.9, the unstandardized beta value for the head teachers' supervision of ASEI-PDSI implementation, was found to be significantly greater than zero (β = 0.425, t (27)= 3.421, $p < 0.05$). Subsequently, the null hypothesis was rejected, hence, the head teachers' supervision of ASEI-PDSI pedagogy implementation had a significant influence on pupils' KCPE performance in mathematics in public primary schools in Kajiado Sub County. This implied that schools where head teachers were keen on supervision of ASEI-PDSI pedagogy implementation, pupils performed better in KCPE mathematics.

H_O3: Teachers' attitude towards the use of ASEI-PDSI pedagogy has no statistically significant influence on pupils' performance in KCPE mathematics in public primary schools in Kajiado North Sub County

As evident from Table 4.9, the unstandardized beta value for the teachers attitude towards the ASEI-PDSI pedagogy was significantly greater than zero ($\beta = 0.207$, $t\ (27) = 2.241$, $p < 0.05$). Subsequently, the null hypothesis was rejected, hence, the teachers' attitude towards ASEI-PDSI pedagogy had a significant influence on pupils' KCPE performance in mathematics. This implied that pupils in schools where mathematics teachers had positive attitude did better in KCPE mathematics.

CHAPTER FIVE

DISCUSSION, SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the discussion of the findings as per research objectives, summary of the findings, and conclusions derived from the findings and discussion. The chapter ends with the recommendations as per the objectives and suggestions of areas of further study. The purpose of the study was to examine the influence of ASEI-PDSI pedagogy on pupils' performance in mathematics in public primary schools in Kajiado North Sub County, Kenya.

5.2 Discussion

This section discusses the results and analysis done in chapter four as per the study's three objectives.

5.2.1 Influence of Mathematics Teachers use of ASEI-PDSI Pedagogy on Pupils' Performance in KCPE Mathematics

The first objective of the study was to assess the influence of the level of teachers' use of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics in public primary schools in Kajiado North Sub County. In reference to section 4.4, most of the teachers indicated that their lessons were activity based, student centred and were generally planned as per ASEI-PDSI approach. This finding corroborated Animata (2015) submission that, teachers who had been exposed to the ASEI-PDSI approach were more confident, planned better and more consistently, attended to students' needs better, were more open to teamwork, tried out new methods of teaching, and were more proactive in using improvised

materials. Additionally, students handled by such teachers were more positive towards activity based learning and especially in mathematics.

Conversely, the findings by the researcher through the mathematics lesson observation rating scale did not support the teachers' rating of how they implemented the ASE-PDSI pedagogy in public primary schools in Kajiado North Sub County. In reference to table 4.4, the teacher production and utilization of improvisation of materials, pupils ability to use improvised materials effectively and active participation of pupils in main teaching steps, were rated as below average. Additionally, the researcher found that most of the learners were neither able to give their own hypotheses, nor did the lessons encourage learners to give their own observations or results. Further, the lessons were found wanting in facilitating process skills such as observing and measuring and above all, the activeness of participation of students in main teaching steps was also rated below average. Thus, it was evident that the mathematics teachers overrated themselves in some aspects regarding the use or implementation of ASEI-PDSI pedagogy. Cognate to the researcher observation findings, Ngetuny (2013) found that despite the SMASSE INSET, most of the teachers in secondary schools in Koibatek Sub County were using teacher centered methods where student involvement in the lesson was minimal. Similarly, Sifuna and Kaime (2007) found out that while teachers perceived the SMASSE INSET programme as having been effective in exposing them to a student-centred approach, this was not reflected in their classroom practices which were largely teacher-dominated. This was partly attributed to large classes, the use of English as second language, and pressure to cover the syllabuses in preparation of the national examinations.

In regard to improvisation of learning materials, the finding that most of teachers neither produced nor improvised materials concurred with Barasa (2015) finding that half of the teacher respondents did not improvise teaching and learning resources in public primary schools in Samia Sub-County, Kenya. Barasa (2015) eventually concluded that ASEI/PDSI approach has not been fully implemented by science teachers as expected after the SMASE in-service training and recommended that MOE, KICD in conjunction with CEMASTEA should provide prepared ASEI/PDSI lesson plans for teachers.

The varied response from head teachers on teachers implementation of ASEI-PDSI pedagogy as demonstrated in section 4.4, was a clear demonstration that ASEI-PDSI approach in mathematics has had mixed results in influencing pupils performance in KCPE mathematics. Most of the head teachers were positive that the SMASE programme could bring about improvement in pupils attitude and performance in mathematics, however, some were apprehensive about the sustainability of the training programme and its enforcement to ensure that all the recipients are in full attendance. The finding was similar to Manyara (2014) whose findings indicated that the SMASE program has had an impact on learners' capability, and that through ASEI-PDSI, there has been a significant improvement in pupils' cognitive skills resulting to the improvement in performance in mathematics and science subjects. Manyara (2014) also found that through ASE-PDSI, teachers were able to arouse interest and curiosity among learners and created opportunity for pupils to take responsibility for their own learning; employing inquiry-based approach as opposed to recipe-type experiments.

Further analysis showed that teachers' use of ASEI-PDSI pedagogy had a significant influence on pupils' KCPE performance in mathematics in public primary schools in

Kajiado Sub County ($\beta = 0.472$, $t = 4.362$, $p < 0.05$). This implied that schools where teachers were keen in use of ASE-PDSI pedagogy, pupils' performed better in KCPE mathematics. The finding was, however, contrary to Gachahi et al., (2014) study which found that SMASE-trained teachers' gender, teaching experience and level of application of SMASE skills were not statistically significantly related to students' academic achievement. Gachahi et al., (2014) attributed their findings to the fact that SMASE programme has been under implementation in Kenyan primary schools for a relatively short period of four years. Therefore, it was unlikely that SMASE-trained teachers of either gender had adopted and implemented the ASEI-PDSI approach in a manner that had any major effects on pupils' achievement within the relatively short period; considering teachers' tendency to resist change as noted by Zimmerman (2006).

5.2.2 Influence of Head teachers' Supervision of ASEI-PDSI Pedagogy Implementation on Pupils' Performance in KCPE mathematics

The second objective of the study was to examine the influence of the head teachers' supervision of teachers' use of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics in public primary schools in Kajiado Sub County. In reference to section 4.5, the head teachers were found to have been conducting mathematics lesson observation to a small extent (mean = 2.1, SD = 0.6). This meant that head teachers hardly supervised the ASEI-PDSI implementation. The finding was consistent with findings of several other studies done in different parts in Kenya, that monitoring of ASEI-PDSI initiative implementation by the school administration and externally by the district quality and standards officers was minimal (Barasa, 2015; Gachahi et al., 2014; Gachuhi, 2013; Ngetuny, 2013).

The findings from the head teachers' interviews corroborated the teachers' response that classroom visits to specifically supervise and monitor the implementation of ASEI-PDSI pedagogy were very minimal. Over 60% of head teachers indicated that they did visit once per term as recommended by the MOE but hastened to clarify that, the visit was just the usual class observation and not geared to assess the implementation of ASEI-PDSI pedagogy

Most of the teachers also indicated that their head teachers hardly encouraged them to use ASEI-PDSI approach. Similarly, the head teachers performed dismally in encouragement of collegial supervision, support in ensuring pupils are attending to given assignments, and enquiry about the remedial work for weak pupils (mean < 2.6). Most of the head teachers were also found to have hardly monitored the performance in mathematics (mean = 2.5, SD = 0.9). Cognate to the study, Aminata (2015) and Ndirangu (2013) found that due to lack of supervision, most of the SMASSE trained teachers abandoned the approach and reverted back to the examination based approach. In so doing, most of the pupils lacked the in depth conceptualization of key concepts in mathematics leading to poor performance in KCPE examination.

In a similar study, Ntwiga and Mwangi (2018) noted that, over emphasis on passing in the examinations can create pedagogies that incline to the test and could have adverse effects on the intended curriculum and the output as well. This comes about when teachers shift goals from those of helping the learners gain a deeper understanding of what they are being taught to that of reproducing the taught content in order to attain high scores and hence good grade.

Nonetheless, teachers rated the head teachers highly in some aspects of supervision of ASEI-PDSI pedagogy implementation. The head teachers were rated highly in regard to checking professional documents (schemes of work, lesson plans, record of work, progress reports) (mean = 2.8). Additionally, most of the head teachers were found to be keen in providing the necessary materials for ASEI-PDSI approach (mean =2.7) and that they did support the improvisation of materials (mean = 3.0). Finally, most of the teachers indicated that their head teachers encouraged mathematics INSET attendance (mean = 3.3, SD =0.8). The finding concurs with Gachahi et al., (2014) who found that despite the financial difficulties in most public primary schools, most head teachers supported teachers in acquiring mathematics resource materials and mobilized the school management committee in paying the stipulated SMASE participation fee.

Overall, the head teachers' supervision of ASEI-PDSI pedagogy implementation was rated as minimal (mean = 2.5, SD = 0.8). However, the study found that head teachers' supervision had a significant influence on pupils' KCPE performance in mathematics in public primary schools in Kajiado Sub County ($\beta = 0.425$, $t = 3.421$, $p < 0.05$). This implied that schools where head teachers were keen on supervision of ASEI-PDSI pedagogy implementation, pupils performed better in KCPE mathematics. The finding was in contrary to Aminata (2015) study which found that principals' support for the adoption of ASEI-PDSI had no influence on girls' KCSE mathematics achievement. It was, however, noteworthy that supervision was more involving than just support for the adoption.

5.2.3 Influence of Mathematics Teachers' attitude towards ASEI-PDSI Pedagogy on Pupils' Performance in KCPE Mathematics

The study third objective was to establish the influence of teachers' attitude towards the use of ASEI-PDSI pedagogy on pupils' performance in KCPE mathematics in public primary schools in Kajiado Sub County. In reference to section 4.6, most of the teachers strongly felt that they enjoyed using ASEI-PDSI approach in teaching mathematics, and believed that ASEI-PDSI approach would lead to improved KCPE mathematics performance (mean > 3.0). Additionally, teachers strongly indicated that use of ASEI-PDSI approach makes pupils' have a more positive attitude towards mathematics and that ASEI-PDSI pedagogy emphasis on method and procedures as opposed to rote learning/answer method, would make pupils better learners in mathematics at secondary level (mean > 3.0).

The finding was similar to Ngetuny (2013) who found that 53 % of mathematics and science teachers had positive attitude towards SMASE whereas 47 % had neither positive nor negative attitude towards the same in Koibatek Sub – County. These findings implied that half of the teachers were yet to acquire attitude change. In a similar study, Mwelese and Atwoto (2014) found that students who went through ASEI-PDSI pedagogy performed better in geometry than the other group. In addition, students taught through the ASEI-PDSI approach had a better view and attitude towards mathematics than those taught through the traditional approaches.

The current study finding was however in contradiction with Gachahi et al., (2014) finding that the headteachers' and teachers' perceptions towards SMASE programme in Murang'a County was negative and that teachers and head teachers' attitudes had no statistically significant relationship with pupils' grades in mathematics and science. Gachahi et al.,

(2014) posited that pupils were performing well in sciences and mathematics regardless of their teachers' attitude towards SEMASE programme. This was due to the intensive examination oriented drill methods employed by teachers. Gachahi et al., (2014), however, noted that failure to embrace activity based student centred learning at primary level especially in sciences and mathematics sets a stage for great difficulties and poor performance at secondary level.

Through the open ended section of the Mathematics teachers' questionnaire, teachers expressed their apprehensions in regard to the implementation of ASEI-PDSI pedagogy. Over 50% of teachers cited the difficulty in preparation of lesson in accordance with ASEI-PDSI approach and the difficulty in finishing the syllabus when they followed activities as recommended in the approach. Cognate to these findings, Barasa (2015) study showed that majority of teachers (77.8%) found ASEI/PDSI lesson plan as difficult to prepare since it was cumbersome and required a lot of time to prepare and execute a lesson. Further, most of the teachers revealed that it was not possible to have an activity in every science lesson arguing that the allocated time of 35 minutes per lesson was not enough to cover the syllabus and realize results if ASEI/PDSI pedagogy was to be fully practiced in classroom. From the ongoing discussion it emerges that for a teachers to effectively adopt the ASEI-PDSI approach, it is imperative to have proper planning of activities quite in advance.

Nevertheless, the current study, mean response on teachers attitude, indicated that most of the teachers had a positive attitude (mean = 3.0, SD = 0.7). Further, the study found that teachers' attitude towards ASEI-PDSI pedagogy had a significant influence on pupils' KCPE performance in mathematics ($\beta = 0.207$, $t = 2.241$, $p < 0.05$). This implied that pupils

in schools where mathematics teachers had positive attitude did better in KCPE mathematics.

5.3 Summary of the Findings

This section presents the summary of the study findings in accordance to the objectives of the study.

The study found that all the sampled teachers had professional training in education, 78.6% had teaching experience of 11 years and above, and 89.3% had attended SMASE INSET. In addition, 57% of teachers had over 30 lessons per week translating to over 6 lessons per day. In regard to use of ASEI-PDSI pedagogy, most of the teachers indicated that their lessons were activity based, student centred and were generally planned as per ASEI-PDSI approach. They also indicated that they do make use of improvised locally available materials to enhance the practical aspect in mathematics. However, through the mathematics class observation rating scale, the researcher findings were to some extent incongruent with the findings from the teachers' questionnaire.

Though, most the teachers guided their pupils from known to unknown as espoused in ASEI-PDSI approach, they still used the teacher centred lecture method. For instance, they taught the concept of perimeter by just drawing the objects on the chalk board and giving the formulaes, instead of giving pupils the chance to do the actual measurement using real objects. Nevertheless, a few teachers had prepared ASEI-PDSI lesson plan, utilized the improvised materials well, involved learners in all learning steps and indeed achieved the set objectives. In most of the schools where teachers were keen in conducting leaner

centred lessons, the KCPE results were better. The study found that teachers' use of ASEI-PDSI pedagogy had a significant influence on pupils' performance in KCPE mathematics.

Most of the head teachers' supervision of the implementation of ASEI-PDSI pedagogy was rated low by mathematics teachers. The interviewed head teachers indicated that they were able to observe mathematics lessons once in a term but emphasized that the observation was a routine check as required by the MOE and not specifically on ASEI-PDSI pedagogy. Most of the teachers rated their head teachers highly in checking and advising on their professional documents, supplying them with the required teaching and learning materials and encouraging them to attend SMASE INSET. However, most head teachers were not keen in monitoring the progress of teachers and pupils in mathematics as they in cooperated the ASEI-PDSI approach.

Most of mathematics teachers were found to be positive towards the ASEI-PDSI pedagogy and had conviction that when well implemented, pupils could have better understanding of concepts in mathematics and eventually perform well in KCPE mathematics. However, they indicated of their inability to plan and prepare activity based lessons due to the heavy workload and overcrowded classrooms. There was also a section of teachers who argued that the ASEI-PDSI is well suited for secondary pupils and teachers where learners are expected to show the working. Thus, some teachers were stuck to methods geared to prepare learners for examination and not understanding of the concepts.

5.4 Conclusion

From the study findings and discussions the following conclusions were made:

Although most of the mathematics teachers in public primary schools in Kajiado North had attended SMASE INSET, they hardly used ASEI-PDSI pedagogy. Their lessons were not activity based, student centred, had no element of experimenting and hardly did they utilize improvised materials. Most teachers use more of teacher centred method where the teacher gives the formula, substitutes values and calculates to arrive to an answer. Subsequently, learners' are expected to regurgitate the taught material follow the same steps to arrive at an answer. Unfortunately, when a bit of creativity is required in an examination, learners are found stuck to the formula route instead of applying the concept to deal with emerging contingencies. According to the mathematics teachers, there several issues that have derailed them from ASEI-PDSI pedagogy. These issues ranged from lack of adequate time for preparation due to high work load and high pupils population, slow progress in syllabus coverage when implementing ASEI-PDSI pedagogy to head teachers lack of follow up and show of interest in the learners/teachers progress.

Head teachers' supervision of implementation of ASEI-PDSI pedagogy was hardly done in public primary schools in Kajiado County. Although the SMASE INSET had also trained the head teachers in order to empower them in supervision, most head teachers just did the routine class observation as required by MOE. However, in four primary schools where head teachers were found be very keen in implementation of ASEI-PDSI, there was notable improvement in KCPE grades in mathematics.

Class seven and eight mathematics teachers in public primary schools in Kajiado County were found to be generally positive towards ASEI-PDSI pedagogy. However, about 30% of teachers were of the opinion that, the approach was not of any impact on the pupils' performance in the multiple choice KCPE mathematics.

5.5 Recommendations of the Study

Based on the findings and conclusions thus far, the following recommendations were made:

In order to enable mathematics teachers to make use of ASE-PDSI pedagogy, it is important to address the various obstacles. The TSC should post more teachers to ease the burden to high work load and overcrowded classes. The MOE should adopt the ASEI-PDSI lesson plan so that teachers schemes of work and lesson plans are always activity oriented, student centred and geared to improvisation. As the SMASE trained teacher continue to exit the profession through retirement and natural attrition, the MOE should plan to entrench the ASE-PDSI approach in teacher training colleges so as to have a continuous supply of teachers who are trained and ready to implement.

The MOE should put more emphasis on head teachers and curriculum support officers to pay special attention to ASEI-PDSI pedagogy especially in mathematics in order to improve the persistent low grades. Head teachers should show interest and monitor the progress made by mathematics teachers and pupils as they implement the ASE-PDSI pedagogy. In so doing, the teacher will become motivated and overcome the perceived burden of planning and extra preparation for activity based classes.

By supporting mathematics teachers in implementation of ASEI-PDSI pedagogy, pupils performance will improve and thus, enhancing teachers positive attitude. Therefore, the MOE in conjunction with other development partners such as JAIKA, should maintain refresher courses post SMASE/SMASSE INSETS.

5.6 Suggestions for Further Studies

i. A similar study can be carried out countywide in order to shed more light on the influence of ASEI-PDSI pedagogy on performance of pupils in KCPE mathematics

ii. A similar study could be conducted in other countries where SMASE/SMASSE programmes have been going on such as Nigeria in order to benchmark with the Kenyan situation.

iii. A similar but more consultative study involving pupils, curriculum support officers, mathematics teachers, head teachers and SMASE trainers and management can be conducted in Kajiado North Sub County. This could shed more light with a possibility of finding solutions to the persistent dismal performance in KCPE mathematics.

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APPENDICES

APPENDIX I: LETTER OF TRANSMITTAL

Dear Respondent,

I am a Post-Graduate Student in the Africa Nazarene University, pursuing a master's degree in Education. I am currently carrying out a research titled: **INFLUENCE OF ASEI-PDSI PEDAGOGY ON PUPILS' PERFORMANCE IN MATHEMATICS IN PUBLIC PRIMARY SCHOOLS IN KAJIADO SUB COUNTY, KENYA.** Your school has been sampled for the study and you have been selected as a respondent. Kindly answer the questions as candidly as possible. There is no right or wrong answer. Do not write your name on the questionnaire. The results of this study will be used for academic purposes only and the information gathered will remain confidential. Thanks

Yours Faithfully,

ZAINABU WANJIRU WAMBUGU

CELL PHONE: 0722494403

APPENDIX II: MATHEMATICS TEACHERS' QUESTIONNAIRE

Kindly respond to all the items in this questionnaire. Your honest response to the questions will be highly appreciated. Thank you for taking your time.

SECTION A: Demographic Data

Please tick (√) where appropriate or fill in the required information on the space provided.

1. Gender: Male [ ] Female [ ]

2. Age bracket:

Below 30years [ ] 30 – 40 years [ ] 41 – 50 years [ ] Over 50 years [ ]

3. Highest Professional level attained in Teacher Education

Post graduate [ ] under graduate [ ] Diploma [ ] Certificate [ ]

P1 [ ] Not trained [ ]

4. Working experience as a teacher?

Below 5years [ ] 5 – 10 years [ ] 11 – 20 years [ ] Over 20 years [ ]

5. What is your total teaching load per week? _____

6. Have you attended the SMASSE INSETs for Mathematics teachers?

Yes [ ] No [ ]

SECTION B: Teachers' Implementation of ASEI-PDSI Pedagogy and Pupils' Performance in Mathematics

7. The following are statements in regard to use of ASEI-PDSI approach in teaching of mathematics. Read each statement carefully and indicate the extent to which each of the statements applies to you. Use the following key to make your choice.

Very large extent (4); Large extent (3); Small extent (2); No at all (1)

Statement	**4**	**3**	**2**	**1**
My lessons are normally activity based and student centred				
My lesson plans are done in accordance with ASEI-PDSI approach				
I do plan and gather teaching aids long before the lesson				
I do improvise and use locally available materials				
I involve my pupils in gathering locally available teaching resources				
I often use experimental/discovery method in derivation of formulas such as $C = 2\pi r$ and $S = 2\pi r^2 + 2\pi rh$				
I do encourage views from pupils on how to improve my content delivery				
I sometimes give research based mathematical problems				
I have divided my class into discussion groups				
I do invite my colleagues to evaluate my lesson as recommended by SMASE INSET, for further improvement				

8. Write any other information in regard to how you have implemented ASEI-PDSI approach in mathematics to improve performance in KCPE mathematics

_____

_____

_____

_____

SECTION C: Head teacher Supervision of the Implementation of ASEI-PDSI Pedagogy

9. The following are statements in regard to head teachers' supervision and support of ASEI-PDSI approach in teaching of mathematics. Read each statement carefully and indicate the extent to which each of the statements applies to your head teacher. Use the following key to make your choice.

Very large extent (4); Large extent (3); Small extent (2); No at all (1)

Statement	**4**	**3**	**2**	**1**
Head teacher observes my lessons occasionally				
Head teacher encourages me to use ASEI-PDSI approach				
Head teacher checks my professional documents (schemes of work, lesson plans, record of work, progress reports)				
Head teacher is keen in providing the necessary materials for ASEI-PDSI approach				
Head teacher supports the improvisation of materials				
Head teachers encourages collegial supervision				
Head teacher is supportive in ensuring pupils are attending to given assignments				
Head teacher monitors my class performance in mathematics				
Head teachers enquires about the remedial work for weak pupils				
Head teacher encourages mathematics INSET attendance				

10. Write any other view on head teachers' support of ASEI-PDSI approach in mathematics

_____
_____
_____
_____
_____

SECTION D: Teachers' Attitude towards ASEI-PDSI Pedagogy and Pupils' Performance

11. The following are statements in regard to your honest view on the ASEI-PDSI approach in enhancing pupils' performance in KCPE mathematics. Read each statement carefully and indicate the extent to which you agree to it. Use the following key to make your choice.

Strongly Agree (4); Agree (3); Disagree (2); Strongly Disagree (1)

Statement	**4**	**3**	**2**	**1**
I enjoy using ASEI-PDSI approach in my lessons				
ASEI-PDSI approach will lead to improved KCPE mathematics performance				
Through ASEI-PDSI approach pupils understand the concepts better				
All lessons should in cooperate learners discovery part				
Teachers should have a one day/two for a refresher workshop on ASEI-PDSI approach every term				
ASEI-PDSI pedagogy stimulates enough to arouse the interest and curiosity of learners				
Use of ASEI-PDSI approach makes pupils' have a more positive attitude towards mathematics				
Through ASEI-PDSI, teacher and students are better in identifying and using improvised materials in their immediate environment				
ASEI-PDSI pedagogy emphasis on method and procedures as opposed to rote learning/answer method, will make pupils better learners in mathematics at secondary level				
I have a better understanding of some concepts through ASEI-PDSI approach				

12. Write any other view you hold in regard to implementation of ASEI-PDSI pedagogy and the KCPE performance in mathematics

_____

_____

_____

_____

Thank you for your cooperate

APPENDIX III: HEAD TEACHERS' INTERVIEW SCHEDULE

Kindly respond to the following questions in regard to pupils' performance in English language in your school

1. To what extent have you been trained on ASEI-PDSI pedagogy?
2. How have you been able to facilitate the implementation of ASEI-PDSI pedagogy as the school lead administrator?
3. In regard to your mathematics teachers in classes seven and eight, how would you rate the accomplishment of SMASE objectives of cultivating a positive attitude and influencing teachers to adopt activity based student centred learning?
4. How frequent do you conduct mathematics lesson observation geared to monitor implementation of ASEI-PDSI pedagogy?
5. What changes in the mathematics teachers and pupils can you attribute to SMASE INSET
6. To what extent do the teachers and pupils improvise the teaching and learning materials
7. Why do you think despite SMASE INSET, the performance in KCPE mathematics has remained low in your school/in the Sub County
8. How do you foresee the improvement of KCPE mathematics in relation to implementation of ASEI-PDSI pedagogy?

APPENDIX IV: MATHEMATICS LESSON OBSERVATION RATING SCALE

School Code …… Class…… Date of observation……..

No. of Students in the observed class……Duration of Lesson……

Time of observation……

Key:

1- Not done 2. Fair 3. Good 4. Very Good

S/N	INDICATOR OF ASE-PDSI IMPLEMENTATION	1	2	3	4
	Introduction				
1	Incorporates previous knowledge/skills/everyday experience				
2	Is clear on what the teacher wanted students to learn				
3	Is stimulating enough to arouse the interest and curiosity of learners				
	Lesson Development				
4	Lesson encourages learners to give their prior Experiences				
5	Learners give their own hypotheses/predictions				
6	Lesson encourages learners to give their own Observations/results in experiments				
7	Lesson facilitates process skills such as observing and measuring				
8	Teacher deals with students' misconceptions and reinforces learning at every step				
9	Active participation of students in main teaching steps				
10	Teacher conducts the lesson taking into account the individual differences in student capability				
	Conclusion				
11	Lesson encourages learners to draw conclusions				
12	Teacher summarizes lesson and gave follow-up activities				
13	Teacher checks accuracy, correctness and depth of content through question and answer technique				

14	Lesson encourages learners to view content in relation to what they come across in the Society.
	Use of Instructional Materials
15	Teacher made effective use of the teaching/learning materials and media
16	Teacher supervised class work
17	Students were effectively encouraged to give their own hypotheses/predictions
18	Students were effectively encouraged to give their own results/ observations in experiments.
19	Students were able to make deductions from practical work.
20	Teacher produced and or utilized improvised Materials.
21	Students were able to use improvised materials effectively

APPENDIX V: KAJIADO NORTH SUB COUNTY PUBLIC PRIMARY SCHOOLS KCPE MEAN PERFORMANCE IN MATHEMATICS

PRIMARY SCHOOLS	ZONE	2017	2016	2015	2014	2013	2012	2011
OLKERI	NGONG	50.98	45.84	42.56	50.9	49.33	52.9	48.09
OLOOLUA	NGONG	53.23	52.42	44.38	49.3	49.05	49.18	53
KISERIAN	O/RONGAI	49.82	47.82	44.97	47.1	45.02	45.29	43.05
ARAP MOI	O/RONGAI	48.77	48.11	47.28	50.3	47.35	55.61	52.4
EMBULMBUL	NGONG	48.88	45.74	46.94	50.5	43.62	43.5	45.46
NAKEEL	O/RONGAI	48.71	44.5	44	48.8	41.65	47.4	39.68
ONG'ATA RONGAI	O/RONGAI	47.92	49.04	43.02	44.7	45.85	45.38	40.15
OLEKASASI	O/RONGAI	45.78	44.32	47.87	47.6	46.63	44.43	44.95
UPPER MATASIA	NGONG	45.03	42.66	37.24	53.4	45.96	47.24	41.54
NKAIMURUNYA	O/RONGAI	43.04	47.48	47.92	47.3	42.75	46.29	46.99
NGONG' BOYS & GIRLS	NGONG	43.69	40.97	39.92	41.1	41.97	42.63	45.59
KERARAPON	NGONG	45.77	48.6	39.1	43.3	48.08	51.2	47.51
NALEPO	NGONG	42.21	46.15	NEW	NEW	NEW	NEW	NEW
ENOOMATASIANI	NGONG	41.45	47.73	43.2	44.8	42.89	38.76	43.58
OVERALL MEAN		**46.80**	**46.5**	**43.7**	**47.5**	**45.4**	**46.9**	**45.5**

Source: Kajiado North Sub County Education Office

APPENDIX VI: AFRICA NAZARENE UNIVERSITY INTRODUCTION LETTER

AFRICA NAZARENE
UNIVERSITY

July, 5th 2018

Re: To whom it may concern

Zainab Wanjiru Wambugu (11GMED008) is a bonafide student at Africa Nazarene University. She has finished her course work and has defended her thesis proposal **"Influence of ASEI-PDIS-Pedagogy on Pupils' Performance in Mathematics in Public Primary Schools in Kajiando North Sub-County, Kenya."**

Any assistance accorded to her to facilitate data collection and finish her thesis is highly welcomed.

Prof. Rodney Reed
DVC, Academic Affairs

APPENDIX VII: RESEARCH AUTHORIZATION LETTER FROM NACOSTI

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/18/95661/24105**

Date: **24th July, 2018**

Zainab Wanjiru Wambugu
Africa Nazarene University
P.O. Box 53067-00200
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Influence of ASEI - PDIS-Pedagogy on pupils performance in mathematics in public primary schools in Kajiado North Sub County, Kenya"*** I am pleased to inform you that you have been authorized to undertake research in **Kajiado County** for the period ending **24th July, 2019.**

You are advised to report to **the County Commissioner and the County Director of Education, Kajiado 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.

BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Kajiado County.

The County Director of Education
Kajiado County.

APPENDIX VIII: RESEARCH PERMIT FROM NACOSTI

THIS IS TO CERTIFY THAT:
MS. ZAINAB WANJIRU WAMBUGU
of AFRICA NAZARENE UNIVERSITY,
0-206 KISERIAN,has been permitted to
conduct research in *Kajiado County*

on the topic: *INFLUENCE OF ASEI - PDIS-PEDAGOGY ON PUPILS PERFORMANCE IN MATHEMATICS IN PUBLIC PRIMARY SCHOOLS IN KAJIADO NORTH SUB COUNTY, KENYA.*

for the period ending:
24th July,2019

Permit No : NACOSTI/P/18/95661/24105
Date Of Issue : 24th July,2018
Fee Recieved :Ksh 1000

.....
Applicant's Signature

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

CONDITIONS

1. The License is valid for the proposed research, research site specified period.
2. Both the Licence and any rights thereunder are non-transferable.
3. Upon request of the Commission, the Licensee shall submit a progress report.
4. The Licensee shall report to the County Director of Education and County Governor in the area of research before commencement of the research.
5. Excavation, filming and collection of specimens are subject to further permissions from relevant Government agencies.
6. This Licence does not give authority to transfer research materials.
7. The Licensee shall submit two (2) hard copies and upload a soft copy of their final report.
8. The Commission reserves the right to modify the conditions of this Licence including its cancellation without prior notice.

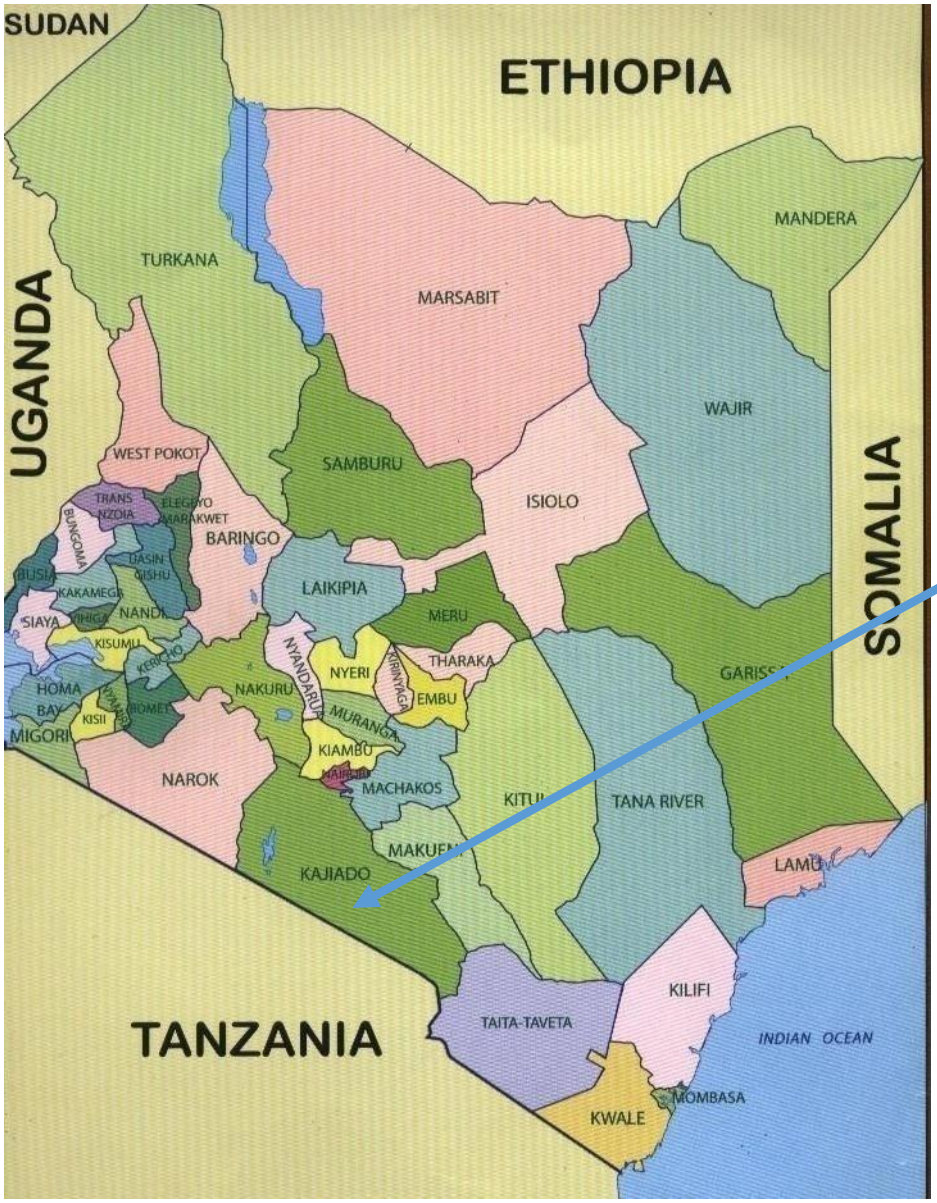
REPUBLIC OF KENYA

NACOSTI

National Commission for Science, Technology and Innovation

RESEARCH CLEARANCE PERMIT

APPENDIX IX: MAP OF KENYA SHOWING KAJIADO COUNTY



Kajiado County

APPENDIX X: MAP OF KAJIADO COUNTY SHOWING KAJIADO NORTH SUB COUNTY

APPENDIX XI: MAP OF KAJIADO SUB COUNTY