APPLICATION OF SMASSE’S ASEI/PDSI PRINCIPLES WHEN TEACHING MATHEMATICS IN SECONDARY SCHOOLS OF NAKURU DISTRICT

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DECLARATION

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

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DEDICATION

To my dear parents and all my former students whose great enthusiasm and dreams enkindled in me the desire to pursue this area of study.
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This work would not have come to its successful completion without the moral, scholarly and material support from a number of persons.

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For your generosity, selflessness and commitment, may you all receive the abundance of God’s blessings.
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LIST OF ABBREVIATIONS AND ACRONYMS

ACRONYMS

ASEI: Activity-Student-Experiment-Improvisation
CEMASTEIA: Center for Mathematics, Science and Technological Education in Africa
DQASO: District Quality Assurance and Standards Officer
FAWE: Forum of African Women Educationists
GOK: Government of Kenya
HOTS: Higher-Order-Thinking-Skills
IMSTEP: Indonesian Mathematics and Science Teacher Education
INSET: In-Service Education and Training
JICA: Japan International Corporation Agency
KCSE: Kenya Certificate of Secondary Education
KESSP: Kenya Education Sector Support Programme
KNEC: Kenya National Examination Council
MOEHRD: Ministry of Education Human Resource Development
NCTM: National Council of Teachers of Mathematics
PDSI: Plan, Do, See and Improve
QASO: Quality Assurance and Standards Officer
SMASSE: Strengthening Mathematics and Sciences in Secondary Education
SPIAS: SMASSE Project Impact Assessment Survey
SPSS: Statistical Package for Social Sciences
TIMSS: Third International Mathematics and Science Study
USA: United States of America
WECSA: Western, Eastern, Central and Southern Africa

ABBREVIATIONS

A.D.E.A.: Association for the Development of Education in Africa
A.T.M.: Association of Teachers of Mathematics
C.C.N.: County Council of Nakuru
D.E.O.: District Education Office/r
D.E.S.: Department of Education and Studies
D.E.S.A.: Department of Education South Africa
H.O.D.: Head of Department
M.E.S.: Monitoring and Evaluation Surveys
M.O.E.: Ministry of education
M.O.E.S.T.: Ministry of Education Science and Technology
M.O.H.E.S.T.: Ministry of Higher Education Science and Technology
M.S.S.: Mean Standard Score
M.T.Q.: Mathematics Teachers Questionnaire
N.C.S.T.: National Council of Science and Technology
S.E.D.: Scottish Education Department
Sb.T.D.: School-based Teacher Development
S.M.C.: Scottish Mathematics Council
T.S.C.: Teachers Service Commission
T.T.C.: Teacher Training College

ABSTRACT
The importance of mathematics education can best be acknowledged through the multiple roles it plays both in the life and development of an individual and of the society, hence the need to make mathematics education more accommodating of student needs. In the attempt to improve performance in mathematics, it is no longer a matter of having trained teachers in a school but teachers whose classroom practices can enhance student achievement. Quality teaching and learning is reflected in high student achievement in an increasingly competitive society where good performance in mathematics is imperative as a prerequisite for any significant advancement. The Kenyan government has continued to intervene so as to enhance achievement in mathematics. One major intervention by the government is the Strengthening Mathematics and Science in Secondary Education (SMASSE) project. This joint initiative between the governments of Kenya and Japan was intended to provide quality In-Service Training (INSET) for teachers in order to enhance teaching and learning hence, achievement in mathematics and sciences. Teachers have had to keep abreast by attending the INSET. Since the INSET’s launch, significant student achievement particularly in mathematics is yet to be realized in national examinations. The purpose of this study was to investigate the application of the principles of Activity-Student-Experiment-Improvisation/Plan-Do-See-Improve (ASEI/PDSI) by mathematics teachers in secondary schools of Nakuru District, with the aim of facilitating greater understanding about the use of principles for enhanced student achievement. Specific objectives of the study were: to assess school preparedness in terms of resources; to investigate how actual instructional sessions are conducted, and to determine prevailing views on ASEI/PDSI principles. Reviewed literature covered aspects of the objectives of this study. The descriptive survey design was used for this study whose target population was 4,040 subjects among them 45 principals, 45 mathematics Heads Of Department (HOD), 118 mathematics teachers and 3,826 form three students. Convenience, stratified and simple random sampling techniques were used to select a total sample of 540 respondents (10 secondary schools, 10 principals, 10 HODs, 40 teachers and 480 students. Questionnaires, interview schedules and class observation schedules were used to collect data. Piloting of instruments was done and the split-half method followed by the Spearman-Brown prophecy formula was used to
determine the reliability of the instruments. Instrument validity was determined through appraisal by experts. Data obtained from the study was analyzed using Statistical Package for Social Sciences (SPSS) computer software, version 17.0 and presented using simple descriptive statistics such as tables, graphs, charts and figures. Data obtained through interviews was reviewed, transcribed, organized into coherent categories and coded for analysis using the SPSS computer software and then presented and discussed thematically. Findings from the study revealed that the schools had adequate, professional and SMASSE trained teachers, school facilities and teaching-learning resources were fairly adequate while mathematics instructional sessions were teacher-dominated with little or no active involvement of students. Prevalent during lessons was the use of text books and the chalkboard, lessons lacked extensive student activities. Application of ASEI/PDSI principles was invisible, teachers’ and students’ attitude towards mathematics and ASEI/PDSI principles was relatively positive albeit factors that hinder their application.

CHAPTER ONE
INTRODUCTION

1.1 Introduction

This chapter discusses the background to this study, statement of the problem, purpose and objectives of the study, research questions, significance, assumptions, scope and limitations of the study, theoretical framework, conceptual framework, definitions of central terms related to this study, and general organization of the rest of the chapters.

1.2 Background to the Study

Mathematics plays a vital role in both the individual and society’s well being as it has greatly facilitated the rise of living standards across the world. Mathematics equips learners with skills for playing active roles in society irrespective of their social and economic status. Willoughby (2000) observes that the world is becoming more mathematical and people are constantly encircled by circumstances that call for mathematical decisions and skills which are often ignored or not taught
in classrooms. He holds the view that good decisions depend on mathematical thinking; hence mathematics education is of great significance across the competitive world. Willoughby further acknowledges that progression in technology has made mathematical thinking crucial: High-Order Thinking Skills (HOTS) and the ability to communicate intelligently about mathematical situations are unique human skills that must be fostered through effective classroom practices. Similarly, Smith (2004) opines that the society fully recognizes the importance of mathematics: its importance for its own sake, as an intellectual discipline; for the knowledge economy; for the workplace; for science, technology and engineering; and for the individual citizen. Hence it would be extremely hard to live a normal life without constant reference to mathematics for logical reasoning problem solving. It is for these reasons that it must be ensured that the youth are empowered with sufficient mathematical skills.

According to the National Council of Teachers of Mathematics (NCTM), many calls for reform in mathematics teaching and learning are based on the conviction that if students develop mathematical knowledge and the ability to use that knowledge, they will become competent participants in the advancement of communities in which they live. There are many obstacles to making significant change in mathematics teaching and learning in schools. These obstacles include the beliefs that students and teachers bring to the classroom, limited teaching and learning resources, lack of teacher and student motivation, the nature of teacher pre-service training or In-Service Training (INSET), class size, time, individual student needs, teaching strategies and assumptions held by school administrators and the society about mathematics among others (NCTM, 2000). In the pursuit for solutions to challenges associated with teaching and learning mathematics, hence low achievement in examinations, many governments and educators across the globe have invest a lot of effort towards mobilization of resources and development of strategies that can enhance good classroom practices.
Strong evidence is provided from Japan by Takahashi (2000) where a major reform movement in teaching and learning mathematics in the 1970s and 1980s saw a shift from a traditional classroom that focused on the teacher to a student-centred classroom that focused on students’ engagement in mathematics activities. Stigler and Hiebert (1999) further describe a typical Japanese teacher after the shift as a facilitator who takes a less active role in the classroom, allowing students to invent their own procedures for solving problems and one who acknowledges that the shift has helped to realize positive student achievement in mathematics.

The Ministry of Education (MOE) of Philippines successfully implemented teaching and learning strategies that included practical work, discussion, problem-solving, investigation, exposition, practice and cooperative learning (Ulep, 2006). These strategies called for students to engage in activities with not just their minds but also with their hands, hence ‘Hands-On-Activities.’ Hands-On-Activities have so far been perceived as the most effective because they have facilitated bringing students to their fullest learning capacities as they are able to depend on themselves. Cooperative learning has exposed them to opportunities where they work in groups instead of alone, hence better sharing knowledge.

Leung (2006) confirms that East Asia students have consistently performed well in mathematics achievement studies because the quality of teaching in their schools is relatively high. This is so because their mathematics classrooms are more interaction-dominated, lessons are more consistent and their presentations are found to be fully developed where students are engaged in meaningful mathematics activities during the lesson.

The government of Indonesia and Japan International Corporation Agency (JICA), in 1998 collaboratively established the Indonesian Mathematics and Sciences Teacher Education Project (IMSTEP-JICA) for the development of mathematics and science teaching in primary and secondary
schools (Muchtar, 2006). The goal of the project was to enhance the capacity of mathematics and science teachers through pre-service and In-Service Education Training (INSET). Emphasis was placed on the understanding that effectiveness in classroom instruction can be guaranteed through well planned lessons and active involvement of learners.

The role of secondary mathematics and science in industrial and technological development of a nation need no emphasis. African countries recognize this role (Forum for African Women Educationists- FAWE, 1998) and have in response made mathematics a core subject in their school curriculum. Waititu and Orado (2009) observe that mathematics concepts and principles are useful and applicable in the study of other subjects such as business studies, biology, physics, chemistry, agriculture, geography and art and design. According to UNESCO (2010) document, mathematics is a core subject in the Kenyan school curriculum for both primary and secondary levels. While poor performance in mathematics is evident in most parts of the country, some areas have a record of perennial mass failures in the subject as Manoah, Indoshi and Othuon (2011) note.

The Government of Kenya (GOK) in its vision 2030 has highlighted education as one of the pillars for propelling Kenya into an industrialized country (GOK, 2007). For this reason, the GOK, recognizing the key role mathematics and sciences plays in the realization of Kenya’s vision to become a globally competitive and prosperous country by the year 2030, has mobilized human, physical and material resources towards enhancing mathematics and science classroom practices in secondary schools: providing qualified teachers; providing teaching and learning facilities; improving teacher remuneration; supplying equipment and resource materials; constructing laboratories; and institutionalizing the (INSET) for teachers of these subjects. Kibe, Odhiambo and Ogwel (2008) observe that a belief that provision of instructional resources was the answer to poor performance in mathematics and sciences has failed to explain why some schools considered well-endowed in this regard have maintained low achievement in national examinations. This situation in many
Kenyan schools reveals a problem well beyond facilities and resources to include the quality of teachers and instructional processes.

Human resource development has been a priority for Kenya’s advancement through education. As a result, comprehensive training has been acknowledged as a need that would produce adequate manpower for quality education in terms of positive student achievement. Studies that have been conducted on the quality of education in Kenya have shown poor performance especially in mathematics and science subjects. Due to resource constraints, the challenge with teaching strategies and the need to improve student achievement in mathematics and science education, the Ministry of Education (MOE) has made efforts to request for assistance from her development partners (MOE, 2010).

The Strengthening of Mathematics and Science in Secondary Education (SMASSE) Project was launched in 1998, as a joint venture between the governments of Kenya and Japan through Kenya’s MOE and JICA, to respond to the continued low achievement in mathematics and sciences. The overall goal and purpose of SMASSE project was to facilitate improved students’ ability in mathematics and sciences and to enhance the quality of mathematics and science education at secondary level through the INSET for teachers. Its objectives were to influence a change of attitude among teachers and students in order to enhance the quality of teaching and learning skills, as well as knowledge and achievement in national examinations (MOEST, 1998). The project employed the INSET for teachers as a tool for improving achievement in mathematics and sciences. Karega (2008) observes that the INSET is one of the approaches used to improve teachers’ skills and competence, and is in conformity with worldwide consensus that improving the quality of education depends on improved quality of classroom practices.
A baseline survey conducted in 1998 in nine of the then seventy-two districts in the country, to determine areas that needed intervention revealed many challenges such as teacher/learner attitudes, inappropriate teaching/learning strategies, inadequate and inappropriate student assignments, inadequate interactive opportunities for teachers and infrequent teacher and student guidance (MOEST, 1998; Njuguna, 2005). Following this survey, a SMASSE INSET was established from a pilot phase (1998 – 2003) to a national phase (2003-2008) to address teachers’ attitude, pedagogy, content mastery and instructional materials with the hope that improved and student-focused instructional strategies, improved use of teaching-learning materials and enhanced student participation during instructional sessions would be realized. The main focus of the SMASSE INSET was “Guided principles of Activity–Student–Experiment–Improvisation (ASEI) and a Plan-Do-See-Improve (PDSI) approach.” The ASEI principles involve providing meaningful teaching Activities that are Student-focused, Experimental/practical learning and Improvising resources where necessary. The PDSI approach embraces orderly steps by the teacher in executing learning activities by first, Planning for the Activity before Doing it while Seeing/observing with the intent to evaluate and finally Improving on the activity and future processes (MOEST, 1998; Association for the Development of Education in Africa - ADEA, 2005; World Bank, 2007). At the INSET, teachers are taught how to improvise instructional materials by using locally available resources and how to incorporate real student life situations during lessons in order to enhance learner participation and scientific skills. They work on improving their skills in work planning, monitoring learning achievement, self and collegial evaluation and utilization of feedback to improve subsequent lessons. The INSET curriculum consists of carefully designed themes that are presented in four cycles of ten days each as shown in Figure 1.1.
Figure 1.1  *The Four Cycles: Themes and Key Issues Emphasized* (Source: Waititu & Hattori, 2004)

Figure 1.1 reflects the INSET’s objectives: enhancing teacher/student attitudes; improving teaching/learning skills, attainment of knowledge, and positive achievement. The curriculum themes form a ladder whose base is attitude change and the apex, impact change. Monitoring and Evaluation by the end of the pilot phase reported a more positive attitude and more student participation during class sessions in SMASSE districts than in non-SMASSE districts. The pilot phase benefitted approximately 4000 (20%) of the targeted teachers (Waititu & Orado, 2009). Following this realization, the SMASSE INSET and its activities was extended to the entire nation during which period Nakuru District mathematics and science teachers attended the INSET. Phase III of the INSET (2009-2013) targets teachers who might not have attended any of the four INSET cycles, primary school teachers and teacher training colleges (TTC).
The SMASSE INSET in Kenya has succeeded to in-service mathematics and sciences teachers and to contribute towards instructional resource materials. According to SMASSE Project Impact Assessment Survey (SPIAS), the project has established 105 INSET centres in the country. By September 2007, the Project had trained a total of 66 national trainers, 1,381 district trainers, 465 secondary school principals, 72 DEOs, 72 QASOs, 72 TSC officers and over 20,000 mathematics and science teachers. The district trained staff are expected to be in charge of in-servicing all the secondary mathematics and science teachers at the 105 established district training centres under the guidance of the national trainers (JICA, 2008).

Nonetheless, improvement in student achievement in mathematics in national examinations has remained dismal as Table 1.1 shows:

<table>
<thead>
<tr>
<th>YEAR</th>
<th>CANDIDATURE</th>
<th>AVE. MARK (Out of 200)</th>
<th>% SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>259,280</td>
<td>39.39</td>
<td>19.70</td>
</tr>
<tr>
<td>2007</td>
<td>238,684</td>
<td>38.08</td>
<td>19.04</td>
</tr>
<tr>
<td>2008</td>
<td>273,504</td>
<td>36.46</td>
<td>18.23</td>
</tr>
<tr>
<td>2009</td>
<td>304,908</td>
<td>42.59</td>
<td>21.30</td>
</tr>
<tr>
<td>2010</td>
<td>337,404</td>
<td>41.34</td>
<td>20.67</td>
</tr>
</tbody>
</table>


Examination results analysis reports reveal that candidates have been unable to tackle questions that required the application of construction skills (KNEC, 2010; 2011, MOE, 2010). This revelation points to the lack of classroom practices that enhance High Order
Thinking Skills (HOTS) and hands-on activities. Nakuru district’s performance records also reveal continued dismal achievement. The best school in 2008 attained a KCSE Mean Standard Score (MSS) of 8.07 in mathematics out of 12 (the maximum possible attainable points) while the lowest attained an MSS of 1.0875 (DQASO, 2009). In 2009 the district attained an MSS of 4.3167 with an MSS of 3.0363 in mathematics with the best school attaining an MSS of 8.56 and the lowest 1.2500 MSS (DQASO, 2010). In 2010 KCSE Mathematics MSS dropped from an MSS of 3.0363 to 2.7983 MSS (DQASO, 2011). The overall KCSE MSS was not any different as manifested in previous years given that the best school attained a Mathematics MSS of 8.20 and the lowest attained a mere 1.4279 MSS (DQASO, 2011).

1.2 Statement of the Problem

Despite the many efforts by the government to eliminate the problem of low student achievement in mathematics in the Kenya Certificate of Secondary Education (KCSE), only a minority of each year’s enrolled candidates (between 15% and 20%) obtain quality grades (KNEC, 2010). National examiners’ reports continue to reveal that students are generally unable to handle mathematics questions that require application of construction skills (these skills can be enhanced through ASEI/PDSI’s hands-on activities. Many studies that have been done to address the problem of low achievement attribute it to many factors. However, not available to the researcher is a study targeting the application of ASEI/PDSI principles by teachers in mathematics sessions. In the researcher’s view, little has been done on specific ASEI/PDSI-based practices that enhance achievement in mathematics generally the Kenyan context and Nakuru district in particular. After seven years of the establishment of
SMASSE INSET in the district, to what extent are ASEI/PDSI principles applied by mathematics teachers in its secondary schools?

1.4 Purpose of the Study

This study endeavored to establish the extent to which ASEI/PDSI principles were applied by teachers in implementing mathematics curriculum in secondary schools of Nakuru District, with the aim of facilitating teachers’ and other stakeholders’ greater understanding on the use of the ASEI/PDSI principles for enhancing student achievement in mathematics.

1.5 Objectives of the Study

Specific objectives of the study included to:

i. Determine the schools’ preparedness in terms of human and material resources.

ii. Identify how actual classroom mathematics instructional sessions are conducted.

iii. Determine teacher and student views on ASEI/PDSI principles.

1.6 Research questions

This study was guided by the following questions:

i. How prepared are the schools in terms of resources for mathematics teaching?

ii. What interactions in relation to ASEI/PDSI principles take place in the classrooms?

iii. What are mathematics teachers’ views on ASEI/PDSI principles?

iv. What are the students’ views on ASEI/PDSI principles?

1.7 Significance of the Study
This research was a product of persistent concerns about low student achievement in mathematics in national examinations. This study in the researcher’s view is relevant to several bodies that are manned with the task of overseeing all aspects related to education in Kenya:

i. The study touches on pertinent aspects mathematics curriculum implementation. Findings from this study will provide additional information for education stakeholders on school preparedness in terms of human and material resources for purposes of effective application of ASEI/PDSI principles.

ii. The study findings will shed more light for the government, QASO, SMASSE INSET trainers, on the SMASSE INSET for teachers and its future.

iii. Findings may be helpful in facilitating the stakeholders’ continued search for more effective classroom practices, and in their efforts towards successful application of ASEI/PDSI principles.

iv. Findings will be informative to all education stakeholders in terms of views from both teachers and students on the application of ASEI/PDSI principles in mathematics sessions.

1.8 Assumptions

The researcher made the following basic assumptions with regard to this study:

i. Respondents from the representative schools would be willing to provide responses, to all items on research instruments honestly and to the best of their knowledge.

ii. The participants’ gender would not affect their way of responding to items in the research instruments.

iii. The sample size was sufficient to provide information with regard to the application of ASEI/PDSI principles meaningful and relevant to stakeholders.
1.9 Scope and Limitations

1.9.1 Scope

The focus of this study was to determine the extent to which the application of ASEI/PDSI principles is taking place in mathematics sessions. It covered the aspects of school preparedness in terms of human and material resources, mathematics classroom interactions and the use of ASEI/PDSI approach, and views on ASEI/PDSI principles. Due to the large number of potential participants in the study, the sample for this study was drawn only from among the principals, mathematics Heads of Departments (HODs), mathematics teachers and the form three students of Nakuru district.

1.9.2 Limitations

Due to the fact that this study was done in a district that is located in an urban setting and that only form three students and not a cross-section of students from all classes were used, findings from this study may not be generalizable to other geographical areas especially the rural areas. Due to the fact that some of the respondents were hesitant to provide honest responses to items on research instruments, findings may not accurately reflect the opinions of a larger population. Available funds limited the study to a small population that might not have been representative of all secondary schools in Kenya. Obtaining information relevant to this study from school principals was a challenging task, as their other unplanned for tasks collided with agreed upon times for interviews.

1.10 Theoretical framework

This research was guided by the Constructivist theory. The theory of constructivism is generally attributed to Jean Piaget who articulates mechanisms by which knowledge is internalized by
learners. He suggests that through processes of accommodation and assimilation, individuals construct new knowledge from their experiences. Constructivism views each learner as a unique individual with unique needs, background and complexity, and encourages, utilizes this uniqueness as an integral part of the learning process (Atwater, 1996; Schwadt, 1994; Staver, 1998; Wertsch 1997). Mathews (1998) observes that constructivism is founded on the premise that we construct our own understanding of the world we live in by reflecting on our experiences.

According to Christie (2005, Kim, 2005) constructivism is an instructional strategy that encourages teachers to provide each student’s preferred learning style, rate of learning and personal interaction with other students. Hein (1991) and Wertsch (1997) present several learning principles of constructivism thinking: learning is an active process where learners use sensory input to construct meaning and systems of meaning; the crucial action of constructing meaning is mental hence hands-on experiences are necessary for learning; learning is a social activity associated with connections with teachers, and interacting with others in relation to what they know; one needs previous knowledge in order to assimilate new knowledge for the more we know the better we can learn, so efforts to teach must be connected to the state of the learner with regard to previous knowledge acquired; it takes time to learn therefore ideas have to be revisited, tried out and used for significant learning to take place; assessment is a valuable way to measure learning as it provides information on the quality of student learning.

According to constructivism, teachers have the role of being facilitators who help learners to get to their own understanding of the content and to play an active role in the learning process (Gamoran, Secada & Marrett, 1998). This dramatic change of focus from the teacher and content to the learner implies that a teacher as a facilitator needs to display a totally different set of skills. While a teacher lectures from the front, giving a monologue and answers student questions according to a set curriculum, a facilitator asks and supports from the back in continuous dialogue with the
learners, thereby providing guidelines and creating a conducive environment for learners to arrive at their own conclusions.

Brooks and Brooks (1999) emphasize that teachers must acknowledge that each student learns in a way that is unique to their nature and nurture as this facilitates opportunities for learners to maximize their learning potential. While it is clear a teacher cannot reach out to every student on the same level during one session, using a variety of teaching strategies during the course allows for all students to have a chance to at least learn in a way that matches their learning style. Brooks and Brooks (ibid) further observe that instructional methods used in the classroom produce particular retention rates: lecture (5%); reading (10%); audiovisual (20%); demonstration (30%); discussion groups (50%); practice by doing (75%); teaching others and immediate use of learning (90%). The teachers’ focus therefore should be on the learner, and what will help the learner to achieve more.

Guidelines provided for teaching with the Constructivist Theory by Brooks and Brooks (ibid) postulate that a teacher needs to encourage student autonomy and initiative while trying to use primary sources, in addition to manipulative, interactive, and physical materials. The teacher should also build on and use student responses when making "on-the-spot" decisions about instructional content, strategies and activities, and should search out students' understanding and prior experiences about a concept before teaching it to them. Teacher-student and student-student communication as well as student-critical thinking and teacher inquiry through asking thoughtful, open-ended or follow-up questions, and seeking elaboration after a student's initial response should be encouraged. It is important for the teacher to wait long enough for students to have time to think about answers to posed questions and be able to respond thoughtfully and to provide enough time for students to construct their own meaning when learning something new.
This theory facilitates the teachers’ efforts towards fostering new understanding in students, modifying their teaching strategies and encouraging students to analyze, interpret, and predict information. By so doing teachers promote extensive dialogue among students and assessment becomes part of the learning process. Teachers in this regard have a task to try and understand how their students can be helped to make sense of related meanings generated during mathematics classroom discourses which may be related to what they are expected or not expected to learn in the mathematics curriculum (Aikenhead, 2006a; Roberts, 1998).

In summary the constructivist theory supports the significant role played by hands-on- activities in making connections in mathematics. It shifts emphasis from teaching and learning and individualizes students’ learning experiences thereby helping students to develop processes, skills and attitudes. The theory considers students’ learning styles, focuses on knowledge construction and not reproduction, and uses authentic tasks/activities to engage students. Constructivism also provides meaningful problem-based thinking, requires reflection of prior and new knowledge and extends beyond the content that is presented to them. The learners’ world, and their developed schema within that world, necessitates that connections are made in brain patterns in order for them to internalize mathematics concepts. It is the hands-on activities that help to make these connections.

1.11 Conceptual framework

Figure 1.2 A Conceptual Framework on Mathematics Classroom Interactions

Presage Variables
- INSET training/Experience
- Teacher attitude
- Content mastery

Context Variables

Process Variables
- ASEI/PDSI principles’ use
- Teacher/student interactions

Product Variables
- Quality teaching/learning
- Positive KCSE results

Interaction with

...
According to Tsuma (1998) and Kombo (2004) several variables affect learning achievement: teacher/learner characteristics; classroom practices; interactions between the learner and the teacher, the learner and instructional materials, and the learner and the learning environment are significant in explaining differences in achievement as they influence quality. In Kenya, achievement at National examinations is used to measure the quality of learning. The product variable (high learning and achievement) is thus dependent on how the presage, context and process variables interact in the classroom setting as shown in Figure 1.2 above.

Ahmad (2008) presents Dunkin and Biddle’s four categories of variables that play a role in the processes of teaching and learning: Presage variables which constitute teacher characteristics that can have effect on the teaching and learning process; Context variables that comprise the existing school and student conditions; Process variables encompass activities that take place in the classroom during mathematics sessions; Product variables are the actual outcomes of teaching and learning. The framework is based on the view that teaching and learning is a dynamic process with inputs and outputs where inputs with suitable resources lead to worthwhile outputs (Hanrahan, 1998). It also tries to explain that poor student outcomes rest not on the inability of the students to learn but on poor classroom practices (Bloom & Habel, 2008; Levin & Wadmany, 2006). The
framework embraces thoughts of constructivism theory that quality interaction between independent variables is the bedrock to quality teaching/learning and achievement.

1.12 Operational Definition of Central Terms

The following definitions are provided to ensure uniformity and understanding of terms as they are used throughout the study. The researcher developed some definitions accompanied by citations while others were not.

**Application:** In this context, application refers to what Waititu & Orado (2009) term as engaging the ASEI/PDSI principles both in lesson planning and lesson presentation, resulting in stimulating lesson introductions, a lot of student activities, use of locally available materials, use of feedback from students and providing thorough lesson conclusions.

**ASEI/PDSI Principles:** These, also known as ASEI/PDSI approach, encompass providing meaningful Active Student-focused teaching sessions that promote Experimentation and Improvisation (ASEI) based on orderly execution steps of Planning for the activity, Doing the activity while Seeing/observing with the intent to evaluate and finally Improving (PDSI) on the process/lesson or subsequent ones (Waititu and Orado, 2009).

**Attitude:** Brink (2008) defines attitude as a predisposition or tendency to respond positively or negatively towards certain people, events, activities and ideas. They are learnt habits and hence are not permanent and should not be confused with personal traits. In the context of this study, attitude is an expression of one’s opinion on mathematics teaching/learning strategies, particularly, the use of ASEI/PDSI approach.
**Capacity Building:** The study borrows from JICA (2006) to define capacity building as the ongoing process of enhancing problem-solving abilities of teachers by taking into account all factors at individual, institutional, and societal levels. It is the development of knowledge, skills and attitudes in teachers that are relevant in the development and upgrading of educational processes that are locally meaningful.

**Classroom management:** Santrack (2006) views classroom management as a process of organizing resources, students, procedures and routines of a classroom so that teaching and learning can proceed in a safe and effective manner. In this context it is the mathematics teacher’s ability to organize and control the classroom: activities, time for activities; student individual needs/differences that emerge during classroom interactions.

**Implementation:** In the context of this study it entails mathematics lesson planning, teaching/learning process and assessment. This understanding is in agreement with the view held by Fullan and Stiegelbauer (1991) that implementation is a process geared towards outcomes. In the implementation, teachers attempt to apply ASEI/PDSI principles when teaching the mathematics curriculum in order to change or improve their practice.

**Classroom Interactions:** In this context the term is used to refer to mutual reciprocal action in class between teachers and learners, learners and teachers, learners and learners, and learners and resource materials. Ahmad (2008) calls it the actual teaching-learning process that creates opportunities for learning and one that helps learners to take advantage of these opportunities. It is about students having active learning sessions.
Mathematics Classroom Practices: In the context of this study, they are activities that take place in the classroom that enhance the quality of teaching, learning and achievement. Lamborde (2006) observes that mathematics classroom practices concern the mathematical content, lesson organization, teaching/learning activities, use of teaching/learning resources, and instructional strategies.

Resources: In the context of this study resources encompass the teaching staff, physical facilities and materials that facilitate a favourable environment for teaching and learning in a school setting.

School Preparedness: The readiness of the school to put into use ASEI/PDSI principles by ensuring that teachers have attended the SMASSE INSET, and that physical and material resources significant to the application of ASEI/PDSI principles are available and adequate.

SMASSE Project: A joint initiative between the governments of Kenya and Japan, aimed at the improvement of mathematics and science education through In-service and Education Training (INSET) for teachers. The project focuses on lesson improvement as its key concept and established a training system using the cascade approach (Nui & Wahome, 2006).

1.13 Organization of the Rest of the Chapters

The rest of the chapters of this thesis consist of more valuable information to the research. Chapter two presents the literature review, a critical component of any Research as observed by Piccano (2004). Chapter three offers the research methodologies that were used to give this study its direction. Chapter four covers the research’s data analysis, presentation and discussion while chapter five presents the research summary, conclusions and recommendations.
CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

In this chapter, the following sub-headings derived from research objectives were critically examined and reviewed in the light of the problem under study: School preparedness in terms of resources, mathematics classroom practices, attitudes in relation to student achievement in mathematics, and a summary of the reviewed literature.

2.2 School Preparedness in terms of Teaching and Learning Resources

Learning mathematics depends on the environment within which the learning is taking place, the way it is presented to learners and the way learners actively interact with the learning experiences presented to them. In today’s world, much emphasis is laid on the learner, the process of teaching and the learning environment.
Many countries in the world are doing all they can to ensure quality in their education systems. According to Botha (2000), quality education constitutes aspects such as learner’s achievement in national/regional/state examinations, teaching approaches, physical, cultural and social settings in the school. School resources like physical facilities, teaching-learning resources and amenities within the school are necessary for improving learning and teaching practices in the classroom. Dimmock (1995) adds by saying that quality education entails one or more of three elements namely: improving standards of teaching and teachers’ performance; improving standards of learning and learners’ performance; and providing a curriculum that is more relevant to client needs.

Low grades in mathematics and sciences are interpreted to mean that the students have not learnt well or the subjects are either difficult to teach or learn, regardless of other factors affecting teaching and learning (World Bank, 2004). Other factors include shortage of teachers, inadequate and poor facilities; limited instructional materials and low teachers' morale due to low remuneration and poor terms of service. Studies on how to improve education quality indicate that this could be done through improvement of quality of teachers that is, making them more effective in the way they teach (World Bank, 2004; 2006).

2.2.1 Teacher Preparedness: INSET

Teachers are the most important resource at the classroom level and the ultimate implementers of any curriculum reform. Research findings recognize that educational innovations fail to succeed if teachers are not provided with necessary skills and knowledge needed to carry them out (Pelgrum, 2001). Teachers’ planning for classroom sessions needs thorough thoughts about the words and
instructional materials to be used. Through appropriate in-service activities, inexperienced teachers can be assisted to enhance their lesson planning and delivery skills.

A common assumption with respect to the relationship between teachers’ experience and student achievement is that students taught by more experienced teachers do better because their teachers have mastered the content and have over time acquired classroom management skills to deal with different types of classroom problems (Slavin & Madden (2006), and Gibbons, Kimmel and O’shea, 1997). Experienced teachers are considered to be able to concentrate on the most appropriate ways to teach particular subject content to students who differ in abilities, prior knowledge and backgrounds (Stringfield and Teddlie, 1991). Important to this process therefore is understanding that in order to improve on any aspect of education, it is imperative to engage a well articulated teacher education programme that will prepare the teacher for the leadership role they are expected to play. The teacher is the most indispensable factor in the effective administration of any education system or any program of study. No matter what amount of resources might be put into the nation’s education system, without properly prepared and motivated teachers, one can never expect good returns from the system.

Ball (2000) acknowledges that teachers have a personal daily responsibility to plan and carry out activities which support their primary objective of helping students to learn mathematics. Appropriate activities are an important part of preparing and maintaining an effective environment in which students can learn mathematics: learning/teaching resources; good questioning strategies; identifying learning difficulties; maintaining discipline in the classroom; and evaluating the effectiveness of their teaching strategies at the end of the lesson.
Walters (1998) and Kriek (2005) opine that the origin of INSETs is rooted in the assumption that a trained teacher is not a finished product. Therefore the INSET is intended to support and facilitate professional enhancement of teachers. It is also an opportunity given to serving teachers to enrich their knowledge and improve on their teaching skills. INSET in mathematics education aims at contributing to the mathematics teachers’ content knowledge of the subject, right attitude and strategies in teaching, improving general teaching practice such as classroom management and lesson planning. According to Lewin (2000) INSETs come in many forms that vary from short courses lasting from a day to several days, to longer vacation programmes, to sandwich type arrangements over a year or more where training and teaching in schools are concurrent. In-service training may be on site within schools (sometimes called on-service), or in colleges or teacher centres and it may be part of regular teacher support. Walters (1998) notes changes in classroom practices that can be attributed to factors such as changes in the curriculum or in instructional methods and new assessment procedures require that teachers be in-serviced in order to keep abreast with the changes. Little (2007) on the other hand, posits that INSETs help teachers to reflect on their use of ineffective teaching strategies, and how to develop and examine new conceptions of teaching and learning. In team-teaching, teachers share ideas on how to plan and prepare lessons, and observe each other's classroom teaching as they learn from each other by being educated together and also educating one another (Little, 2007). Professional development of teachers is important because teachers are also likely to learn more from each other and change their perceptions as they interact/socialize within school environment during professional development (Putman & Borko, 2000).

Evidence from studies that have been done indicates that in-service programs appear to be more successful in changing teacher beliefs about teaching and learning than pre-service programs (Richardson, 1996). Changes in teacher beliefs and practices are influenced by the context and
teachers’ existing beliefs and knowledge. Richardson argues, further, that staff development programs that concentrate on teacher beliefs are important in changing instructional practices while constructivist approach-based programs are successful in engaging participants in examining and changing their beliefs and practices. Richardson further states that for successful staff development programs, their goal is to facilitate what will allow participants to understand their own beliefs and practices, consider alternatives, and experiment with new beliefs and practices. In these programs, teachers should be given control of the agenda, process, and content during discussions among them and staff developers.

The Scottish Mathematics Council (SMC), in a survey conducted observed that a learner who had been described by the teacher as lacking concentration proved interested and alert in an activity-centred environment (SMC, 2005). It was thus concluded that the greatest obstacle to continued improvement in mathematics education in school was the teacher’s lack of knowledge in the subject and the schools which were responsible for providing appropriate resource materials that would facilitate high learning achievement for every student. These findings have thus shifted the cause of difficulties in learning from the deficiency of learners to the deficiency of the school and teachers in terms of preparedness, resource materials and strategies.

Manouchehri and Goodman (2000) in their case study in the USA to investigate the elements that enhanced and impeded the work of teachers as they taught a new curriculum in their classes, focused on two complex and inter-related factors: the teachers’ interaction with the curriculum, and the teachers’ thinking about their practice. Findings from this research revealed the extent of teachers’ mathematical knowledge as manifested through the way they planned their lessons and interacted with students. Findings suggested that when using
innovative curriculum materials, teachers need to re-learn their role in the classroom, to re-examine their curriculum and instructional goals based on new needs, and to re-conceptualize the nature of their interaction with learners. Teachers have to know how to build on student insights towards different mathematical investigations, to connect student insights to a specific mathematical idea and to be willing to learn from their teaching and the use of the innovative materials in class so as to help them grow mathematically. These findings support the need for teachers to be adequately prepared for any innovative task and to be given enough time and room to understand, accept and embrace the change.

In a critical investigation into the nature and quality of INSET programmes for further education and training of mathematics teachers Mensah (2008) found out that monitoring and supervision of teachers after the INSET attendance was not being done effectively as principals and HODs rarely visited teachers in class nor did external specialists. Respondents indicated that factors beyond their control hindered their maximum application of knowledge and skills obtained during the INSET: lack of facilities and/or resources; overcrowded classes; pressure to complete the syllabus; and learning mathematics in a second language. Respondents were very positive about the trainers at the INSET as they acknowledged that the trainers were selected from experienced local teachers who encouraged them on various INSET activities.

In another qualitative case study done by (Fricke, 2008) to establish the effect of a mentoring programme on secondary school mathematics teachers, it was found that teachers had greatly improved in terms of content knowledge and that their confidence levels had grown. This was noted especially among teachers who initially never completed the syllabus, were able to do so, while those who consciously omitted sections of the syllabus had a change of attitude and could
now seek peer assistance. Classes were observed to be more student-focused, where students engaged in group activities.

Findings by Owiti (2011), in his study to determine the present level of the university mathematics teachers’ preparation in as far as making connections in mathematics is concerned so as to provide recommendations to the university faculties involved in teacher training, indicated that majority of the teacher trainees tried linking their lesson introduction with learners’ prior experience, yet again in majority of these lessons introduction included review of previous lesson’s homework and assignment. While this was an opportunity for the trainees to demonstrate creativity and innovativeness, that did not happen as in many of the cases recitation by the trainees of what was done previously was the practice. It was also revealed that a majority of the trainees displayed lack of realization of the role of connections in mathematics and students’ outside classroom experiences in their practice. Besides, university’s observation schedule had no item on trainees’ connection of mathematics. The study recommends that mathematics teacher training institutions help trainees improve on connecting mathematics and learners’ experiences as this may translate into improved academic achievement in the subject.

Musungu & Nasongo (2008) in their study to determine the head-teacher’s instructional role in academic achievement in secondary schools concluded from findings that head-teachers’ instructional role included regular checking of teachers’ professional records, regular class supervision, and management plan for carrying out curriculum goals. Therefore, since the role of the head-teacher is associated with high student achievement, the study recommended that head-teachers enhance internal supervision of teachers. The study also confirmed that effective supervision of teachers is necessary if they are to remain productive. Influencing through a healthy working relationship was noted to be a key process in supervision. It is almost impossible to work
with teachers towards a common goal by use of force or coercion. Head-teachers were encouraged to establish good working relationships with the teachers in the school.

These studies provide information that enriches findings from similar studies, several gaps are identified. Studies by SMC (2005) and Manouchehri & Goodman (2000) have information that can be verified through a similar or related study in a different locale, particularly here in Kenya. In the study by Owiti (2011), pertinent information for teacher training institutions is provided but important to note is that the small sample for the study was drawn from one university. A stronger case would also be built if this study covered not only teacher trainees, but also teachers who have been in the practice for some time and have had the opportunity to put into use the knowledge and skills obtained during their pre-service. The findings by Musungu & Nasongo (2008) would be enhanced even more by a study with a specific objective on schools and their role in the teachers’ endeavors to apply ASEI/PDSI principles when teaching mathematics.

Gaps in the study by Mensah (2008) reveal that teachers and the INSET were the tested variables; the study did not cover INSET trainers, Principals of schools and mathematics HODs and students. Findings were based on data from a small sample of mathematics teachers from five schools through personal in-depth interviews. Similar gaps are observed in Fricke (2008). The current study chose to undertake a study that would engage the descriptive survey design, a larger sample consisting of principals, HODs, mathematics teachers and students in obtaining data and besides interviews, questionnaires and observation guides for data collection. Findings from this study will enrich and/or confirm those presented in this reviewed literature as they provide information from a different locale.
2.2.2 Preparedness in Terms of Teaching and Learning Materials

Eshiwani (2004) opines that poor school facilities, inadequate instructional resource materials, and inappropriate teaching methodologies, are major causes for low achievement in mathematics and sciences. Teaching methodologies are rendered poor by the inadequate training and preparedness of mathematics teachers. A vital skill in planning is the teacher’s ability to recognize appropriate tasks/activities that will work with specific subject content, the type and ability of students, tasks and activities that require students to reason and communicate mathematically.

According to Kibe, Odhiambo and Ogwel (2008), in analyzing data of surveys conducted by SMASSE over a period of four years, achievement in mathematics has not been necessarily positive in many schools with qualified teachers and adequate teaching resources but on the contrary, schools poorly equipped in terms of facilities and instructional materials whose teachers teach effectively have realized relatively positive exam results. This implies that student achievement is to a large extent directly linked to what goes on in the classroom: effective planning, approaches/strategies used, instructional resource materials, teaching/learning activities, management of the teaching/learning environment. These findings point out that training teachers and providing resource materials alone is not enough, their effective use in the classroom plays a key role in enhancing learning outcomes.

Ouko (2004) posits that teaching aids significantly contribute to learner’s achievement and that those taught using improvised teaching aids tend to score higher marks. Developing effective teaching aids requires a teacher who is creative, proactive and appreciates the power of teaching aids in improving students’ achievement. But teaching aids developed by teachers are not always
adequate. The government and school managements need to devote more resources to the production of non-basic teaching aids including the use of locally available materials. One way of increasing the availability of non-basic teaching materials is through working as subject teams so that the developed materials can be shared across streams and that their effectiveness is evaluated by the subject team. Having a clear school policy on the development and utilization of teaching aids would go a long way in ensuring the availability of effective aids in the classrooms.

A research that investigated how instructional materials were used to teach Social Studies subject and how they impacted on student’s performance especially during the Primary School Leaving Examinations contends that the manner in which students are taught eventually impacts on the goal of teaching students to become vibrant and active citizens (Jotia and Matlale, 2011). Results from the study reveal that there is absolute need for teachers to change their teaching approaches so that lessons are conducted both theoretically and practically to facilitate students having some hands-on experiences on matters that are directly related to their active engagement in society. So basically teaching-learning processes were dominated by the teacher hence, students’ involvement in the learning process was minimal. The failure to use appropriate materials in class denied students the opportunity for active participation in their learning. Jotia (2006) has observed this and posits that lack of student involvement in the teaching process makes teachers the subjects of the learning process while students are dissolved to the level of objects that are just receiving deposits and their critical awareness is compromised.

Reche, Bundi, Riungu & Mbugua (2011) in their study aimed at finding out factors that contribute to poor performance examination found out that inadequate learning resources, inadequate monitoring by head teachers, understaffing, inadequate prior preparation and a large workload
were among the major factors behind low student achievement. The adequacy and use of teaching and learning materials affects the effectiveness of a teacher’s lesson. Teaching and learning resources enhance understanding of abstract ideas and improves performance. Their findings emphasized that school facilities have a direct effect on teaching and learning.

While these studies present key information on school preparedness in terms of teaching and learning resource materials, it is also evident that gaps exist in them. Kibe, Odhiambo & Ogwel (2008) report on findings from data collected by researchers other than them as they did not engage themselves on an actual study. In the case of Jotia and Matlale (2011) their study was conducted using a qualitative approach. The sample for this study was made up teachers of social studies and it was conducted in primary schools of one region in Botswana. As a way of affirming findings from this study, a survey could be conducted in a different locale and with a sample consisting of teachers, heads of schools and students. The same of observation can be attributed to Reche, Bundi & Mbugua (2011). The current study engaged the descriptive survey design in the Kenyan setting, with a larger sample and to investigate the resource variable with regard to the teaching of mathematics.

### 2.3 Mathematics Classroom Practices

Classroom practices play a key role in determining the nature of learner achievement. Lim (2006) and Zweck (2006) note four guiding principles for defining good classroom practices: a good practice is not the same the world over; it needs to be developed at the school level; models of good practices need to be shared; and good practices need to be valued at school, community, district and national level. Lim further proposes that good practices involve: listening to the voices
of the learners; designing learner-centred curriculum; students enjoying the learning process; active learning where there is doing in order to understand; relating learning to the world of the learner; teachers becoming learners too; and providing regular professional development. Hence good classroom practices are shaped by all the parties involved particularly, students, teachers, schools, and education officials since mathematics teaching is an artistic activity. This observation makes it easier to understand that a teaching strategy being effectively applied in one instructional session may not necessarily work in another setting. More has to be done therefore, to assess the reality on the ground before introducing any classroom reforms.

Owiti (2011) observes that results of the Third International Mathematics and Science Study (TIMSS) of 1996 indicated an intolerable mediocrity in mathematics teaching and learning where in many classrooms, mathematics instruction included review of homework from previous lesson, assignment, quick delivery of a set of rules and procedures by the teacher and the rest of the lesson, and the rest of the time was filled out with a set of exercises for practice. Owiti (ibid) advises that the methodology of teaching mathematics must involve the scientific approach and its connections with the real world. Well organized lessons and presentations facilitate students’ perceptions of connections of mathematical concepts and major ideas.

Research in Kenya and elsewhere has however shown that poor performance, disillusionment, poor attitudes and helplessness characterizes mathematics classrooms (Owiti, 2011). In Kenya for instance, performance in mathematics is perpetually dismal with an average of about 25% in Kenya Certificate of Secondary Education Examination - KCSE (Ayodo, 2009). Besides, only about 10% of students in Kenyan schools like mathematics as compared to Singapore where 86% of students like
the subject (Owiti, 2008; Ayodo, 2009). Lack of creative teaching of mathematics whereby links are made between learners’ experience, classroom work and industry has been demonstrated to be a major contributing factor to the aforesaid. Many young Kenyans do not realize the value and application of mathematics to popular games and day-to-day living. Consequently a majority think of mathematics as isolated pieces of rules and ideas (Ayodo, 2009). This in part could be contributed to by the failure of teachers to provide the needed connections and experience.

2.3.1 Classroom Interactions

An important point is presented by Darling-Hammond (2000) in his argument that to imagine that mere provision of facilities and resources as well as amenities, without paying attention to how they will be used in school and in the classroom will guarantee a high quality teaching process is unrealistic. Clarke (1995) is of a similar opinion and he adds that quality can be obtained via efficiency and effectiveness in the classroom where students are provided with opportunities to interact with their teachers, with the learning resources and with each other.

Studies conducted by the National Council of Teachers of Mathematics (NCTM) in the USA indicate that a basic model of an efficient mathematics classroom must first embody five processes through which students obtain and use their mathematical knowledge: valuing mathematics, becoming confident in their ability to do mathematics, becoming problem-solvers, communicating and reasoning mathematically (NCTM, 2000). These findings imply that teaching/learning mathematics is a complex interaction of these processes and that the development of each of the processes is necessary. Linked to this processes are several key variables which include resource materials and perceptions/values.
Mathematics teachers need to provide students with steps they will be willing and able to use effectively to solve problems of all kinds. Four steps for better mathematics education are presented by Willoughby (2000). Step one suggests that teachers should derive mathematics from students’ own realities as this helps students to understand mathematics better and to see it as a useful and powerful tool for solving their problems. In the second step, the teacher should help students to discover the power of abstract thinking in mathematics by guiding them to understand and appreciate the role of mathematics in the real world. Step three postulates that for students to be really good at a particular skill, constant pleasant practice must be guaranteed. The fourth and last step is that of applying mathematics problems to something of interest to students. Situations taken from learners’ real lives provide best applications.

The Association of Teacher of Mathematics (ATM), in their large scale international survey to determine the impact of classroom practices on mathematical achievement involved countries from Europe, United States Of America (USA) and Asia (ATM, 1998). The study revealed that a typical Japanese class lesson consisted of students of mixed abilities unlike other countries but the way lessons were developed was the same. The Japanese teacher and learners devoted most of their time to mathematical reasoning and understanding. By the end of the lesson, students were able to make explicit links between concepts and to understand well the complex problem presented at the beginning of the lesson. Such achievement was later translated by the students to better achievement in tests that were given. In a similar mathematics test administered to all participating students from these countries, Japanese students scored best in Mathematics while England, Wales, Scotland and the USA all scored considerably lower than the Japanese students. Conclusions from the survey attributed Japan’s positive outcomes to the effective classroom practices that placed more emphasis on the learner and the lesson presentation approach.
Keiser and Lambdin (1996) in their research to assess time constraint issues in implementing a mathematics teaching reform in the classroom and factors that influence the teachers' pacing through the new curriculum identified six major reasons that cause teachers to struggle with the time issue: cooperative group learning; mastery learning; homework; assessment; and practical considerations. Cooperative group learning was challenge as nearly three-fourths of student time was spent working in small groups. Group work hindered the pace with which the class moved through the materials as it always took more time than planned for students to work while correcting homework and assessment also required more of the teachers’ time.

Skowron (2006) observes that planning enables the teacher to be innovative and to present lessons in a variety of interesting ways that will arouse learners’ interest and in evaluating the teaching/learning processes; teachers accept feedback from colleagues as this helps them to see and avoid mistakes made in earlier lessons. In the process teachers become more open to feedback and ready to improve on mistakes to enhance learning and quality outcomes.

A cross-national research that sought to explore and compare features of teacher/student interactions in the mathematics classroom and the extent to which these interactions were sustained in St Petersburg in Russia and North-East of England revealed that private interactions in both locations occurred in sessions when students were working on written tasks. Private interactions were intended to be synonymous with the term monitoring of student progress by the teacher or teacher engagement with individual students. (Wilson,
Andrew & Below, 2006). Public interactions in both locations involved either a whole class or an individual response.

This study also revealed the existence of profound ideological and culturally-rooted differences in pedagogical approach. Differences in culture were evident during classroom practices/interactions and perceptions. The Russian schools’ findings revealed an approach well tuned to bring about a desired formulaic approach to teaching/learning mathematics. The English schools’ findings revealed a mixed approach of using whole class interactive teaching as a basis for getting learners to think for themselves and to relate mathematics to their own prior cognitive structures. The Russian approach appeared more successful in its own terms as findings showed: it appeared to build capability, mastery, confidence and enjoyment, which in turn motivated learners. The English approach and its emphasis on the ability to apply reasoning in new situations became difficult because learners could be asked to think for themselves about things on which they had an imperfect grasp.

According to Oyaya (2000), quality classroom activities are critical to achieving effective learning: meaningful hands-on (manipulation); minds-on (intellectual); mouths-on (discussion); hearts-on (motivation) student activities. Apart from schemes of work and lesson plans, the teacher is expected to carefully plan and assemble teaching aids and activities before the lesson. Emphasis is laid on how instructional resources and activities facilitate learner understanding, retention and more interest in mathematics.

Sifuna and Kaime (2007) in their study to assess the effectiveness of SMASSE and the School-based Teacher Development (SbTD) programs on classroom interactions in primary and secondary schools
in Kenya established that while teachers evaluated the INSET programs as having been effective in exposing them to student-centered teaching approaches, this was not reflected in their classroom practices which were largely teacher dominated. The researchers attributed the lack of student-centered practices to large class sizes, language and the pressure to complete the syllabus in preparation for National examinations.

A nationwide survey involving form two students, teachers and principals of selected secondary schools was conducted in Kenya to establish how SMASSE intervention principles translated into achievement (Waititu & Orado, 2009). Findings revealed that teachers exposed to the INSET planned their lessons better and were more open to teamwork; they attended to student questions and needs, and were ready to try new methods. Constraints revealed included lack of resources and large class sizes. However, students were actively involved, showed greater interest in mathematics and their attitude was gradually becoming positive.

Findings from reviewed studies in this section would be enhanced by a study that would attempt to attend to the many gaps noted. These studies have been conducted in locales apart from Nakuru district. The study by ATM (1998) and Keiser and Lambdin (1996) could be replicated in the Kenyan context so that a comparative analysis can be made. Studies from the Kenyan reality also have noted gaps. Findings of Sifuna & Kaime (2007), are based on data obtained from primary schools, hence, a study the secondary school reality will provide additional information. The use of a variety of data collection tools besides questionnaires is a gap in this study just as it is the case for Waititu & Orado (2009), who did not engage a cross-section of students in their study. This study attempted to attend to the noted gaps.

2.3.2 ASEI/PDSI Principles as a Teaching/Learning Strategy
According to Willoughby (2000) today’s learners need to be able to relate their mathematical skills to the world around them and to use the same skills to help solve problems that are of importance to them and the society. A change in the way mathematics is taught will result in positive outcomes. According to Mutunga and Breakell (1992) learners need to develop basic skills and techniques, logical thinking and the ability to distinguish fact from opinion. Classroom practices ought to stimulate intellectual curiosity and independence, motivation and study habits which are central to continuous interest and learning of mathematics.

JICA (2000) opines that mathematics teaching should be by far learner-centered while the teacher’s role should be that of a facilitator, motivator, counselor and innovator. There must be many activities during any given one lesson: student centred activities involving a lot of improvisation will help demystify mathematics. Similarly, Johnston-Wilder, Johnston-Wilder, Pimm and Westwell (1999) note that the mathematics teacher’s task requires that: they use teaching methods which sustain the momentum of the learners’ work and keep them engaged by stimulating intellectual curiosity, communicating enthusiasm; they match approaches used to the content to be taught and to the nature of learners to be taught; they effectively question, select and make good use of resource materials; and they exploit opportunities that contribute to the quality of students’ wider educational development. If teachers are able to perform these tasks, the result of such effort will be a motivated student and positive achievement will also be realized.

A group of Mathematics teachers came up with a list of necessary ingredients for rich mathematical student activities. Such activities should: be accessible to all students at the start of the lesson; not restrict students’ searching in one direction; offer further challenges and are extendible; promote discussion and communication; invite students to make decisions, encourage originality and invention, involve students in speculating, encourage questions, have an element of surprise and
are enjoyable (Department of Education and science, 2007). Activities with ingredients such as these will enhance understanding, the thinking and skills capacity thereby leading to enhanced positive achievement by students.

A qualitative study focusing on whether novice teachers used hands-on activities in the classrooms revealed that teachers were able to effectively use hands-on activities that they themselves modeled (Axtell-Dean, 1998). The teachers also acknowledged that learning how to model hands-on activities in their pre-service training was bearing good fruit. The study concluded that hands-on activities in mathematics can be taught at pre-service level and also at the INSET and that the mathematics curriculum needs to contain clear directions as to how this is to be accomplished.

Reys, Suydam and Lindquist (1995) provide a summary of reasons for a well planned lesson: at the heart of every well planned lesson is the learner; well planned lessons establish definite objectives for each lesson and help the teacher to ensure that essential content is included. Plans help ensure that lessons begin interestingly, maintain a good pace throughout and have a satisfying ending. They help the teacher to hold the interest and attention of the learner and to avoid unnecessary repetition hence creating confidence.

Nui and Wahome (2006) observe that good practices for effective classroom sessions in Kenyan schools are embraced through the ASEI paradigm shift. Four inherent and basic principles guide SMASSE INSET activities, aiming at a shift from a pre-ASEI (before INSET) to an ASEI (after INSET) condition: from content to activity-focused teaching/learning; teacher-centred to student-centred learning; lecture to research based approaches; few demonstrations to improvisation.
Ndirangu (2011) in her study indicated that the knowledge and skills acquired through the ASEI and PDSI principles had not been fully implemented by the in-serviced teachers. In addition, not all the teachers had attended all the four cycles of the in-service training. The study further revealed that majority of the principals, who should be enforcing the implementation of the acquired knowledge and skills from ASEI/PDSI informed. The participation of the students in the classroom is yet to be fully attained. The change of attitude by the teachers and the students towards teaching and learning, though changed is yet to be fully attained. The researcher concluded that achievement could still be low because students have not yet been taught using all the acquired knowledge and skills teachers gained during in the SMASSE INSET. The researcher’s view was that SMASSE INSET should be made mandatory for all teachers and head teachers to ensure uniform exposure.

Findings from the study by Liburu (2011) on the impact of SMASSE project on teaching and learning of mathematics revealed that there was partial implementation of ASEI/PDSI principles with teachers averagely involving students in the teaching/learning process. Teachers also did not fully apply students-focused methods of teaching. Performance of mathematics by students in KCSE however remained low. Teachers and students acknowledged that use of ASEI/PDSI principles in enhancing teaching and learning of mathematics should be continued. Major challenges reported by teachers while implementing ASEI/PDSI principles were students' discipline, teachers' workload, availability of physical facilities and students' absenteeism. The study recommended that SMASSE INSET be continued for mathematics teachers and that specifically it should be rolled down to primary education level.
The current study attempted to narrow the gap realized in this study by engaging a larger sample from a different locale and a variety of data collection tools such as interview schedule and observation guide. In particular, the study by Ndirangu (2011) targeted the teaching of Biology while the current study on embarked mathematics teaching.

2.4 Attitudes for Enhanced Achievement

Attitudes have very serious implications for the teacher, the learner, and the entire school. Learners draw from their teachers’ dispositions to form their own attitude, which in turn affects their learning outcomes. According to Yara (2009) teachers are, invariably, role models whose behaviours are easily copied by students. Many teachers seldom realize that how they teach, behave and interact with students can be more paramount than what they teach. In a nutshell, teachers’ attitudes towards their students need to be favourable enough to carry students along. The teacher’s attitude towards teaching mathematics plays a significant role in shaping attitudes of students towards learning mathematics. In this regard therefore, students’ positive attitudes towards mathematics are enhanced by the teacher’s enthusiasm, resourcefulness and helpful behavior, thorough knowledge of subject content, and their ability to make mathematics learning interesting.

It is on the premise that the teacher’s attitude towards teaching mathematics plays a significant role in shaping the attitude of students towards the learning of mathematics that their attitude of teachers, and their disposition to the subject, students and classroom environment could make or unmake the attitude of the students towards the learning of mathematics. The attitude of the mathematics teacher can mold the attitude of students to want to learn or not. Hence mathematics
teachers should not only be professionally but also psychologically prepared to teach the subject given that their role as facilitators of learning and contributors to students’ achievement is enormous.

Selinger (1994) provides a number of ways through which teachers can keep students’ interest in learning mathematics high, hence, help them to build a positive attitude towards mathematics: mathematics teachers must be interested in finding ideas that can be used with groups of students who have a wide range of interests, in different ways of motivating students in a way that will promote a variety of responses to problems given to them. Effective mathematics learning is determined by among other things the ability of students to make connections, to retain skills and to have positive attitudes. Attitudes also in some settings predispose teachers towards the use of traditional teaching strategies as revealed by an analysis of teaching practices in seven European countries (Handal, 2003 & Hattie, 2003). Teachers consciously or unconsciously bring to the process of implementation, cultural and professional belief systems, which impact on learners’ experiences of mathematics in the classroom. A study on the culture of mathematics teaching and learning in some Malaysian schools (Lim, Fatimah & Tan, 2003) shows that many mathematics teachers tend to hold a strong belief of “practice make perfect” as a way of learning mathematics. Consequently, students are usually given large amount of home work and past year examination questions to practice their mathematics skills.

A qualitative case study involving a secondary school in Portugal focused on the views and attitudes of teachers and students participating in a pilot mathematics curriculum that emphasized active teaching/learning strategies (Ponte, Matos, Guimaraes, Leal & Canavarro, 1990). The study set out to determine major problems associated with the implementation
process. Findings revealed that consultant teachers played a critical role of assisting teachers to express their doubts and insecurities and of being shock-absorbers for teachers. Pedagogical issues important to teachers should have been addressed in the INSET sessions emerged during implementation phase: training on assessment, development of students’ attitudes; dealing with new objectives and strategies, facing realities of changing the teacher’s classroom role; maximizing educational possibilities; and organizing group work satisfactorily. Teachers felt insecure in applying advanced strategies in the classroom.

Evers, Andre & Welko (2002) investigated the teachers’ beliefs on the implementation of an innovative educational system in the Netherlands, aimed at establishing the extent to which teachers have a negative attitude towards new instructional practices. They found that implementation of the practices and coping with stress involved in the home-study innovation, related negatively to the teachers’ burnout levels. The results of the study showed that self-efficacy beliefs were significant and negatively related to depersonalization and emotional exhaustion dimensions.

Findings from a study conducted by Makewa, Role, & Biego (2011) showed that teachers’ attitude towards SMASSE INSET tended towards the positive as they appreciated the facilitation and curriculum offered. However, despite their liking of the SMASSE INSET, they were not comfortable with the training period of 10 days each cycle during the holidays. From their responses, most teachers seemed to be uncomfortable with the training done during school holidays when other teachers were free to attend to their own personal needs. According to some teachers, the period
of 10 days is quite long and should be reduced to one week per cycle. This, they argued, would help them to have time to attend to other personal matters and to conduct remedial teaching, which is done during the school holidays in many secondary schools in Nandi Central district. Most mathematics teachers stressed that SMASSE had added to their knowledge in the teaching of mathematics. Further, it had helped them solve problems they encountered in the field.

Findings from these studies are important and applicable in many instances where the implementation of a educational innovation has been a challenge to teachers. They are also applicable in many Kenyan mathematics contexts: change in attitudes towards mathematics is more apparent with students because they still have an interest in what the school may offer them whereas senior students are driven mostly by immediate or long term personal or career interests. Mathematics teachers have the potential to influence younger students’ attitudes and to accept new guidelines for a more active role of students in the classroom even though it remains a challenge for them to change their culturally rooted views, attitudes and practices, such as their defensive and individualistic tradition. These studies largely focused on teachers and had a limited instruments for data collection. The current study expanded the sample composition, and the research instruments it engaged.

2.5 Summary of the Reviewed Literature

Several key points that emerge these reviews: when the teacher resource is not sufficiently provided for and effectively motivated, the quality of instruction and of outcomes is affected; a well-equipped teacher in terms of mathematics knowledge, skills, resources, planned sessions, greater awareness of learner needs and interests, will most certainly be able to facilitate quality student learning; planning of lessons and availability of appropriate teaching/learning resources be
they the school’s availed or improvised, are non-negotiable for positive achievement. If these are lacking, the result is inadequate implementation of lessons and a holdup of quality learning achievement.

Critical to the attainment of high achievement in mathematics are appropriate and effective classroom practices that have the learner at the centre of that mathematics classroom. Classroom activities therefore ought to be geared towards enabling learners to maximize their potential in terms of their understanding, knowledge and skills attainment for overall achievement. When appropriate teaching resources and strategies are engaged, classrooms become easy to manage and individual student needs are addressed. Teacher attendance to individual students continues to be a challenge because of large classes and heavy teaching loads as witnessed in many Kenyan secondary schools.

Reviewed studies reveal that every school is unique and with unique values that could help reshape or redefine the application of ASEI/PDSI principles. Of importance is a need to continue transforming both teachers and students’ attitudes towards ASEI/PDSI principles. This study focused on schools and mathematics teachers’ preparedness and how they apply ASEI/PDSI principles as a means to enhancing student achievement in mathematics.
CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents a description of the methodology used by the researcher to carry out the study and where the study was carried out. It is organized under the following sections: Research design, study locale, target population, Sample size and Sampling Procedures, Research Instruments, and Data Collection Techniques.

3.2 Research Design

This study was guided by the descriptive survey research design. This was to facilitate an in-depth study of the objectives of the research. In order to establish existing conditions in the schools, this design was found to be ideal as the study sought to collect data on what teachers and students do,
and on different types of mathematics education facts. The study was intended to collect data from a small scientifically selected sample, which would be presented in summaries and projected to a larger population. Kumar (2005) and Orodho and Kombo (2002) opine that a descriptive survey describes and interprets what prevails and relationships as they are in order to employ the collected data to justify current conditions or practices, improve them, obtain significant information about their status and where possible, to draw valid and general conclusions from facts discovered. De Vaus (2001) notes further that descriptive surveys answer the questions who, what, where, when, why and how. The researcher considered this design appropriate for the study because the study involved collecting data on the application of ASEI/PDSI principles by secondary school mathematics teachers.

3.3 **The Study Locale**

According to the profile presented by the County Council of Nakuru (CCN), Nakuru District is a vibrant and cosmopolitan district, with a population originating from all the ethnic groups around the country. It is situated 160 km north-west of Nairobi at 0.28333S and 36.0667E at an altitude of 1850 m above sea level. Nakuru district is surrounded by the vast and rich farmlands of Nakuru County. Nakuru district also hosts the Rift Valley Province Administration Headquarters. The estimated population density of Nakuru district is 974/km². Residential areas account for 70% of the district’s built-up area outside the park and is followed by industrial and commercial land use, which accounts for 18% of the area. For the last three decades, the population has been growing at a rate of 10% per year. To accommodate the growing population, the town’s boundaries have been
progressively extended and it presently occupies an area of 290 km². Nakuru district, located at the heart and immediate surroundings of Nakuru town, in the Rift Valley province of Kenya, with roughly 500,000 inhabitants, enjoys a diversity of geographical and ecological features: to the South and adjacent to the town, lies Lake Nakuru National Park, wetland of global significance; to the West is the Mau Escarpment, a water tower of national importance; to the North is the extinct 8-12 km wide Menengai Crater, one of the largest craters in the world (CCN, 2010).

Nakuru district is home to many educational institutions among them 45 secondary school. Academic achievement, particularly in mathematics is of concern in Nakuru district just as it is in other districts. The locale was selected on grounds that the researcher was familiar with it, hence providing the opportunity for the researcher to easily interact with the environment and the participants. Hence, convenience sampling was used to select the district for this study because of its accessibility to the researcher, a view supported by Singleton (1993) who observes that an ideal location for any study should be easily accessible to the researcher and should facilitate instant rapport with respondents.

### 3.4 Target Population

The target population for this study consisted of 4,040 subjects (45 principals, 45 Mathematics Heads of Department, 118 mathematics teachers and 3,826 form three students) from 45 secondary schools of Nakuru district. Principals and mathematics HODs were targeted in the study because of the crucial role they play in monitoring the implementation of the school curriculum and as teachers while mathematics teachers were also targeted on grounds that they are the implementers of ASEI/PDSI approach after attending the SMASSE INSET. Form three students were
3.5 Sample Size and Sampling Techniques

3.5.1 Sample Size

A total sample of 540 (13.36%) participants was selected from the target population to for the study. This sample selected from 10 (22.22%) of the 45 secondary schools consisted of 10 (22.22%) principals, 10 (22.22%) mathematics HODs, 40 (33.90%) mathematics teachers and 480 (12.55%) students. In the researcher’s view this sample fulfilled the requirement for a representative sample. The sample size was within the range advocated by Kothari (2004) whereby he opines that a representative sample for a descriptive survey study that fulfils requirements of efficiency, reliability and flexibility, should be in the range of 10% to 20%.

3.5.2 Sampling Techniques

The stratified random sampling technique was used to select ten schools to compose the sample. According to Gall (1996) stratified random sampling ensures that satisfactory representation of the categories of the population is included in the sample. In this study the population strata included national schools, provincial schools, district schools and private schools. The ten secondary schools hence, consisted of 1 national school, 3 provincial schools, 3 district schools and 3 private schools. A simple random sampling technique was considered ideal for the selection of schools from each stratum as it ensured equal chance to all the schools in the stratum to be part of the research sample. This technique was used to select 10 (22.22%) of the total secondary schools in Nakuru District. Schools from each stratum were selected for the sample while ensuring the selection of
each one school did not affect the selection of another by selecting one school at a time, with replacement as postulated by Koncar (1992) and Mugenda and Mugenda (2003). A sample was selected using the rotary method of writing names of each school in a stratum on small pieces of paper of equal size which were then folded uniformly. The researcher picking a paper at a time with a school name recorded and immediately replaced it before picking the next school. The picking continued until ten schools had been selected for the sample. Principals and mathematics HODs from the 10 (ten) selected schools were automatically included in the study on the basis of accessibility and their crucial role in monitoring the implementation of the school curriculum and as teachers.

Simple random sampling technique was also used to select 30 mathematics teachers (two from double stream schools and three from schools with more than two streams) to whom the questionnaires were administered. Also selected were 10 form three mathematics teachers (one from each school) whose lessons were observed. These selections were done using pieces of paper (equal to the number of teachers in each school) on which a “YES” or a “NO” was written. The “YES” papers were equal to the required number of teachers from each school. According to Kasomo (2007), the rotary technique ensures every individual in the target population has an equal chance of being a participant in the study. From a list of all form three students in a class, 48 students per school were selected, using the random numbers table technique, for the study sample.

### 3.6 Research Instruments

The research instruments for this study were Interview Schedules, Questionnaires, and Lesson Observation Schedules which were developed by the researcher. These instruments were chosen and viewed as ideal for this study by the researcher, supported by annotations of Gray (2004) that
interviews facilitate the attainment of highly personalized data, opportunity for probing and a high return rate while questionnaires facilitate faster collection of data from a large sample and ensure confidentiality. On the same note, questionnaires were ideal for this study because they facilitate data collection from a large sample within limited time, ensure anonymity that give respondents freedom to respond without fear of victimization while allowing them to make suggestions. The researcher used the Lesson Observation Schedule as a tool to help verify data collected by interviews and questionnaires and to collect useful data from the classroom that might not have been elicited by questionnaires and interviews. Gray (ibid) credits lesson observation schedules for their complementary role to other methods of data collection. The researcher’s choice of these instruments was also supported by other observations made that complexity of classroom practices requires a researcher to think beforehand of best instruments to use so as to avoid loss of any useful data.

3.6.1 Principals’ Interview Schedule

An interview schedule with five sections of structured items was used for principals. The in-depth interview instrument was considered appropriate for principles because the researcher intended to collect in-depth data from them on aspects of the school and the application of ASEI/PDSI principles by mathematics teachers. Instrument was made up of sections: A contained four items on Demographic Information; B had three items on School and Teacher Preparedness; C had three items on Lesson Actualization, D contained three items on Views on ASEI/PDSI principles; and E had two items on Improved Classroom Practices.

3.6.2 HODs’ Questionnaire
This instrument with five sections of open-ended items was deemed appropriate for this sub-sample because the researcher intended to collect in-depth data from them. Instrument items were placed in sections as follows: A contained four items on Demographic Information; B had three items on School and Teacher Preparedness; C had three items on Lesson Actualization, D contained three items on Views on ASEI/PDSI principles; and E had two items on Improved Classroom Practices.

3.6.3 Mathematics Teachers’ Questionnaire (MTQ)

This instrument was used to collect data from mathematics teachers. The MTQ had five sections consisting of open-ended and closed-ended items: A had three items on Demographic Information; B carried three items that sought to determine the Schools’ and Teachers’ Preparedness to implement the SMASSE principles; C consisted of three items based on Lesson Actualization; D had three items on Views of Teachers of Mathematics and ASEI/PDSI Approach; E had two items on Improved Classroom Practices variable.

3.6.4 Students’ Questionnaire

The Student Questionnaire had 32 items in six sections: A had only one item on demographic information; B contained five items used to measure the variable on school/teacher preparedness; C had ten items which were to measure the variable on lesson actualization; D contained ten items (five on teacher perceptions and five on student perceptions on mathematics and ASEI/PDSI approach); E consisted of six items on improved classroom practices. 30 of the items of this instrument were in a 5-Point Likert scale nature, were intended to measure preferences, attitudes and subjective reactions from respondents. Gray (2004) observes that the likert rating scale facilitates responses about the degree of agreement with each statement on the questionnaire. A rating scale of 1 to 5 was used for sections B and E where respondents were expected to respond to items in five ways. Responses for sections B and C were: 1-Always, 2- Most of the time, 3-
Undecided, 4- Rarely and 5- Never, while those for sections D and E were: 1- Strongly Agree (SA), 2- Agree (A), 3- Undecided (U), 4- Disagree (D) and 5- Strongly Disagree (SD) respectively.

3.6.5 Mathematics Lesson Observation Schedule

The Lesson Observation Schedule consisted of five major sections: A contained four items on demographic information; B had 20 items for measuring school/teacher preparedness and lesson actualization variables; C contained ten items for measuring teachers’ and students’ views’ on mathematics and ASEI/PDSI approach; D had five items for the variable on improved classroom practices; and E covered general or any additional observations that might have been made in the classroom.

3.7 Pilot Study

Instruments were pilot-tested in two randomly selected schools from the targeted population but not part of the study sample as a means towards determining the reliability of the instruments. Two principals and HODs were interviewed and their responses were recorded by the researcher, who also administered questionnaires to mathematics teachers and form three students in the two schools and conducted two form three lesson observations in the two schools. Pilot-testing was intended to help the researcher to review the structure and to locate ambiguities inherent in the instruments, to determine the level of understanding exhibited by respondents and to modify revealed flaws in questions and inadequacies in the coding system. Pilot-testing also provided the researcher with the opportunity to be acquainted with the administration of research instruments.

3.7.1 Validity of Instruments
To ensure validity of instruments, the researcher involved supervisors and other experts knowledgeable in Kenya's secondary school mathematics curriculum and ASEI/PDSI approach to appraise the suitability of items in obtaining intended information as per the research objectives. Instrument validity is determined by its ability to facilitate the acquisition of accurate and meaningful information and is measured through continual reviews and judgment by experts (Kasomo, 2007; and Kothari, 2004). The researcher undertook to ensure the validity of all the instruments used for this study guided by views of Nkpa (1997) that a research instrument is of no practical use if it is not valid, however highly reliable it may be. Amendments and corrections recommended by all the consulted experts were done to guarantee face and content validity.

3.7.2 Reliability of Instruments

Kasomo (2007) observes that reliability determines the strength and constancy of an instrument, where same results will be achieved and same degree of consistency demonstrated whenever the same technique is repeated to a similar study. To ascertain the reliability of research instruments for this study, the Split-Half technique was used whereby the researcher placed odd-numbered items of the instruments in one subset and even-numbered ones in the other. Responses from the two halves were analyzed and compared to determine the reliability of the instruments. The process was repeated for all the research instruments. The reliability coefficient was then calculated for each instrument using the Spearman-Brown prophecy formula:

\[ \alpha = \frac{n \cdot r}{1+r} \]

where

\[ \alpha = \text{reliability coefficient} \]

\[ r = \text{split-half correlation (correlation between the two halves)} \]
\( n \) = the number of times longer the full test is (for split-halves, the instrument is twice as long as each of the halves, so the value of \( n \) is 2).

\( r \) was calculated using the Pearson Product Moment formula:

\[
    r = \frac{XY}{\sqrt{\langle \Sigma X \rangle \langle \Sigma Y \rangle}}
\]

where

\[
    X = x - \bar{x}
\]

\[
    Y = y - \bar{y}
\]

\( x \) stood for scores from the first half of the pilot sample and \( y \) scores from the second half. \( \bar{x} \) and \( \bar{y} \) were their respective means. A reliability coefficient for each of the instruments was obtained: Interview Schedule (0.80); Mathematics Teachers’ Questionnaires (0.80); Students’ Questionnaire (0.75); and Lesson Observation Schedule (0.85). An average of 0.80 reliability coefficient was obtained and considered to fulfill the required degree of consistency.

3.8 Data Collection Procedures

The researcher obtained a permit from National Council of Science and Technology office (NCST) in the Ministry Of Higher Education Science and Technology (MOHEST), visited Nakuru DEO and the schools for the study to seek permission to conduct this study and to create a rapport with respondents prior to data collection. A drawn itinerary and diary were used to guide the researcher. Clermont (2011) acknowledges these tools in keeping track of activities to be done and in facilitating recording of events by the researcher as they happen. Data collection activities were guided by appointments with and approval of the concerned principals. The researcher conducted interviews in each sampled school at the agreed upon times by respondents and responses from each participant were duly recorded. Questionnaires were administered to mathematics teachers and to form three students of each school on the agreed scheduled times after which they were
immediately collected by the researcher. The researcher conducted lesson observations as per agreed upon schedule that was in line with each school’s teaching timetable and detailed records of each lesson observed were duly kept.

CHAPTER FOUR
DATA ANALYSIS, PRESENTATION OF FINDINGS AND DISCUSSION

4.1 Introduction
This chapter presents and discusses findings of the study on application of ASEI/PDSI principles by mathematics teachers. Findings are presented using descriptive statistics such as frequency tables, charts and percentages under themes established from the objectives of the study. This study endeavored to look into the teachers’ application of ASEI/PDSI principles when teaching mathematics in secondary schools of Nakuru district. This endeavor was intended to facilitate greater understanding on the use of the ASEI/PDSI principles for enhancing positive student achievement in mathematics. A number of areas related to mathematics teaching, learning, and
student achievement were investigated. These areas were clearly spelt out in the following specific objectives of the study:

1. Determine the schools’ preparedness in terms of human and material resources.
2. Establish how actual mathematics instructional sessions are conducted.
3. Assess teachers’ and students’ views on ASEI/PDSI principles.

The study was guided by the following research questions: How prepared are schools in terms of human and material resources for teaching mathematics? What interactions take place during mathematics sessions in relation to the ASEI/PDSI principles? What are mathematics teachers’ views about ASEI/PDSI principles? What are students’ views about ASEI/PDSI principles?

4.2 Data Analysis Procedures

Two types of data were obtained from this study because of the type of research instruments that were used: qualitative and quantitative. Qualitative data comprised of data obtained through open-ended items in HOD’s and teachers’ questionnaires, and through recorded data collected through interviews and observation schedules. Before analysis was done, the researcher reviewed and transcribed the qualitative data obtained to identify key points. This was followed by organizing the data so as to make it more manageable and easy to navigate after which, coding of key points into coherent categories (broad themes) already established from research objectives for purposes of isolating similarities and differences. These broad themes were further broken down into sub-themes established from research questions. Data analysis was done followed by interpretation and presentation of the data whereby the initially sorted and coded data was subjected to a series of statistical analyses using the Statistical Package for Social Sciences (SPSS) computer software.
version 17.0. This procedure for analysis was in line with the view by Taylor (2004) that qualitative data can be analyzed using a computer software package after reviewing, organizing and coding of the data has been done. According to Jennings (2001) the SPSS computer software package enables the researcher to enter and store data, utilize retrieval strategies, engage in statistical analyses, generate frequencies, percentages, tables, charts and graphs, and to write reports.

Analyzed data was presented using frequency tables, graphs, charts and percentages. This technique was chosen because it enabled the researcher to describe trends in data and to determine whether or not relationships existed between variables. The same technique was used to organize and summarize quantitative data and, in embracing the opinion of Kasomo (2007), the technique facilitated more comprehensible data and easy communication of findings to readers in a simplified manner. A numerical code was developed for each of the response sets in the Likert scale questionnaire after which responses were turned into a series of numbers to be captured by SPSS for further statistical analysis. Discussion of findings and conclusions were drawn from the analyzed data that had been clustered in already established themes.

4.3 School Preparedness in Terms of Resources

The aspect of school preparedness is central to successful implementation of any educational or curriculum innovation. The human resource, facilities and other material resources play a critical role in the dissemination and acquisition of knowledge. Schneider (2002) observes that school’s teaching staff and facilities like buildings, classroom space and furniture affect both teaching and learning. If facilities and resources are substandard, then one cannot expect students to attain high achievement. Nascimento (2008) opines that availability, adequacy and quality of both human and material resources alongside appropriate facilities, have great influence on teaching and learning processes. The ASEI/PDSI principles are an innovative strategy that can be appropriately utilized by
mathematics teachers when there is adequate preparedness in schools in terms of teachers, facilities and material resources. Availability, adequacy, effectiveness of the teaching staff, facilities and teaching-learning resources for the application of ASEI/PDSI principles were investigated this study.

4.3.1 Preparredness of the Human resource (Teachers)

The first objective of this study was to investigate school preparedness in terms of human, physical and material resources for implementing the ASEI/PDSI principles. To achieve this objective, the researcher used interview schedules for principals and questionnaires for mathematics HODs and teachers. The items in the research instruments that were used sought to find out if teachers of mathematics were professionally trained and adequate, teachers’ attendance of the SMASSE INSET, the adequacy of the INSET in preparing teachers for application of ASEI/PDSI principles, and other INSET activities had the teachers been exposed to for purposes of enhancing their knowledge and teaching skills. Findings to these items are presented in the figures and tables illustrated below.
From the information presented in Figure 4.1 above, seven out of the ten (70%) principals stated that they had a very adequate number of mathematics teachers in their schools, with another two (20%) of them reporting that their teaching staff was adequate. However, one out of the ten (10%) indicated that the number of mathematics teachers in the school was fairly adequate. The findings having revealed that generally the schools were adequately staffed with graduate or trained teachers, the researcher went ahead to find out how many of the teachers had attended the SMASSE INSET and how many of the INSET cycles they had attended. It is important to note that curriculum of the four cycles of SMASSE INSET build on each other beginning at cycle one on
attitude change, the second on hands-on-activities with the third building on hands-on activities into actualization in real classrooms and the last cycle being on impact transfer. Therefore, it is important that teachers attend all the cycles for them to be able to appropriately apply the principles in their school situations. Table 4.1 presents data obtained on teacher attendance of the SMASSE INSET.

### Table 4.1: Teachers' SMASSE INSET Attendance Rate (N=30)

<table>
<thead>
<tr>
<th>Cycles</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Four</td>
<td>13</td>
</tr>
<tr>
<td>Three</td>
<td>10</td>
</tr>
<tr>
<td>Two</td>
<td>3</td>
</tr>
<tr>
<td>One</td>
<td>1</td>
</tr>
<tr>
<td>None</td>
<td>3</td>
</tr>
</tbody>
</table>

According to Table 4.1, all except three of the thirty (90%) respondents who completed and returned the questionnaires had attended SMASSE INSET, thirteen out of them (43.33%) indicating they had attended all the four cycles while ten (33.33%) noted that they had attended only three. Three (10%) of the respondents said that they had attended two cycles but noted that they intended to attend the remaining two, together with one (3.3%) other teacher who had attended only one cycle. These responses on teacher attendance of SMASSE INSET prompted the researcher to further seek the views of principals on the adequacy of the SMASSE INSET cycles in preparing
As illustrated in Table 4.2 above, majority (80%) of the principals expressed their dissatisfaction with the SMASSE INSET except for two (20%) of them who acknowledged that the INSET was adequate. In the researcher’s attempt to find out why the principals held the rating opinions they expressed, about the INSET, they cited several reasons which are presented in summary form in Figure 4.2 below.
As the presented data above reveals, only two of the ten (20%) principals, who were positive about SMASSE INSET, said that it had facilitated a shift from teacher to student-focused teaching whereby teachers planned lessons having the needs and abilities of their students in mind. Two (20%) others reported that had not seen anything of significance out of SMASSE INSET while three (30%) of them felt that the INSET curriculum required more than two weeks per cycle if it is bear some fruits in terms effective application of principles and improved learning and student achievement. Others views that were expressed by individual teachers included that the INSET added no value to the teacher, KCSE results still remained poor and that the QASO-teacher collaborative efforts needed to be enhanced in order to facilitate teacher acceptance and embracing of the ASEI/PDSI principles.
The researcher further sought to find out from HODs about other regularly attended INSET activities by mathematics teachers for purposes of enhancing their knowledge of subject content and teaching skills. Findings are illustrated in Table 4.3 below.

### Table 4.3  HODs’ Report on Other INSET Activities Attended by Teachers (N=10)

<table>
<thead>
<tr>
<th>INSET Activity</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>QASO Seminars/Workshops</td>
<td>10</td>
</tr>
<tr>
<td>Inter-School Workshops</td>
<td>7</td>
</tr>
<tr>
<td>National Examiners’ workshops</td>
<td>5</td>
</tr>
</tbody>
</table>

Data presented above shows that all the ten HODs (100%) who filled and returned their questionnaires said that besides the SMASSE INSET, mathematics teachers regularly attended workshops organized and facilitated by the district QASO. Seven out ten (70%) reported that their teachers also attended inter-school workshops/seminars while five (50%) indicated that teachers attended national examiners workshops organized by their schools.

### 4.3.2  Preparedness in Terms of Teaching and Learning Materials

Another aspect of school preparedness that was investigated by the researcher was resources. These resources comprised physical facilities, procured and improvised teaching aids or resources. Through the principals’ interview schedule, the researcher sought to establish how schools were
prepared for ASEI/PDSI principles in terms of physical facilities. Table 4.4 below presents the data that was obtained.

<table>
<thead>
<tr>
<th>Level of Adequacy</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very adequate</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Adequate</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Fairly adequate</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Inadequate</td>
<td>3</td>
<td>30</td>
</tr>
</tbody>
</table>

Table 4.4 presents the state of the schools in terms of available physical facilities. Two of the ten (20%) principals who were interviewed said that facilities were very adequate and another also acknowledged that they were just adequate while three (30%) of them admitted that facilities were fairly adequate. Three (30%) others noted that their school facilities were inadequate as their classrooms were crowded, with as many as 60 students. In particular, one principal noted that the school was operating a double shift system because of lack of space for students. Hence one set of students attended lessons in the morning while the other embarked on assignment awaiting their lessons to begin in the afternoon. With findings indicating variations from one school to another in terms of the adequacy of physical facilities, the researcher embarked on determining which teaching and learning material resources were available in the schools. Findings are reported in Table 4.5 below.
### Table 4.5  Mathematics Teaching/Learning Resources Available in Schools (N=10)

<table>
<thead>
<tr>
<th>Type of Resource</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syllabus</td>
<td>10</td>
</tr>
<tr>
<td>Schemes of work</td>
<td>10</td>
</tr>
<tr>
<td>Teacher reference books</td>
<td>7</td>
</tr>
<tr>
<td>Teacher Guide books</td>
<td>6</td>
</tr>
<tr>
<td>Student text books</td>
<td>8</td>
</tr>
<tr>
<td>Library books</td>
<td>6</td>
</tr>
<tr>
<td>Revision materials</td>
<td>10</td>
</tr>
<tr>
<td>3Dimension Models</td>
<td>9</td>
</tr>
<tr>
<td>Geometrical Instruments</td>
<td>9</td>
</tr>
<tr>
<td>Charts</td>
<td>2</td>
</tr>
<tr>
<td>Computers</td>
<td>4</td>
</tr>
<tr>
<td>Improvised materials</td>
<td>0</td>
</tr>
</tbody>
</table>

As shown in Table 4.5, all the HODs (100%) who completed and returned questionnaires said that syllabi, teacher-prepared schemes of work and lesson plans were available for teachers’ use. Seven out of ten (70%) said that the school had procured teacher reference books besides the class text books while another six of them (60%) said their schools had enough teacher guide books. Eight of the HODs (80%) indicated that student text books were available and adequate in their schools. Two (20%) of the HODs noted that student text books were inadequate in their schools while four
(40%) of them reported that their schools had obtained computers for teachers’ use. Improvised teaching and learning materials were not available in all the schools except for the locally made 3-dimension models in nine of the ten (90%) schools. Although majority (70%) of the schools under this study depended on government finances for teaching resources, some of them still lacked adequate the most basic resources, such as student textbooks. In one particular school, the teacher read out mathematics questions for students to write down in their notebooks before they could start to solve them.

Generally, it can be concluded that the data obtained in this study illustrated some level of preparedness by individual schools to embrace the principles of ASEI/PDSI. It is also evident from the findings that more could still be done in order for schools to be sufficiently prepared for ASEI/PDSI principles. An additional glance at the findings of this study reveals that lack of school preparedness in terms of adequate and appropriately prepared teachers, adequate facilities and teaching resources as acknowledged by respondents can be an impediment to effectively teaching mathematics and, more so, in the application of ASEI/PDSI principles. These findings agree with those of Mutai (2006) who concluded that learning is strengthened when there are adequately prepared teachers, adequate physical facilities, enough reference materials such as textbooks, teaching aids and revision materials, and the correct use of these materials to guarantees high academic achievement. Similarly, Yadar (2001) and UNESCO (2008) in their reports acknowledged that resources such as teachers, classrooms, textbooks, teaching aids and revision materials can affect the academic performance of learners.

### 4.4 How Actual Mathematics Instructional Sessions are Conducted

The second objective of the study sought to establish how mathematics lessons are conducted by teachers. Two aspects were targeted under this objective: lesson preparation; and classroom
interactions in relation to ASEI/PDSI principles. Specific items on the questionnaires for the HOD and teachers, as well as classroom lesson observation schedules were used achieve this objective.

4.4.1 How Mathematics Teachers Prepare for Instructional Sessions

Teacher preparedness for lesson delivery fulfills many characteristics of a good lesson that is student-centered. Planning for meaningful activities that encourage understanding, active student participation, use of appropriate teaching aids that enhance student understanding and skills is the task of the teacher prior to lesson delivery (Lim, 2006). Teachers were asked to indicate documents or material resources, either procured by the school or obtained locally that facilitated their activities of lesson preparation or planning. Findings on this aspect of resources are presented in Figure 4.3 below.
According to the data presented in Figure 4.3, fifteen of the thirty (50%) teachers who returned their filled questionnaires indicated that they used text books to plan their lessons and seven (26.7%) of them also referred to schemes of work. Three (6.7%) of the teachers said they used teachers’ guide books and two used records of work to plan subsequent lessons. Only one of the thirty (3.3%) teachers reported to have used a variety of improvised materials during lesson preparation and actual execution. In their response to the item on how the SMASSE INSET had helped them in lesson preparation, responses presented in Figure 4.4 emerged.
From the findings presented in Figure 4.4, three of the thirty (10%) teachers who filled and returned their questionnaires acknowledged that SMASSE INSET had instilled in them a positive attitude towards improvisation while nine (30%) of them reported that the INSET had enhanced their planning for active student involvement during lessons. Seven (23.3%) of the respondents said the INSET had exposed them to a variety of lesson presentation strategies which they incorporated in lesson planning and, two (6.7%) of them reported that they appreciated the opportunity to interact with mathematics teachers from other schools for exchange of ideas. However, a number of the teachers felt that SMASSE INSET had not helped them as four (13.3%) of them reported that the wide syllabus inhibited their efforts to use ASEI/PDSI principles and, one (3.3%) of the teachers argued that the INSET was not practical, and another one (3.3%) said that there was a lot time involved in planning and executing an ASEI/PDSI-compliant lesson.

Another important aspect of rewarding or rather effective instructional sessions is supervision. The Department of Education, South Africa - DESA (2000f) underlines that meaningful teaching and learning cannot be achieved without regular supervision done through deployment of teachers, timetabling, providing teaching/learning materials and creating an atmosphere conducive for effective teaching and learning. They go further to highlight the principal’s role of monitoring and guiding instructional sessions by ensuring that schemes of work, lesson plans, records of work, lesson notes and performance records are prepared regularly, otherwise effective classroom sessions cannot take place where and when the head of the school is incapable of executing supervisory functions. Besides these, the aspect of regular actual monitoring of classroom sessions or activities is seen to be the major responsibility of the school Principal. The HODs were asked to
state who in their school conducted instructional supervision and their responses are presented in Table 4.6 below.

### Table 4.6  HOD’s Data on who Conducted Instructional Supervision in School (N=10)

<table>
<thead>
<tr>
<th>Person</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal</td>
<td>2</td>
</tr>
<tr>
<td>Deputy Principal</td>
<td>1</td>
</tr>
<tr>
<td>HOD</td>
<td>6</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>

Data obtained from the HOD who participated in this study showed that eight of the ten (80%) schools where the study was done had regular instructional supervision while the other two reported that supervision was not done on a regular basis. Six of the ten (60%) HODs said that HODs conducted regular instructional supervision which ranged from checking lesson plan books and records of work to actual lesson presentation in the classroom. Two (20%) of the HODs indicated that principals conducted supervision in their schools while one (10%) teacher reported that this was done by the deputy principal and yet another teacher indicated that there was no specified person responsible for supervising actual classroom instructions as this responsibility was shared. Hence, supervision was not regular in this school and when it was done, either the principal or the HOD did it.

### 4.4.2 Classroom Interactions in Relation to the Application of ASEI/PDSI Principles

The researcher embarked on establishing the type of interactions that were prevalent during mathematics lessons. This was meant to help determine whether or not lessons were student-
focused and if teachers embraced the principles of ASEI/PDSI. This course was guided by the understanding that an interactive classroom is one which is student-focused, one where students participate actively through group activities, problem-solving and even team teaching. Silverthorn (2006) provides a unique definition of an interactive class where he notes that interaction in the classroom entails listening and watching your students, deciding on adjustments to make during or in the next lesson so that learning can continue to be fruitful. He opines that when stop trying to improve their teaching, fruitful interactions cease, hence, it is time for teachers who are unable to bring new life to each lesson to retire.

Silverthorn (ibid) proposes that teaching should entail clear, step-by-step demonstrations of each procedure, restating steps in responses to student questions, providing adequate opportunities for students to practice procedures, and offering specific corrective support when necessary. It requires teachers to provide recurrent opportunities for students to refresh and strengthen their mastery of previously taught content. These views are supported by Schneider (2002) who suggests that student-centred teaching and learning strategies have value in the classroom and are interactive in nature.

To identify the different types of interactions that were prevalent during mathematics lessons, the researcher used an observation schedule. Items on the observation schedule sought to identify aspects of the lesson that facilitated teacher-student, student-student, teacher-teaching aids, student-learning aids and teacher/student mathematics content interactions. A summary of data collected through lesson observations on the type of interactions that were dominant during lessons are illustrated in Table 4.7 below.
Table 4.7 Types of Interactions that were Observed during Lessons (N=10)

<table>
<thead>
<tr>
<th>Interactions</th>
<th>Frequency</th>
<th>Percentage Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Demonstrations</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>Group Activities</td>
<td>0</td>
<td>00</td>
</tr>
<tr>
<td>Individual Seatwork</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>Whole class Activities</td>
<td>7</td>
<td>70</td>
</tr>
<tr>
<td>Student Demonstrations</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Use of Text Books</td>
<td>8</td>
<td>80</td>
</tr>
<tr>
<td>Group Problem-Solving</td>
<td>0</td>
<td>00</td>
</tr>
</tbody>
</table>

Findings from lessons observed by the researcher revealed that all (100%) of the ten lessons were dominated by teacher demonstrations except for three (30%) of them where teachers allowed students to lead demonstrations on the chalkboard. In eight (80%) of the ten lessons observed teacher demonstrations were conducted and problems for solving were derived from the student text book while seven (70%) of them were dominated with whole class activities which comprised of responses to teacher questions and during demonstrations. Group activities, checking of group activities by the teacher and problem-solving in groups were not eminent in any of the lessons that were observed, however in five of the ten (50%) lessons, students were engaged in individual seatwork as the teacher went around to check the students’ progress and this was followed by more teacher demonstrations.

An item on the teachers’ questionnaire was used to obtain data on whether teachers felt they had been influenced by ASEI/PDSI principles in their planning and actual lesson execution. Findings on this aspect are presented in Figure 4.5 below.
As shown in Figure 4.5 above, eighteen of the thirty (60%) said that they had been positively influenced by ASEI/PDSI principles while the remaining twelve (40%) noted that they did not feel they had been influenced by the principles. To authenticate this, one item in the teachers’ questionnaire sought to establish how teachers had specifically been influenced by principles of ASEI/PDSI while an entire section of the observation schedule sought to identify specific principles that teachers had embraced in their teaching. Data obtained is presented in Figure 4.6 and Table 4.8 below.
Data presented above shows that eight of the thirty (26.67%) teachers who took part in this study admitted that ASEI/PDSI principles had enhanced their creativity in lesson planning and execution while five (16.67%) of them said that they had facilitated active student involvement during lessons. Three (10%) of the teachers noted that ASEI/PDSI principles prompted lesson planning before going to teach while two (6.67%) others said that they had been stretched into making efforts towards improvisation. However, seven (23.33%) of the thirty teachers felt that ASEI/PDSI principles had not influenced them with yet another four (13.33%) indicating that the principles had very little influence on their work. To authenticate the teachers’ views, HODS were asked to
identify aspects of ASEI/PDSI principles they felt had influenced the work of teachers. Details of the findings are presented in Table 4.8 below.

<table>
<thead>
<tr>
<th>Table 4.8</th>
<th>HODs’ Identification of Aspects of ASEI/PDSI Principles that have Influenced Teachers Positively (N=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASEI/PDSI Principles</td>
<td>Frequency</td>
</tr>
<tr>
<td>Lesson preparation</td>
<td>3</td>
</tr>
<tr>
<td>Demonstrations</td>
<td>8</td>
</tr>
<tr>
<td>Hands-on activities</td>
<td>4</td>
</tr>
<tr>
<td>Local teaching aids</td>
<td>2</td>
</tr>
<tr>
<td>Lesson evaluation</td>
<td>3</td>
</tr>
<tr>
<td>Student involvement</td>
<td>4</td>
</tr>
<tr>
<td>Continuous assessment</td>
<td>10</td>
</tr>
<tr>
<td>Team teaching</td>
<td>2</td>
</tr>
<tr>
<td>Self Confidence</td>
<td>5</td>
</tr>
</tbody>
</table>

Findings displayed in Table 4.8 provide some aspects of the principles of ASEI/PDSI that HODs felt had influenced teachers. All the ten (100%) HODs said that teachers had embraced the aspect of continuous assessment of students to determine their level of understanding. Eight of the ten (80%) HODs noted that teachers were much more keen on using demonstrations in class to enhance student understanding and skills, with four (40%) others reporting that teachers were gradually shifting to involving students in hands-on-activities during lessons and two (20%) of them indicating that the principles have influenced teachers to using locally available teaching/learning resources. To confirm the findings from HODs, the researcher engaged specific items of the observation schedule to establish which aspects of the principles of ASEI/PDSI were incorporated into actual lessons. Table 4.9 below illustrates the findings.
Table 4.9  Aspects of ASEI/PDSI Principles Used by Teachers during Lessons (N=10)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objectives were clearly stated</td>
<td>7</td>
<td>70</td>
</tr>
<tr>
<td>Teacher referred to previous lesson</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>Students were engaged in activities</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Activities aroused interest</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Students asked questions</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Students involved in demonstrations</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Students worked in groups</td>
<td>0</td>
<td>00</td>
</tr>
<tr>
<td>Demonstrations were adequate</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Time management was good</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Teacher applied improvisation</td>
<td>0</td>
<td>00</td>
</tr>
<tr>
<td>Teacher used positive reinforcement</td>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td>Students enjoyed classroom activities</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>The teacher built on learners ideas</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>The teacher summarized the lesson</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Lesson evaluation was done</td>
<td>0</td>
<td>00</td>
</tr>
</tbody>
</table>

As pointed up in Table 4.9 above, several aspects of ASEI/PDSI principles were incorporated in the lessons observed. However, the extent to which this was done was minimal. Observation findings indicated that lessons implemented by teachers were planned, but they were less ASEI/PDSI approach-focused. In seven of the ten (70%) lessons observed, objectives of the lesson were well
spelt out to students, while in five (50%) of them reference was made to the previous lesson. Positive reinforcement was also noted particularly during student demonstrations on the chalkboard or when responding to questions by the teacher in six (60%) of the observed lessons. In three of the ten (30%) lessons, students were engaged in activities, in demonstrations, they asked questions and seemed to show interest in activities they did. In the same three lessons the teacher made effort to build on ideas from students. However, interesting student activities and summarizing lessons or bringing lessons to a meaningful conclusion were aspects only noted in two (20%) of the ten lessons. Aspects of improvisation, group activities and lesson evaluation were absent in all (0%) the ten lessons. Findings further revealed that only three (30%) of the ten observed teachers made a significant attempt to apply the ASEI/PDSI principles despite the variations that clearly noted from lesson to lesson.

It can therefore be concluded based on data that has been presented for this study that mathematics classrooms (teaching and learning processes) was less interactive as lessons reflected teacher domination with student participation manifesting itself through individual seatwork and whole-class responses. Students played a passive role in most of the lessons except in two (20%) of the ten lessons, where they engaged teachers in questions for more understanding. These findings are in agreement with those of Kisangi (2009), who investigated the extent to which lessons in Japanese schools were interactive and student-centered for purposes of adaptation in the Kenyan situation. Findings revealed that learning at senior high school level was less interactive. Similarly, in his study, Yara (2009) postulates that student achievement in mathematics depends on the way it is presented to learners, the way learners actively interact with the learning experiences presented and the environment within which these interactions are taking place. Results from this study revealed that teachers did not provide adequate opportunities for students to interact with
each other and with the learning resources. This would have been facilitated through, active student-centred lessons, healthy balancing of individual and group student activities among other aspects. The ASEI/PDSI principles reflect and focus on instruction strategies that support meaningful and active student-learning. Hence ASEI/PDSI principles were not being adequately applied by teachers during lessons as lesson observations revealed.

4.5 Teachers’ and Students’ Views about ASEI/PDSI Principles

The initial step in encouraging teachers to embrace any innovation is by involving them as much as possible and by keeping them informed. This keeps the teachers positive about the innovation no matter how challenging it might be. In his opinion Yara (2009) argues that no matter what amount of resources we might put into a nation’s education system or curriculum, without properly prepared and motivated teachers, little can be expected from the system. This observation underscores the need for passionate and committed teachers in schools. The third objective of this study was to establish teachers’ and students’ views with regard to ASEI/PDSI principles. To facilitate achievement of this objective the researcher used the teachers’ and students’ questionnaires.

4.5.1 Teachers Views about ASEI/PDSI principles

According to Yara (2009), the teacher’s views and disposition on any aspect of teaching can make or unmake the views and attitudes of students on corresponding aspects of learning. Students’ attitude can therefore be enhanced by teachers’ views that reflect enthusiasm, resourcefulness and the ability to make learning interesting. The teachers’ views can mold the mind-set of students to want to learn or not. To verify these opinions, an item on the questionnaire was designed to solicit
teachers’ views about the use of ASEI/PDSI principles. A summary of their responses is presented in Figure 4.7 below.

![Figure 4.7 Mathematics Teachers' Views about the Use of ASEI/PDSI Principles](chart.png)

According to the findings presented in Figure 4.7 above, mathematics teachers were more positive in their responses on how they viewed the use of ASEI/PDSI principles. Ten (33.3%) of the thirty teachers remarked that they were good principles which facilitated a shift from teacher-centred to student-centred teaching strategies and another six (20%) noted that the principles were viable and should be domesticated to fit Kenya’s educational reality. Seven (23.3%) teachers said that if these
principles were appropriately embraced they had the potential to enhance student achievement in KCSE. However, there are those teachers who had a different opinion about ASEI/PDSI principles. Four (10%) of these teachers reported that the application of ASEI/PDSI principles was time-wasting and another four of them also felt that ASEI/PDSI principles were not practical given the Kenyan reality. The researcher used another item in the teachers questionnaire to find out why teachers held the views they expressed about the principles of ASEI/PDSI. All teachers who participated in the study expressed personal reasons for the specific views they held. Figure 4.8 provides details of what they said.

Figure 4.8  Challenges Teachers Associated with the Use of ASEI/PDSI Principles
As exposed through the findings in Figure 4.8 teachers had a variety of reasons as to why they held the views they had expressed. Nine of the thirty (30%) teachers who returned their questionnaires said that time was a real challenge as application of the principles required more of it. Eight (36.7%) of the teachers reported that large class sizes made it hard for them to plan for student activities and to also monitor those activities during lessons, while another four (13.3%) shared that limited resources narrowed their eagerness to use the principles when teaching. Three (10%) of the teachers reported that the expectation on teachers to be instantly creative with regard to improvisation was too high given that not all teachers are necessarily creative as persons. They also cited examples of mathematics content like Differentiation and Integration, Logarithms, Vectors and probability that are challenging to teach with improvised teaching aids. On the other hand, there are two (6.7%) of these teachers who felt that their expressed opinions to QASO and SMASSE trainers were always ignored and that these principles were not applicable in all mathematics content. Probing teachers further, the researcher, using an item on their questionnaire which asked them to indicate their views about the future of ASEI/PDSI principles in relation to their application in mathematics lessons. Their views are summarized in figure 4.9 below.
As shown in the presented summary above, six out of thirty (20%) teachers were of the opinion that the ASEI/PDSI principles be fully embraced by the school administration and by teachers, while a similar number of teachers acknowledged that, if the principles’ Hands-On activities concept was fully embraced, it will facilitate greater understanding, interest and fun among students during learning sessions. Six (20%) more teachers held the view that it is the teachers themselves who needed to examine and modify their attitude towards the application of ASEI/PDSI principles while two sets of five (16.67%) each maintained that the principles of ASEI/PDSI needed to be intensified at the pre-service level and that more time needed to be allocated for teaching mathematics using the ASEI/PDSI principles. Two (6.67%) of the teachers brought their argument to another level by stating that, if extra time cannot be allocated for teaching with the principles, then mathematics
syllabus should be reviewed with the objective to accommodate the requirements of ASEI/PDSI principles.

4.5.2 Students’ Views about ASEI/PDSI Principles

This study also set out to determine learners’ views about the ASEI/PDSI principles as a learning strategies used in teaching mathematics. It is important to note that this objective was not effectively achieved because to determine opinions of students required more time for researcher to interact with students, a process that would facilitate collection of significant data. The researcher used students’ questionnaire in which a section contained statements that asked students to indicate their views towards aspects of the principles on a 5-point Likert scale rating. Another item on the questionnaire also sought to find out which strategies of learning mathematics were preferred by students. Findings are illustrated in Table 4.10 below. The initials used alongside the Likert scale rating are as follows: SA stands for Strongly Agree, A for Agree, U for Undecided, D for Disagree and SD for Strongly Disagree.

<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher helps those with difficulties</td>
<td>180</td>
<td>171</td>
<td>22</td>
<td>83</td>
<td>24</td>
</tr>
<tr>
<td>Teacher encourages us to love math</td>
<td>336</td>
<td>100</td>
<td>6</td>
<td>28</td>
<td>10</td>
</tr>
<tr>
<td>Performing hands-on-activities in class</td>
<td>174</td>
<td>135</td>
<td>30</td>
<td>96</td>
<td>35</td>
</tr>
<tr>
<td>Group discussions and demonstrations</td>
<td>305</td>
<td>105</td>
<td>14</td>
<td>36</td>
<td>20</td>
</tr>
<tr>
<td>Students ask questions during lessons</td>
<td>189</td>
<td>136</td>
<td>20</td>
<td>100</td>
<td>35</td>
</tr>
<tr>
<td>Teaching using local teaching aids</td>
<td>268</td>
<td>136</td>
<td>10</td>
<td>20</td>
<td>46</td>
</tr>
<tr>
<td>Teacher asks us to evaluate the lesson</td>
<td>108</td>
<td>72</td>
<td>20</td>
<td>47</td>
<td>233</td>
</tr>
<tr>
<td>Math lesson full of student activities</td>
<td>209</td>
<td>196</td>
<td>19</td>
<td>10</td>
<td>46</td>
</tr>
</tbody>
</table>
As displayed in Table 4.10, findings reveal that students viewed positively mathematics lessons that incorporated aspects of ASEI/PDSI principles. The table further reveals that between 309 (64.4%) and 436 (90.8%) of the 480 students who filled and returned their questionnaires agreed that they enjoyed lessons within which teachers helped them according to their unique needs and encouraged them to love mathematics, performing hands-on-activities, group discussions, demonstrations and group work, or used local materials and daily issues to learn, the teacher built on their own ideas, revised the previous lesson before starting a new one, checked student work and engaged students in questions that facilitated discussions and discovery of new knowledge and skills. It was noted from the students’ responses that only 180 (37.5%) of them were aware of lesson evaluation as an activity the appreciated during lesson. This implied that a majority (58.1%) of the students did not either agree with the statement on lesson evaluation or they were not even familiar with it.

In summary, findings from this study show that whereas teachers’ views indicated that they were positive about ASEI/PDSI principles, their failure to apply these principles and their citing of many challenges experienced when applying the principles as a reason for not using them, implies that they held a low opinion on the principles. Students on the hand expressed a lot enthusiasm around the aspects of ASEI/PDSI principles. This is indicative of the positive view of this teaching approach
which is more student-focused. These findings are in accord with those of Yara and Otieno (2010) who observed that students were positive towards teaching approaches that enhanced active learning. The findings are also in harmony with those of Ouko (2004) who noted that interactive lessons with actively involved students and a variety of teaching aids (including improvised ones) significantly contribute to a positive outlook by students not only on the learning process, but also on the subject content. This in turn enhances academic achievement in examinations.

4.6 Conclusion

Having presented findings of this study on the application of ASEI/PDSI principles by mathematics teachers, it can be concluded that schools that took part in this study had adequate professionally trained teachers, a majority of whom had attended the SMASSE INSET. Whereas physical facilities were adequate as well as teaching-learning resources in most schools, a few of them were struggling with available limited materials. It emerged that the adequacy of teachers, facilities and material resources was not translated to a readiness to apply the principles of ASEI/PDSI by teachers as findings reveal that lessons were less-interactive and more teacher-dominated. The principles of ASEI/PDSI were generally invisible during instructional sessions. It was also realized that teachers were more negative in their views about the use of ASEI/PDSI principles as opposed to their students whose responses reflected a lot of interest and positive energy around many aspects of ASEI/PDSI.

It is evident from the presented findings that successful application of ASEI/PDSI principles depends on the extent of school preparedness and more so teacher preparedness. When preparedness is insufficient, the outcome is the inability to put the principles into use for the sake so as to enhance student achievement in examinations. While it has been said that a good teacher can teach
anywhere, it is important to a mathematics teacher to understand that the principles of ASEI/PDSI call for a reasonable intensity of planning, execution, evaluation and constant improvement of instructional sessions by the teacher. Teachers are charged with the task of planning for a healthy classroom atmosphere, adequate interaction with and among students and teaching resources, and they must be committed enough to embracing an entire shift from teacher to student-focused teaching.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of study findings and their implications. It also presents conclusions arrived at, recommendations made with regard to the application of ASEI/PDSI principles for enhanced achievement in mathematics and suggestions for further study.
5.2 Summary

The purpose of this study was to investigate the application of ASEI/PDSI principles when implementing mathematics curriculum in secondary schools. A number of areas were investigated among them: school preparedness in terms of human and material resources; actual mathematics instructional sessions in relation to the use of ASEI/PDSI principles; and prevailing views of teachers and students about the ASEI/PDSI principles. The study sample consisted of 10 secondary schools, 10 principals, 10 HODs, 30 mathematics teachers, 10 observed mathematics lessons and 480 form three students of Nakuru district. Findings of this study revealed that the application of ASEI/PDSI principles was yet to be fully realized in secondary schools of Nakuru district. Discussions that follow will attempt to provide a summary and draw conclusions based on findings that have been presented in chapter four.

5.2.1 School Preparedness in Terms of Human and Material Resources

It is evident from the findings of this study all secondary schools that participated in the study had adequate professionally trained teachers who had attended the SMASSE INSET. It was also noted from the findings that besides SMASSE INSET, schools ensured mathematics teachers, alongside other subject teachers, participated in other INSETs organized by either QASO or individual or a group of schools that shared a common interest or vision. With this kind of exposure of teachers to a variety of INSETs, one can conclude that the teachers were indeed well prepared to embrace not only the principles of ASEI/PDSI, but also the most current teaching-learning strategies that are more student-focused.

Another important piece of information that is provided through the findings of this study is on facilities and teaching-learning resources. Generally, results of this study showed that facilities and
teaching-learning resources were fairly adequate but there was an expressed need for extra learning space from nearly half the schools that participated in the study. The schools were well equipped with ample and appropriate professional documents for lesson preparation like the syllabus, teachers guide books, reference books, schemes of work and records of work as well as a variety of teaching resources such as student text books, chalkboard geometrical instruments and the 3dimensional models among others. However, not visibly present in one school were learning resources for students, particularly textbooks, meaning that students in this school relied heavily on the teacher to provide all the information they needed with regard to problems for solving during lessons.

The implication of these findings is that the potential for students to be provided with ample opportunities to engage in a variety of learning activities that enhance ASEI/PDSI-focused learning and that promote Higher-Order-Thinking-Skills (HOTS), understanding and good performance in mathematics was evident, however, teachers were reluctant to plan for student, activity-focused instructional sessions or even to embrace the principle of improvisation in lesson preparation and execution citing time and large class size constraints. It was also observed that teacher preparedness for mathematics sessions matched closely with their own orientation towards teacher-focused strategies and the demands of the curriculum and national examinations.

5.2.2 How Teachers Conduct Mathematics Instructional Sessions

Research studies in diverse school settings and across a wide range of content areas have revealed that students engaged in learning experiences that are interactive by nature tend to have higher self-esteem, higher-level reasoning skills, collaborative skills, positive social skills and a greater comprehension of the content and skills they learn. In the context of this study, schools were well equipped with ample and appropriate professional documents for lesson preparation, and a variety
of teaching resources. However, findings through observed lessons revealed that teachers did not exhaustively prepare for creative lessons that would arouse interest among students and at the same time facilitate enhancement of mathematical thinking and skills.

Interactions in mathematics instructional sessions reflected a sense of respect, openness and attentiveness to all processes undertaken. In classes where students asked questions or sought clarification, there was a strong manifestation of the teachers’ mathematical knowledge portrayed through the way they dealt with student thinking. It was however noted that mathematics teachers preferred using teacher-focused to student-focused teaching strategies. Sessions observed helped to build a picture of the role of the teacher as the authority in the classroom and the role of the student as the passive participant during instructional sessions. Students’ active involvement was limited to individual seatwork after teacher demonstrations or answering of questions from the teacher. Group activities or discussions, hands-on-activities, lesson summaries and evaluations were absent from all the lessons that were observed. Results hence, revealed that teachers did not provide adequate opportunities for students to interact with each other and with learning resources. This would have been facilitated through active student-focused lessons with balanced individual and group student activities among other aspects. Instead, the teacher was the centre of focus, and at times, the text book upon which students relied for derived problems for demonstrations and individual seatwork.

The ASEI/PDSI principles that reflect and focus on meaningful and active student-learning or rather, facilitate interactive sessions, were not being adequately applied by teachers during lessons as majority of the teachers opted for teacher-centered teaching strategies. The student was not the
focus of attention during lessons and teachers did not ensure a bridge between theoretical knowledge and practical activities. Findings presented reveal that teachers from the schools that participated in this study did not incorporate improvisation and practical activities in their mathematics sessions so as to facilitate student acquisition of skills. This is against the backdrop that the majority of them had a relatively long teaching experience, had attended at least three out of the four cycles of SMASSE INSET and their teaching load was within the specified limits.

The implication here is that students did not have the opportunity to explore widely on lesson content or to enhance their thinking and construction skills and to discover their individual unique needs. The use of a variety of classroom organizational styles (individual, small groups, etc) and the creation of an environment where the teacher is the facilitator who builds on student ideas was not cultivated. The interest and motivation of students whose teachers did not provide any demonstrations remained low as opposed to that of students whose teachers provided adequate demonstrations and opportunities for student demonstrations in order to internalize skills. Such teachers also offered corrective support and recurrent opportunities for students to refresh and enhance their mastery of previously learnt content when necessary. It is also important to note that local issues as a focus of instruction, the adaptation of improvised materials and instruction based on the local context were not evident in all the schools under this study. Principals, HODs and mathematics teachers manifested relatively adequate knowledge about the potential of ASEI/PDSI principles if appropriately applied in the classroom. However, it emerged that their acknowledged awareness of the skills emphasized by the SMASSE INSET for lesson preparation, actual instruction and assessment failed to be fully manifested at the school level, and in particular, in the classrooms.
There is also an implicit practice of teaching for positive KCSE results emerging from findings that have been discussed. An examination oriented culture is a reality in the Kenyan situation and examination results particularly in KCSE are used as a yardstick for explaining student and school achievement. From the education minister to the parents of students, everyone is very anxious about performance in examination. Hence, it is common practice for school principals to use students’ performance in examinations as a yardstick to evaluate teachers’ teaching competency. Consequently, many teachers believe that their teaching priority is to ensure that their students achieve good results in the examinations. The task of ensuring the entire syllabus has been taught before examination takes preference in the plans of principals, HODs and teachers before taking any consideration of how delivery of the content to students in the classroom might affect achievement that is so much desired. This outlook has impacted negatively on the application of SMASSE principles.

5.2.3 Views of Teachers and Students on the Use of ASEI/PDSI Principles

Under this objective, several findings emerged with regard to teachers views about the principles of ASEI/PDSI. Information obtained from teachers indicated that majority of them were positive about ASEI/PDSI principles. However, further probing revealed that teachers were somewhat negative in their views and this was authenticated by findings obtained through lesson observations where actual application of the principles was expected. It emerged that teachers felt more discouraged by the low student achievement in mathematics during KCSE. Their attitude towards the application ASEI/PDSI principles was epitomized through the views they expressed: inadequate facilities and to some extent instructional resources; time constraints with regard to lesson planning and execution; large class sizes; the fact that the principles are not applicable to all mathematics content; the wide syllabus; demands of KNEC in relation to the subject content.
coverage; conditions of the INSET centres; and their ignored views by QASO. Thus, it was apparent that teachers still nurtured a low opinion about the demands of ASEI/PDSI principles.

Unlike the teachers, students exhibited great interest and a lot of energy around the principles of ASEI/PDSI and they showed a strong will towards transforming their performance in mathematics at KCSE. Research findings also revealed that students were generally positive about many aspects of ASEI/PDSI principles and were optimistic that the encouragement they received from their teachers would translate to a great love for mathematics and enhanced achievement in KCSE. They admitted that they enjoyed lessons that were more action-oriented, those that involved working in small groups and lessons that incorporated the use of teaching aids but were quick to note that such lessons were rare in their schools.

The implication here is that students rely on their teachers in their efforts towards shaping a positive attitude towards mathematics learning. Students’ positive attitudes towards learning mathematics and towards ASEI/PDSI principles and other student-focused learning strategies could be enhanced by the teachers’ enthusiasm, resourcefulness, thorough knowledge of the subject content and their ability to make mathematics learning interesting. It is on this premise that the attitude of students can be constructed or destroyed by the teachers’ disposition towards the subject content, the students themselves, resources and classroom environment. Hence, it is the responsibility of mathematics teachers to exhibit a sense of commitment and to be prepared to teach students and to instill in them a positive viewpoint not only about ASEI/PDSI principles and other student-focused strategies of learning, but also about the value of being positive about their potential for acquiring important mathematical knowledge and skills.
5.3 Conclusion

From the findings of this study, it can be concluded that majority of mathematics teachers have attended the SMASSE INSET and that majority of them have adequate facilities and teaching-learning resources. It is also evident that although most schools have adequate facilities and resources, teachers do not apply the various aspects of ASEI/PDSI principles when planning and executing instructional sessions. Several factors hamper the appropriate application of these principles, among them, limited time for planning and incorporating the principles in instructional sessions and large class sizes that make it difficult to create a supportive environment in the classrooms for embracing the principles.

Application of ASEI/PDSI principles encompasses aspects that not only concern the teacher, but also those that call on school principals and HODs to play their role of monitoring and supervising teachers’ lesson preparation and execution activities. Findings of this study provide another concluding remark that, even though relatively regular instructional supervision of teachers’ activities is done so as to keep abreast with their progress and that of students, this task is more identified with HODs than with principals whose main task it is. The ASEI/PDSI principles are viewed as a viable and the kind that need to be domesticated to fit the reality of the Kenyan education system as well as the demands of KNEC. It is observed that the current Kenyan education system has indeed is yet to recognize and appreciate the fact that mathematics is a practical subject, just like the sciences, one that can also accommodate other forms of assessment notably project work, group presentations and practical activities. This system of education is viewed as the magnet that keeps drawing teachers back to the trend of teaching for the one and only exam that is known as KCSE.
Another conclusion that can be drawn from findings already discussed is that even though teachers have been exposed to student-centered teaching strategies (contextual and interactive learning through the ASEI/PDSI approach) at the SMASSE INSET centres, it seems difficult to change the culture of mathematics teaching in schools. Lim (2006) provides a justification for this by opining that many teachers tend to believe that giving clear explanations with suitable examples (teacher-centered approach) is practical and sufficient to achieve most teaching objectives. They believe that it is always time consuming to allow students to construct their knowledge through student-based activities. Furthermore, they are not certain whether or not their students will acquire enough knowledge and skills if they were allowed to explore by themselves. Hence, teachers tend to feel more certain if they can control the teaching and learning pace of their students. Therefore, any new strategy introduced for their application, must in the first place meet the demands and expectations of the national examinations, the school principals and parents of students. It is thus a challenge to change the entrenched teacher-focused culture of teaching and learning in schools but not an impossible one to overcome.

A major contribution of this study is the awareness that any requirement on teachers to implement a range of teaching/learning strategies, must first address teachers’ views/opinions on workable teaching/learning strategies or else it is likely to fail. A positive attitude should be fostered among teachers to facilitate openness to use a range of teaching strategies alongside the traditional ones, hence providing a more holistic and accurate representation of student capabilities. Indeed the teacher’s attitude towards teaching mathematics plays a significant role in shaping the attitude of students towards learning mathematics. In his opinion Yara (2009) observes that no matter what amount of resources we might put into a nation’s education system, without appropriately
prepared, positive-thinking and self-stimulated teachers, one can never expect positive outcomes from that system.

5.4 Recommendations from the Study

Research findings from this study are, in the researcher’s view relevant to several bodies that are entrusted with the task to oversee all aspects related to quality education in Kenya in terms of positive attainment of required knowledge, skills and results in national examinations. Based on this view, the researcher makes the following recommendations:

i. There is need for the Kenyan government and SMASSE INSET personnel to conduct an assessment so as to establish the actual prerequisites for application of ASEI/PDSI principles besides SMASSE-trained teachers. This assessment would look into aspects of school preparedness like classroom space, student enrolment per class, available time and expected content coverage in relation to an effective ASEI lesson.

ii. It is recommended that Teacher pre-service institutions consider suggestion by teachers to amalgamate the SMASSE INSET curriculum with that of the institutions in order to ensure ample time for preparing teacher trainees for the application of ASEI/PDSI principles.

iii. It is also recommended that the SMASSE INSET program be reviewed and/or adjusted so as facilitate provision of non-threatening and meaningful opportunities for observing interactive ASEI/PDSI lessons, learning improvisation skills, learning collaboration skills and sharing
ideas based on individual teacher realities at the school level a possible solution or step towards enhancement of good mathematics teaching practices in secondary schools.

iv. It is also recommended that a mathematics curriculum review, aimed at reducing its subject content, or making it less examination driven, or incorporating alternative assessment strategies be conducted by the government bodies charged with this responsibility.

v. The SMASSE INSET was established after a baseline survey whose findings formed the basis of its curriculum. However, the view among majority teachers who are relatively positive about the ASEI/PDSI principles is that there is need for teachers to have a greater level of participation in appraising the feasibility of these principles. It is therefore recommended that the stakeholders once again conduct a survey so as to bring on board the teachers’ views.

5.5 Suggestions for Further Research

i. Further research should be conducted on the impact of class size on application of ASEI/PDSI approach for mathematics curriculum delivery in secondary schools.

ii. A study should be done on time as a resource that plays a key role in influencing the teacher’s choice of mathematics teaching-learning strategies.

iii. A research study should be done on how the comprehensive aspects of ASEI/PDSI principles impact on the applicants’ views.
iv. A similar research like this one should be carried out with a larger sample or in another locale particularly in a rural setting.
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*School Science and Mathematics;* 97(6), 302-310.


Nakuru.


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347-365: Springer


Washington DC: World Bank


**APPENDIX I**

**LETTER OF INTRODUCTION**

KENYATTA UNIVERSITY,

P.O BOX 43844,

NAIROBI

NAKURU DEO
Dear Sir/Madam,

RE:   REQUEST TO CONDUCT RESEARCH IN THE DISTRICT

I am a post graduate student undertaking a Master of Education degree in curriculum studies at Kenyatta University. I am just about to embark on a research on the application of SMASSE principles during mathematics curriculum implementation in secondary schools in Nakuru District, Nakuru County.

I kindly request you to allow me to carry out the research in the district. I assure you that any information obtained from the research will be treated with utmost confidentiality and that it will be used purposely for this study.

Thank you in advance.

Yours faithfully,

Nyakwama Joyce Kwamboka
PRINCIPALS’ Interview Schedule

The purpose of this interview is for you to provide your views on the ASEI/PDSI principles and mathematics teaching. Your honest responses will facilitate efforts towards measures towards enhanced teaching/learning and achievement.

Section A: Demographic information

1. School Category: National [ ] Provincial [ ] District [ ] Private [ ]

Role: ____________ 3. Years in current role: [ ] 4. Years in this school: [ ]

Section B: School Preparedness

1. a) Are there any teacher development or in servicing plan for your teachers?

_____________________ Please explain.

___________________________________________________________

b) What is your opinion about the SMASSE INSET and teacher development?

___________________________________________________________

2. How adequate is mathematics teaching staff in your school? _______________

How adequate are the physical facilities? _______________________________

3. a) Does your school have guidelines regarding preparation for instruction? ______

b) What professional documents are used for lesson preparation?

___________________________________________________________

Section C: Lesson Actualization

1. Which mathematics teaching/learning resources are available in this school?

___________________________________________________________a) Is instructional supervision done in your school? ______________________

b) Whose responsibility is it to supervise instructional sessions? __________
c) What guidelines are in practice with regard to instructional supervision?

Section D: Views about Mathematics and ASEI/PDSI Approach

1. a) Does the school have any plan for teacher and student motivation? ______

Please state: ____________________________________________________________

b) Would you say your teachers are motivated by ASEI/PDSI principles to teach?

____________ Please explain ________________________________

c) What is your opinion about mathematics teachers valuing the use of ASEI/PDSI principles? ____________________________

2 a) What views prevail in your school with regard to mathematics subject?

______________________________

b) What are your personal views about the use of ASEI/PDSI approach to teach mathematics?______________________________

Section E: Improved Classroom Practices

1. In your opinion is the INSET adequate for mathematics teachers? ______

Please explain. ________________________________

2. How has the ASEI/PDSI approach helped to enhance achievement in mathematics?______________________________

3. What challenges have you encountered with the ASEI/PDSI approach?

__________________________________________

Thank you very much for participating in this process

APPENDIX III
MATHEMATICS HODS QUESTIONNAIRE

The purpose of this questionnaire is for you to present your views on the ASEI/PDSI principles for teaching mathematics. Your honest responses will facilitate efforts towards measures for enhanced teaching/learning and achievement. Any information you give in this questionnaire will be treated with utmost confidentiality.

Section A: Demographic information

1. School Category: National [ ] Provincial [ ] District [ ] Private [ ]

Role: _____________ 3. Years in current role: [ ] 4. Years in this school: [ ]

Section B: School Preparedness

1. a) What kind of professional development opportunities does your department have for mathematics teachers? ____________________________
   ____________________________
   ____________________________

   b) How many of your mathematics teachers are in your department: ____________

   c) What is the required CBE for your department? ____________________________

   d) How many of these have attended the SMASSE INSET? ____________________________

2. a) What mathematics teaching and learning resources are available in this school?
   _______________ _______________ _______________ _______________

3. a) Does your school have guidelines/professional documents for lesson preparation and instruction? ______

   b) What documents are most available to teachers for lesson preparation and implementation?
   _______________ _______________ _______________ _______________

Section C: Lesson Actualization

2. a) Is instructional supervision done in your school? ____________________________

   b) Whose responsibility is it to supervise instructional sessions? ____________________________
c) What aspects of instructional supervision are looked into? __________________
__________________

Section D: Views about ASEI/PDSI Principles

1. a) In which ways does the department reach out to motivate teachers and student?
________________________________________________________________________

2. b) In your opinion do mathematics teachers value the use of ASEI/PDSI principles?
________________________________________________________________________

   c) How have teachers shown they are motivated to use ASEI/PDSI approach?
________________________________________________________________________

3. a) What kinds of views prevail in the department about mathematics subject?
________________________________________________________________________

4. What is personal view about the use of ASEI/PDSI principles to teach mathematics?
________________________________________________________________________

Section E: Improved Classroom Practices

1. a) In your opinion is the INSET adequate for mathematics teachers? __________

   Please explain: __________________________________________________________

   b) How have ASEI/PDSI principles helped mathematics teachers

   ____________________________________________________________________

   c) What challenges have you encountered with the ASEI/PDSI principles?

   ____________________________________________________________________

   Thank you very much for participating in this process

APPENDIX IV

QUESTIONNAIRE FOR MATHEMATICS TEACHERS
The purpose of this questionnaire is for you to give your views on the ASEI/PDSI principles for mathematics teaching. Your honest responses will facilitate efforts towards putting in place measures for enhanced teaching and learning of the subject. Information given by you in this questionnaire will be treated with utmost confidentiality.

Please tick [v] or fill in the necessary information where appropriate

Section A: Demographic Information

1. Your school Category: National [ ] Provincial [ ] District [ ] Private [ ]
2. Teaching Experience in years: 1-3 [ ] 4-6 [ ] 7-9 [ ] 10 and above [ ]
3. SMASSE INSET Cycles attended: I [ ] II [ ] III [ ] IV [ ] none [ ]

Section B: School Preparedness

1. What mathematics teaching resources does your school avail for your use?
   - Text books [ ] 3D Models [ ]
   - Geometrical instruments [ ] Computers [ ]
2. How does the school administration support you as a mathematics teacher?
   - Provision of teaching resources [ ] Facilitate INSET attendance [ ]
   - Motivation aspect [ ] No support from administration [ ]
3. Has the SMASSE INSET helped you as a teacher in lesson preparation? _______
   Please explain.
   - Led to active involvement of students in class [ ]
   - The use of ICT in lesson preparation [ ]
   - Interaction with other teachers from other schools [ ]
   - Exposure to diverse presentation skills [ ]
   - Inset is not practical [ ]
The syllabus is too wide inhibiting application of SMASSE principles [ ]

There is a lot time involved in the planning and implementation [ ]

Section C: Lesson Actualization)

1. Which teaching strategies do you prefer to use in class? (tick as appropriate)
   
   Student-centered [ ]  teacher-centered [ ]  A combination of both [ ]

Explain the rationale for your preferred strategy

Student- centred:

   Facilitates active participation of students [ ]
   
   Allows the teacher to attend to individual student needs [ ]

Teacher – Centred:

   Facilitates the coverage of more content [ ]
   
   It saves time [ ]

A Combination of both:

   Some concepts require teacher exposition [ ]
   
   Helps the teacher to control the learning environment [ ]

2. How have you been influenced by the ASEI/PDSI principles as a teacher?

   Prior planning before implementation [ ]
   
   Active involvement of students [ ]
   
   Use of locally available teaching/learning materials [ ]
   
   There has been little influence [ ]
   
   There has been no influence [ ]

3. What in your opinion have been your challenges with regard to the use of ASEI/PDSI principles?

   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________

Section D: Views about ASEI/PDSI Principles
1. a) What is your view about the use of ASEI/PDSI principles to teach mathematics?

__________________________________________

b) How do you rate the school administration’s support for mathematics teachers?

1. Very poor [ ] 2. Poor [ ] 3. Neither poor nor good [ ]
4. Good [ ] Very good [ ]

Section E: Improved Mathematics Classroom Practices

1. How in your opinion can ASEI/PDSI principles be utilized to improve achievement in examinations? ________________
   ____________________________________________
   ____________________________________________

2. What can be done to help improve mathematics classroom practices? _________
   ____________________________________________

Thanks so much for participating in this exercise

APPENDIX V
QUESTIONNAIRE FOR STUDENT

Through this questionnaire, your views about Mathematics teaching and learning are requested. Your honest responses will facilitate efforts towards improved achievement in KCSE. Any information given will be treated with utmost confidentiality.

SECTION A: Demographic Information

(Put a tick [✓] where appropriate)

1. School's category: National [ ] Provincial [ ] District [ ] Private [ ]

SECTION B: School/Teacher Preparedness

Tick [✓] the correct box for each statement. Initials used in this stand for:

A- Always   M- Most of the time   U- Undecided   R- Rarely   N- Never

Our school is equipped with mathematics learning resources because our teacher:

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>A</th>
<th>M</th>
<th>U</th>
<th>R</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>comes to class with a variety of text books</td>
<td></td>
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<td></td>
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<tr>
<td>brings a variety of teaching aids to class</td>
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<tr>
<td>Explains what we will learn at the beginning of lesson</td>
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<tr>
<td>invites other teachers to come and teach us</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>has given us enough text books to use</td>
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</tbody>
</table>

SECTION C: Lesson Actualization

Tick [✓] the correct box for each statement. Initials used in this section stand for:

A- Always   M- Most of the time   U- Undecided   R- Rarely   N- Never
Our teacher:

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>A</th>
<th>M</th>
<th>U</th>
<th>R</th>
<th>N</th>
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</thead>
<tbody>
<tr>
<td>explains concepts very clearly in class</td>
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</tr>
<tr>
<td>uses teaching aids/ resources to teach</td>
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<td></td>
</tr>
<tr>
<td>allows students to ask questions</td>
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<td></td>
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<tr>
<td>gives us activities to perform and discuss</td>
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<tr>
<td>checks and guides us when performing activities</td>
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<td>discourages me by the way he/she teaches</td>
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<tr>
<td>uses the text books a lot</td>
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<tr>
<td>helps those with mathematics difficulties</td>
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<tr>
<td>asks us to comment on how the lesson was</td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>

SECTION D: Views about ASEI/PDSI Principles

Tick [V] the correct box for each statement. Initials used in this section stand for:

SA- Strongly Agree    A- Agree    U- Undecided    D- Disagree    SD-Strongly Disagree

1. Our mathematics teacher:

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loves using a variety of activities to teach</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Uses improvised teaching/learning aids

Encourages us to love and do mathematics

Allows us to evaluate the lesson

Spends extra time to help those with difficulties

2. In my opinion:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics is important for solving societal problems</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics is not necessary for my future career</td>
<td></td>
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<tr>
<td>Mathematics helps me to do well in other subjects</td>
<td></td>
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<tr>
<td>Mathematics should be optional in secondary schools</td>
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<tr>
<td>I always look forward to our mathematics lesson</td>
<td></td>
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</tr>
</tbody>
</table>

SECTION E: Improved Classroom Practices

Tick [V] the correct box for each statement. Initials used in this section stand for:

SA- Strongly Agree       A- Agree       U- Undecided       D- Disagree       SD- Strongly Disagree

I am able to learn and understand mathematics better through:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
</table>
activities that help me to discover my ability

Simple locally available teaching/learning aids

Small group discussions and presentations in class

Teacher’s demonstrations before class activities

Revision of the previous lesson before a new one

Doing problems on my own with the teacher’s facilitation

Thank you so much for your responses

APPENDIX VI

LESSON OBSERVATION SCHEDULE

Section 1

School................. Number of students in class ............ Date............... Topic: ............................................................................................................................

<table>
<thead>
<tr>
<th>No.</th>
<th>Section II: Actual Lesson</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Planning is reflected through:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Lesson objectives stated in terms of what learners are expected to achieve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>The teacher had sufficient readily prepared teaching/learning aids</td>
<td></td>
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<tr>
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<td>-----------------------------------------------------------------</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Content was geared to the level of learners</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Introduction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Teacher made reference to previous lesson</td>
<td></td>
<td></td>
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<tr>
<td>5</td>
<td>Introduction helped learners to focus on content of lesson</td>
<td></td>
<td></td>
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<tr>
<td>6</td>
<td>Introduction increased the level of interest/enthusiasm among students</td>
<td></td>
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<tr>
<td></td>
<td><strong>Lesson Development</strong></td>
<td></td>
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<tr>
<td>7</td>
<td>Teacher defined and explained difficult terms</td>
<td></td>
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<tr>
<td>8</td>
<td>Teacher used appropriate and familiar examples to illustrate main concept</td>
<td></td>
<td></td>
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<tr>
<td>9</td>
<td>The teacher engaged students in activities</td>
<td></td>
<td></td>
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<tr>
<td>10</td>
<td>Instructions for activities were clearly given</td>
<td></td>
<td></td>
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<tr>
<td>11</td>
<td>The teacher checked the students’ activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Teacher provided sufficient time for learners to ask questions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Teacher was friendly in terms of communication with learners</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Lesson Summary</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>The lesson summary made reference to main points of the lesson</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>The teacher gave students some assignments for the next class.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>The teacher asked the learners to evaluate the lesson</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Classroom Management</strong></td>
<td></td>
<td></td>
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<tr>
<td>-------------------------</td>
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<tr>
<td>17 Time was appropriately distributed in the execution of the lesson</td>
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</tr>
<tr>
<td>18 Teacher ensured students were engaged in relevant learning activities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 The teacher actively solicited students’ ideas on content being taught</td>
<td></td>
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</tr>
<tr>
<td>20 Students were actually well disciplined throughout the lesson</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Section III: Principles of the ASEI**

<table>
<thead>
<tr>
<th><strong>Activity</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>21 Learners were meaningfully engaged in learning activities</td>
<td></td>
</tr>
<tr>
<td>22 The activities aroused and sustained interest</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Student</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>23 Students asked questions</td>
<td></td>
</tr>
<tr>
<td>24 Students involved in demonstrations</td>
<td></td>
</tr>
<tr>
<td>25 Students worked in small groups</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Experiment</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>26 Demonstrations were adequate</td>
<td></td>
</tr>
<tr>
<td>27 Demonstrations were appropriate for the purpose</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Improvisation</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
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</tr>
<tr>
<td>28</td>
<td>The teacher used locally available teaching/learning materials</td>
</tr>
<tr>
<td>29</td>
<td>Teacher was able to use the materials to arouse interest among students</td>
</tr>
<tr>
<td><strong>Section V: Views about ASEI/PDSI Principles</strong></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Positive reinforcement was used by teacher</td>
</tr>
<tr>
<td>31</td>
<td>Learners enjoyed classroom activities</td>
</tr>
<tr>
<td>32</td>
<td>Student active participation was displayed</td>
</tr>
<tr>
<td>33</td>
<td>The teachers built on learners’ views</td>
</tr>
</tbody>
</table>