INFLUENCE OF TEACHERS' BACKGROUND AND PERCEPTION OF SMASSE PROGRAM ON QUALITY OF TEACHING MATHEMATICS IN PUBLIC SECONDARY SCHOOLS IN KISUMU COUNTY, KENYA

BY

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SCHOOL OF EDUCATION

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DECLARATION

Declaration by Candidate:

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

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To my sister Syvil Atieno Otieno

ABSTRACT

Pre-service training is not adequate to last teachers for their entire career. Due to advancement in knowledge, technology and curriculum, teachers ought to update on teaching methodologies through in-service programs. Teachers of Mathematics in Kenya have attended in-service program for the purpose of enhancing their skills and improving quality of teaching. However, this has not translated into improved performance as expected. There has been persistent low performance in Mathematics in secondary schools in general for the period 2012-2019 during which the mean score dropped from 20.12% to 19.86% nationally. The trend of low mean score has been identified in secondary schools in Kisumu County which dropped from 34.00% to 20.45% for the same years. The purpose of this study was to establish the influence of teachers' background and perception of in-service program on quality of teaching Mathematics. Objectives of the study were to: establish the influence of teachers' professional qualification on quality of teaching mathematics; establish teachers' teaching experience on quality of teaching mathematics; establish teachers' gender on quality of teaching mathematics; determine combined influence of teachers' qualification, experience and gender on quality of teaching mathematics and determine influence of teachers' perception of in-service program on quality of teaching Mathematics. The study was anchored on Bowles (1970) Educational Production Function model from which a conceptual framework was developed to illustrate the relationship between teachers' qualification, experience, gender and perception of in-service program on quality of teaching mathematics. Descriptive survey and correlation designs were employed in the study. Population size was 234 teachers, 25 INSET trainers, and 7 SQASO. Sample size was 70 teachers, 6 SQASO and 22 INSET Trainers. Saturated sample was used to select 6 SQASO and 22 INSET trainers. Research instruments were MTQ, LOG, ITIG and SIG which were scrutinized by experts to establish their validity. A pilot study was carried using test-retest method and the reliability coefficient of MTQ was .72, LOG .78, ITIG .81 and SIG .82. Quantitative data was analyzed using arithmetic mean, standard deviation, frequencies and percentages. Inferential statistics involved correlation analysis, regression analysis, Independent t-test and ANOVA (one-tailed). Qualitative data was analyzed by creating thematic categories and reported as verbatim excerpts. Findings revealed that teachers' qualification had significant differences with Master's holders performing best (M=67.3; SD=6.63). Teachers' experience had significant differences with teaching experience of over 10 years performing best (M=63.82; SD=5.39). Independent t-test established teacher gender as statistically insignificant (t= -.572, p=.571).Multiple regression analysis revealed the combination of teachers' qualification, experience and gender explains 42.4% as signified by Adjusted R^2=.424. On perception, teachers' were positive about the in-service program and the most significant input variable which influences perception on quality of teaching mathematics is implementation of ASEI/PDSI with a correlation coefficient of .715 significant at the.01 level(2-tailed), with R^2=.552. It is recommended that teachers' with qualification of M.Med to be appointed INSET trainers, over 10 years' experience be appointed as HOD, many female teachers to be posted in boys' schools, more qualified and experienced teachers to be appointed as SQASO and SQASO to do a follow up on implementation of ASEI / PDSI.

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LIST OF ABBREVIATIONS AND ACRONYMS

ASEI	Activity, Students centered, Experiment, Improvisation
CEMASTEA	Centre of Mathematics, Science, Technology Education in Africa
HoD	Head of Department
INSET	In-service Education and Training
ITIG	INSET Trainer Interview Guide
JICA	Japan International Cooperation Agency
KCPE	Kenya Certificate of Primary Education
KCSE	Kenya Certificate of Secondary Education
KNEC	Kenya National Examinations Council
LOG	Lesson Observation Guide
M. Med	Masters in Mathematics Education
MoE	Ministry of Education
MTQ	Mathematics Teachers Questionnaire
NCTM	National Council of Teachers of Mathematics
PDSI	Plan, Do, See, Improve
QTM	Quality of Teaching Mathematics
SESEMAT	Secondary Science and Mathematics
SIG	SQASO Interview Guide
SMASE	Strengthening of Mathematics and Science Education
SMASSE	Strengthening of Mathematics and Science in Secondary Education
SQASO	Sub-County Quality Assurance and Standard Officer
TSC	Teachers Service Commission
WECSA	Western, Eastern, Central and Southern Africa

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The global community's commitment over quality in education at basic level of education has been emphasized in many international forums including the world conference on Education For All, adopted in Jomtein, Thailand in 1990. Mathematics education is a global challenge that needs urgent local solutions (UNESCO, 2009). Research has shown that successful professional development experiences have a noticeable impact on teachers work in and out of the classroom (Villegas-Reimers, 2003). Armstrong *et al.* (2010) asserts that in order to provide quality experiences for all learners, lessons must be planned and prepared properly for quality teaching and learning. Indumuli *et aI*. (2009) supports Armstrong's view on teachers' preparation as being vital for quality teaching and learning progress. Federal Government of Nigeria (2010) noted that the best way one can show that quality of education is being provided and teachers are effective is by the number of students who qualify for university education.

For many decades, studies have been conducted to investigate the teaching and learning of Mathematics (Darling-Hammond, 2000). A growing body of research shows that differences in students' achievement is attributed to teachers' and their teaching methods (Ingvarson *et al.* 2004). Teachers' background influences teaching and learning in classrooms (Adeyemo, 2005). It has been established by Olaleye (2011) that there is a relationship between teachers' background and students' performance. Teachers' background is seen as a strong determinant of students' performance in secondary schools (Adu & Olatundun, 2007). Availability of qualified teachers determines the performance of students in schools (Akinsolu, 2010). In contrast a study done by Kosgei (2013) reveals that there is no difference in performance

between teachers who have degree or diploma suggesting that teacher professional qualification does not result to increased students' academic achievement. Similarly, Kimani, Kara and Njagi (2013) is in support of Kosgei (2013) findings hence concluded that teachers' age, gender, both professional qualification and experience did not have significant effect on academic achievement in secondary schools in Nyandarua County.

Mathematics education has had issues including gender differences and this has been tackled by various researchers (Amelink, 2009; Halls, 2012; Kiptum *et al.*, 2013 and OCDE, 2014). Most of the studies were focusing on gender issues in mathematics, or gender disparity in mathematics. A study by Antecol *et al.* (2012), titled "The effect of Teacher Gender on students Achievement in primary schools" found that female students who were taught by a female teacher without a strong mathematics background had low scores in mathematics at the end of academic year. In contrast, they did not find any effect of having a female teacher on male students' scores in mathematics. Few studies have focused on female teachers' quality of teaching mathematics in elementary schools (Dee, 2006; Zogheib *et al*., 2015). Dee, (2010) findings of gender interactions within classrooms have centered on controversial claims that teachers consistently privilege boys over girls. However, the literature on student teacher interactions (Dee, 2006) has also focused on whether student outcomes differ when a student and teacher share the same gender. Assignment to a same-gender teacher could be educationally relevant for a number of reasons such as it could influence student engagement or behavior through role-model effects and stereotype threat. Furthermore, same-gender teacher may also communicate different expectations to the boys and girls in their classrooms (Dee, 2006). An analysis of upper-secondary education students in 69 schools in Stockholm (Sweden), found no evidence to show that teacher gender improves student outcomes (Holmlund & Sund, 2008).

One way of improving the quality of education is through quality of teaching. Examining the quality of teaching will improve understanding of what happens in the classrooms that may explain differences in performance among schools. Some researchers (Hattie, 2009; Morrison *et al.* 2005), assert that teacher's pedagogy and interaction with students in classrooms can determine how much is learned. Other important factors influencing quality teaching are school administration and culture, funding, teacher training both pre-service and in-service, and teachers background (Rice, 2003), though there is no consensus on how best to measure quality of teaching. Understanding what quality mathematics pedagogy looks like has not been finalized (Walshaw and Antony, 2008). Teachers need to have a good command of mathematical knowledge to enable them to use a variety of teaching strategies at their disposal when faced with different situations in classroom (Darling-Hammond & Bransford, 2005). Teachers' mathematical knowledge can better be assessed when they are observed in class. Since the study proposed to establish quality of teaching mathematics there was need for the researcher to observe teachers in class to establish their interaction with students in the process of teaching learning. The researcher studied work on quality of teaching because it is a requirement in curriculum development and therefore content to be delivered requires quality and appropriate materials to enhance teaching as well as appropriate methods to be used in delivering the content. Quality is mandatory in selection and preparation of materials and equipment to be used in teaching and learning process. For content to be delivered to learners, teachers must be involved since they are the implementers of curriculum in schools (Oluoch, 1984).

Pre-service training is not adequate to last teachers for their entire career. Teachers need to attend in service programs to enable them meet new demands in their subject areas. Unfortunately teachers attending INSET courses are often exposed to a flood of new

information, much of which is lost or rejected because of the way it is presented (Mwangi & Mugambi, 2013). Their views need to be addressed for the INSET to be effective (Kennedy, 2001). INSET if well designed has a powerful influence on quality of teaching (Borg, 2006). Mathematics and science teachers from Botswana perceived INSET conducted by department of mathematics and science as not having an impact on education system. They had complains like lack of regular follow up activities to support the workshop and difficulties they encountered in implementation due to lack of time (Ramatlapana, 2009). Similarly, Massari (2012) studied Kindergarten teachers' perception on in service training and impact on classroom practices and found that there is a significant difference in perception between newly qualified teachers and those with more than 10 years' experience. Also, Ndlovu (2013) findings on teachers' perception of INSET program specific to the topic of transformation in mathematics revealed that teachers wanted more time to be allocated for the INSET.

Teachers perceive INSET differently and the INSET may have an impact on teaching and learning. The aforementioned studies established various opinion of teachers on INSET program none of them looked at mathematics teachers' perception of INSET program in relation to objectives on attitudinal change of teachers and students, pedagogic skills and their implementation, assessment and evaluation of learners work. Therefore there was need for the current study to establish mathematics teachers' perception of SMASSE INSET Program in relation to objectives stated in the four cycles. The researcher saw it wise to look at perception of teachers towards in-service program instead of their attitude because with perception the teachers give their opinion without emotions attached while in attitude there is emotional evaluation (Bergman, 1998). Moreover perception can be reversed depending on circumstances.

In Ghana, in-service programs are organized to prepare newly appointed and promoted teachers, to update them on pedagogic skills and subject matter knowledge (Sadiega *et al*. 2019). Beside the in- service training program, it is not being followed strictly although the new structure and content of education of the Ministry of Education makes provision for INSET as part of the continuing education for teachers in Ghana Education Service. The cost of providing INSET program in the country is donor- driven, initiated and funded by donor agencies on small scale involving few regions of the country. In the case of Kenya, SMASSE INSET program has covered all regions in the country. A study conducted on perception of teachers' on effectiveness of the INSET program at Basic schools in Akatsi District Ghana, revealed that majority of the teachers perceived the INSET program as being adequate and very effective with regard to teaching and learning. On the other hand, 70 percent of head teachers had a view that most teachers who have attended the in-service training do not perform effectively in their work with regard to understanding pupils problems, preparing effective lesson notes, selection and use of appropriate teaching and learning materials and interpreting the curriculum concerning teaching and learning in the District (Sadega *et. al.,* 2019).

According to Junaida and Maka (2015), teachers in Ghana are not motivated hence this hampers their participation in School Based INSET and Cluster Based INSET activities. The authors further say that the timing of the two INSETS after school hours, and other activities create an obstacle to the successful implementation of the School Based INSET. Implementation of the INSET by the government of Ghana is indicative of policies, but if teachers views are ignored since they are not linked to their career progression this makes them to be reluctant to take part or be less committed to the training.

In Uganda, INSET program of serving teachers of Mathematics and Science is done by Secondary Science and Mathematics (SESEMAT) project. The project came to exist as a result of the persistent poor performance in science and mathematics to help improve the teaching of those subjects through the INSET. Findings on impact of the program in Jinja District revealed challenges on implementation like inadequate time and lack of instructional materials which has made the teaching of mathematics difficult (Agwot & Osuu, 2014).

In Kenya, the provision for improvement of teachers' in-service courses has been given prominence in government policy documents. The Kenya Education Commission chaired by Ominde (Republic of Kenya 1964) recommended in-service in teaching methods and child psychology as one of the ways to improve the quality of education in post- independence Kenya. Provision of INSET program in Mathematics and Science in Kenya has been done by the Ministry of Education (MoE) in conjunction with Japan International Co-operation Agency (JICA) through a project called Strengthening of Mathematics and Science in Secondary Education (SMASSE). The current study focused on this project. The inception of the project was an intervention to improve the quality of teaching mathematics (MOEST, 1998).The INSET was delivered through a two tier cascade system in which training was conducted at national and sub county level. At national level, the national trainers facilitate INSET to sub-county trainers who in turn train all other mathematics teachers in their respective sub county throughout the country (Nui & Nyacomba, 2006).

The project which is a technical cooperation initiative between the Government of Kenya and Japan was signed in 1998. The project aimed at the improvement of mathematics and science education through INSET for teachers with innovative approach in order to upgrade the capability of young Kenyans in mathematics and science and strengthening of quality of

mathematics and science education in Western, Eastern, Central and Southern Africa (WECSA) member countries. A baseline survey conducted in 1998 in nine of the then 72 districts in the country to determine areas in mathematics that needed intervention revealed many challenges amongst them was inappropriate teaching and learning strategies (MOEST, 1998; Njuguna, 2005).

From the baseline survey, the purpose of the project was to address areas of concern which were identified to cover attitudinal change of teachers and students, pedagogy/ teaching methodology, mastery of content, development of teaching and learning materials and administration and management. To handle these areas the curriculum for INSET was divided into four cycles of ten days each year during the school holidays.

The first cycle covered attitude change and the objectives stated were:

1. To determine the causes of acquired attitude and its effect on the teaching and learning of mathematics and science.
2. Share experiences for the purpose of developing a common understanding on the management of attitude for effective teaching and learning of mathematics and science.
3. Explain methods that may be used to change already formed attitudes

The second cycle targeted pedagogy which puts into practice the principles of Activity, Student-centered, Experiment, Improvisation / Plan, Do, See and Improve (ASEI /PDSI). The objectives stated were:

1. Identify key elements of ASEI-PDSI Approach and appreciate its potential to promote effective teaching and learning.
2. Identify and appreciate key elements of learner-centered pedagogy.

3. Demonstrate enhanced ability to employ learner-centered pedagogy (ASEI/PDSI) in mathematics.

The third cycle focused on implementation of ASEI/ PDSI in classrooms which is learner-centered pedagogy. For implementation of ASEI /PDSI to be effective work planning and effective curriculum delivery was to be done through use of teaching and learning resources. Objective stated were:

1. Explain the fundamentals of work planning.
2. Prepare different work planning tools.
3. Appreciate importance of work planning for effective teaching and learning.
4. Identify resources for effective teaching and learning.
5. Identify criteria for selection of teaching learning resources.
6. Identify and use appropriate teaching and learning resources for learners with disability.
7. Appreciate the importance of using teaching and learning resources.

Work planning refers to the systemization of activities to be carried out in a given time schedule in order to achieve a certain goal. Work planning tools for teaching include the mathematics syllabus, the scheme of work, the lesson plan, record of work covered and textbooks (CEMESTEA, 2014).

The fourth cycle targeted assessment and evaluation of learners work in classroom. The objectives were:

1. Distinguish between assessment and evaluation.
2. Identify and explain common methods of assessment used in Kenya.
3. Describe the modern trends of assessment.
4. Explain purpose of assessment.

5. Distinguish between Reliability and Validity in assessment
6. Apply Bloom's taxonomy in the development of assessment tools.
7. Apply assessment knowledge and skills at subject level(CEMESTEA,2014)

For effective classroom practice SMASSE team came up with Activity, student-centered, Experiment and Improvisation (ASEI) movement to upgrade teaching and learning. To achieve the ASEI condition, SMASSE came up with an approach of Plan, Do, See, Improve (PDSI) to teaching and learning. Under Plan, teachers make schemes of work and lesson plan and carefully try out the teaching and learning activities, materials before the lesson. Under Do, a teacher carries out the lesson as planned: teachers are encouraged to be innovative in lesson presentation; ensure active learner participation and reinforce learning at each step. Under SEE, the teacher evaluates the teaching and learning process during and after the lesson, using various techniques and feedback from students; teachers also allow their colleagues to observe their lessons and offer feedback. Under IMPROVE, this reflects on classroom performance, evaluation reports and effectiveness in achieving the lesson objectives. It enables the teacher to see the good practice in the lesson and strengthen them; sees mistakes made in earlier lesson and therefore avoids them in future lessons (MOEST, 1998; Association for Development of Education in Africa-ADEA, 2005). The project's implementation has cost the government of Kenya a lot of money of over Ksh. 472,326,270.00 (SMASE-JICA, 2003) and a huge amount of the Ministry of Education's budget goes towards the course (MoE, 2005).

A situational analysis on secondary schools was done by Centre for Mathematics, Science and Technology in Africa (CEMASTEA,2009) and among the objectives of the study was to find out the extent to which Activity, Student-centered, Experiment, Improvisation/Plan Do, See, Improve (ASEI/PDSI) approach was being practiced by Mathematics and Science

teachers at secondary school level in Kenya. Descriptive design was used and the target population was all public secondary schools in Kenya. The sample size was 45 schools distributed equally in the then four provinces of Rift-Valley, Eastern, Central and Nyanza were used in the study. Data collection tools were interview guides, observation schedule and questionnaires. Results from the study showed that teachers' perceptions of the practice of ASEI-PDSI in the teaching of Mathematics and Science scores ranged between 49 to 92 percent with a mean of 72 percent. From the findings it implies that teachers had a high self-perception of their practices of ASEI-PDSI approach. Results on preparation of ASEI lesson plan showed that only 10.7 percent of teachers indicated they always prepared a written lesson plan while 72 percent indicated that they rarely or never prepared a written lesson plan. On extent of students' involvement in the lesson showed that 59 percent of teachers always involved students in predicting outcomes. This finding implies that the practice of writing ASEI lesson plan was very low among teachers, and students were averagely involved in the lesson (CEMASTEA, 2010). Similarly, findings from a study by Kwamboka (2012) on application of SMASSE ASEI/PDSI principles which used a descriptive research design with a target population of 4034 subjects-45 principles, 45 heads of department, 118 mathematics teachers and 3826 Form 3 students from 45 secondary schools of the then Nakuru district revealed that the application of ASEI/PDSI principles were yet to be fully realized in secondary schools in the district.

An assessment of centrally designed in-service education programs in terms of outcomes shows that few perform satisfactorily (Mwangi & Mugambi, 2013). Improvements to such generic programs will come from understanding the interaction between in-service education processes and school level factors. Some research findings (Gaberscek & Roeders, 2013) have emphasized on critical need for improvement of INSET programs and have recommended development of new strategies, plans and programs through which all teachers

may gain required skills and knowledge. The current study is based on the premise that teachers background and perception of INSET and the support they receive in their schools can be viewed holistically as a web of influences that affect teachers' quality of teaching mathematics. Identification of the variables involved and the relationship between them would provide a model of teacher development that could be tested empirically.

Mathematics is one of the core subjects in secondary school curriculum. Performance in the subject is crucial for students' admission to scientific and technological professions.

Despite the implementation of the in service program and the importance attached to mathematics by society there has been low performance in secondary school Mathematics in Kenya as provided in Table1.1. This has prompted the researcher to establish through a study whether there is quality of teaching the subject in secondary schools in Kisumu County.

Table 1.1: KCSE National Results in Mathematics as Percentage from 2012- 2017

YEAR	MEAN SCORE
2012	20.12
2013	21.42
2014	20.64
2015	21.45
2016	18.12
2017	19.24
2018	20.44
2019	19.86
Average	**20.17**

Source: Kenya National Examinations Council (KNEC) results analysis (2012 - 2019)

Table 1.1, shows mathematics results at the national level given the average of means as 20.17 per cent, for the eight years 2012-2019 which is below a quarter of one hundred per cent. The same trend of low performance in mathematics as evidenced by the average of means has not only been noted in Kisumu county but also including other counties within Nyanza region a case of Siaya, Nyamira, Kisii, Migori and Homa-bay. The analyzed results in terms of means for the Nyanza region counties and national level is given in Table 1.2.

Table 1.2: KCSE analyzed Results in Mathematics for National level and Counties within Nyanza region for the years 2012-2019

Year	National	Kisumu	Migori	Siaya	Kisii	Nyamira	HomaBay
2012	20.12	34.00	32.33	37.33	29.83	32.83	35.33
2013	21.42	29.42	29.42	33.00	37.33	29.33	30.41
2014	20.64	27.33	28.08	31.55	29.67	28.67	28.67
2015	21.45	25.50	26.50	26.33	27.33	27.50	27.33
2016	18.12	23.75	24.50	24.83	25.58	23.92	26.00
2017	19.24	24.33	25.86	25.17	24.17	24.83	25.83
2018	20.44	20.68	21.74	20.98	22.44	22.57	21.88
2019	19.86	20.45	20.58	21.45	21.48	21.45	20.77
Average	**20.17**	**25.68**	**26.13**	**27.58**	**27.23**	**26.39**	**27.03**

Source: County Directors of Education - Kisumu, Migori, Siaya, Kisii, Nyamira, and Homa-bay

Performance of Mathematics in Kisumu County shows that it is below average as compared with an average mean of 50 percent given that the total candidature in each of the counties in Kenya is lower than that of the national level. At the same time the performance shows a

negative deviation. Comparing the performance of Kisumu County with her five regional counties for the years 2012 to 2019 there is a clear indication that Kisumu County's performance is the lowest with an average of means at 25.68. Basing on KNEC results, the researcher has enough evidence to show that performance in mathematics in Kisumu County is below average of 50 percent. These results are indication that INSET attended has not been matched with improved academic performance of students. This could also reveal teachers' perception of the in-service program and a need to investigate the implementation of the activities of the in-service program. To add on this, INSET for teachers has been characterized by low attendance and poor organization (Matambuki, 2014). Given the results, the questions to be asked are; what are the qualifications of mathematics teachers in the county? What are the teaching experiences of these teachers? Is teacher gender affecting the results? It is evident from the results that quality of teaching mathematics is lacking which determines high performance in mathematics hence quality grades in the subject. Most of the studies conducted (Akinsolu, 2010; UNESCO, 2009; Holmlund, 2008; Adeyemo, 2005; Ingvarson *et al*.2004), have looked at either teacher background variables or perception of teachers towards INSET. Other studies, (Massari, 2012; Birjandi and Derakhan, 2010; Matseliso & Loyiso, 2010; Ramatlapana, 2009), have not reached a conclusion on which variable is the most effective.

This raised the urgent need to conduct a study to establish influence of mathematics teachers' background which in this case were teacher qualification, experience and gender to help determine the most significant variable amongst them hence quality of teaching mathematics. On the same note the study needed to establish the most significant construct of perception; attitudinal change, pedagogy (ASEI/PDSI), implementation of ASEI/PDSI and assessment and evaluation of learners work. If this cannot be done, performance of mathematics in

secondary schools may keep on deteriorating and students may keep on missing admission to scientific and technological professions at the university hence not allowing Kenya to achieve her vision by 2030.

1.2 Statement of the Problem

The first major in-service program for Mathematics and Science teachers in Kenya is SMASSE program which has been conducted since 2004. The inception of this INSET was seen as an intervention to improve the quality of teaching Mathematics. The key targets of the in-service program were mastery of content, development and use of teaching-learning resources, attitudinal change of teachers and teaching methodology. Whereas the in-service training has been conducted to update teachers' on use of Activity, Student, Experiment, Improvisation/Plan, Do, See, Improve (ASEI/PDSI) approach of teaching, this has not been reflected in students Mathematics achievement as shown by Kenya Certificate of Secondary Education examination (KCSE) results particularly in Kisumu County. Moreover studies have not established teachers perception of the in service program with reference to objectives in the curriculum of SMASSE program. Low performance at KCSE indicates that the positive impact of SMASSE program has not been seen in students' performance despite teachers' undergoing SMASSE training, their experiences and qualification which studies have shown that do influence performance. More so students have missed admission to scientific and technological professions at the universities due to low performance in the subject.

Some of the questions asked are; what is the influence of teachers' qualification, experience and gender on quality teaching? Does teacher's perception of in service program influence quality of teaching mathematics? What is the quality of teaching mathematics by teachers?

Seemingly, a conclusion has not been reached on which teacher background particularly influences quality of teaching mathematics, and more so teachers perception of the in-service program has not been established in secondary schools. If these questions cannot be answered through a study then students' performance in mathematics may keep on deteriorating. This raised the researcher's interest to unearth the influence between teachers' qualification, teaching experience, gender and perception of in-service training program on quality of teaching mathematics in secondary schools in Kisumu County through a study.

1.3 Purpose of the Study

The purpose of the study was to establish influence of teachers' background and perception of SMASSE program on quality of teaching mathematics in public secondary schools in Kisumu County, Kenya.

1.4 Objectives of the Study

Objectives of the study were to:

i. Establish influence of teachers' qualification on quality of teaching mathematics.
ii. Establish influence of teachers' experience on quality of teaching mathematics.
iii. 3. Establish influence of teachers' gender on quality of teaching mathematics.
iv. Determine the combined influence of teachers' qualification, experience, and gender on quality of teaching mathematics.
v. Determine influence of teachers' perception of in-service program on quality of teaching mathematics.

1.5 Research Questions

The following research questions guided the study:

i. What is the influence of teachers' qualification on quality of teaching mathematics?

ii. What is the influence of teachers' experience on quality of teaching mathematics?

iii. What is the influence of teachers' gender on quality of teaching mathematics?

iv. What is the combined influence of teachers' qualification, experience and gender on quality of teaching mathematics?

v. What is the influence of teachers' perception on quality of teaching mathematics?

1.6 Assumptions of the Study

The study was based on the following assumptions:

i. That all respondents in the study gave honest and truthful responses to the instruments.

ii. The presence of the observer in the classroom did not interfere with the teacher's way of teaching during lesson observation time.

iii. All public secondary schools provide similar conditions for teaching and learning.

iv. That during the in-service training program, teachers were learning under a conducive environment.

1.7 Scope of the Study

The scope of the study included the following:

i. Trained mathematics teachers who are also SMASSE trained mathematics teachers who were viewed as appropriate to be included in the study so as to establish their perception of SMASSE in-service program.

ii. INSET trainers who facilitated the training therefore they were made to be part of the study.

iii. The SQASO who have been assigned the duty of checking on quality of curriculum implementation in schools by the teachers' employer, since they were to provide important information concerning teaching of mathematics in the sub county they represent.

1.8 Limitations of the Study

i. The study focused on public schools and not private schools.

ii. The study did not use students instead they were used by teachers during lesson observation.

iii. KCSE results issued by the County Director of Education office combined both public and private schools.

1.9 Significance of the Study

The findings of this study may influence policy and practice of the in-service program as follows:

i. The Ministry of Education may establish a policy framework that would guarantee the institutionalization of the in-service program so that all mathematics teachers could have equal opportunities for continuous professional development.

ii. The study may also inform the in service provider (CEMASTEA) on teachers' perception on the objectives of the four cycles of in-service program and what takes place in classrooms after attending the in-service program.

iii. The Ministry of Education in collaboration with CEMASTEA might set up teachers' resource centres which could serve as in-service training centres where teachers could meet and discuss problems, learn new ideas and methods of teaching and even prepare teaching and learning resources.

1.10 Theoretical Framework

This study was guided by the theory of Educational Production Function (EPF) model advanced by Bowles (1970). The theory was used by Wood *et al*. (1990) in the US state of Tennessee in the mid-1980s. According to Hanushek (1979), in EPF, the amount of output depends on the amount of inputs, given the constraints imposed by the underlying technical process. In the same vein, Pritchett and Filmer (1997) noted that EPF is a theoretical construct which gives mathematical expression to the production relationship that defines the maximum output to be produced from different combinations of given sets of inputs. In any firm, Production Function is expressed in a functional form as: $Q=f(X_1, X_2, X_3, \ldots, X_n)$, Where Q = the quantity of output and $X_1, X_2, X_3, \ldots, X_n$ are the quantities of factor inputs (such as capital, labour, land or raw materials).This model was used to measure the internal efficiency of an education system in Kenya in a study entitled: Effects of Teacher Characteristic on Teaching of Mathematics in public secondary schools in Kisumu District, Kenya (Achieng, 2006).

The internal efficiency of an education system depicts the relationship between inputs of education and its output. Inputs in education are indicators of educational quality and in this study they included teachers' background (professional qualification, teaching experience and gender) and teachers' perception of in-service program whose indicators were derived from objectives of SMASSE in-service program which produced four constructs; attitudinal change, pedagogy (ASEI-PDSI), implementation of ASEI-PDSI and assessment and evaluation of learners work. On the other hand output was viewed as quality of teaching mathematics whose indicators were preparation of schemes of work, ASEI-lesson plan and lesson presentation. Under lesson presentation, it involved lesson introduction, lesson

development; communication, use of ASEI-PDSI approach; use of resource materials; classroom organization and management; lesson conclusion.

The theory was adopted for this study because the researcher wanted to establish relationship between inputs and output. Applying Educational Production Function as expressed by Bowles (1970) to the present study, the equation was as follows:

$C = f(X_1, X_2,)$ where

C = Quality of teaching mathematics

f = function of

X_1= attitudinal change

X_2= Pedagogy

X_3=implementation of ASEI/PDSI

X_4=assessment and evaluation of learners work

According to Vaizey (1972), learning institutions like secondary schools can be equated to industrial firms which take a set of inputs and combine them in a way that produces a set of outputs. This may be in terms of performance by students or teachers who acquire skills and successfully graduate from school or college. In this study, the EPF theory has been translated to a conceptual framework to show the relationship between input variables hence output variable which is teachers' quality of teaching mathematics as was measured by their individual scores obtained through Lesson Observation Guide (see Appendix III).

1.11 Conceptual Framework

A conceptual frame was developed from Educational Production Function (EPF) theory by Bowles (1970) to show the relationship between teachers' background and teachers' perception of SMASSE in service program. Teachers background was considered as input variable while quality of teaching mathematics was considered as output variable. In the study teachers' background referred to professional qualification, teaching experience and teacher gender. Teachers' background and their perception of SMASSE in service program were (input) independent variables. The dependent variable (output) was quality of teaching mathematics. Teachers' perceptions of in-service program was measured using the Likert scale which was developed by the researcher using statements from objectives of the four Cycles of SMASSE program stated in the Curriculum which were to be achieved at the end of each cycle. The objective to be achieved in Cycle 1 was attitudinal change of teachers and students; Objective of Cycle 2 was Pedagogy (ASEI-PDSI); objective of Cycle 3 was implementation of ASEI-PDSI and objective of Cycle 4 was assessment and evaluation of learners work.

Educational Production Function (EPF) model by Bowles (1970) was used to develop the conceptual framework. According to EPF model, the internal efficiency of an education system depicts the relationship between inputs of education and its output. Inputs in education are indicators of educational quality and in this study they included teachers' background (professional qualification, teaching experience and gender) and perceptions of teachers on in-service program whose indicators were teachers' attitudinal change, pedagogy (ASEI/PDSI), implementation of ASEI/PDSI and assessment and evaluation of learners' work. On the other hand output was viewed as quality of teaching mathematics whose indicators were preparation of schemes of work and ASEI-lesson plan and lesson

presentation. On lesson presentation, teachers were to teach and it involved lesson introduction, lesson development; communication, use of ASEI-PDSI Approach; use of resource materials; classroom organization and management; lesson conclusion. It is believed that when a lesson is well conducted this would convert to students performance (output) in KCSE.

Teaching methods influence the level and quality of participation and performance in mathematics by learners. According to National Council of Teachers of Mathematics (NCTM, 2000), the teaching of mathematics relies on those methods best suited to promote the acquisition of skills which will improve performance in the subject. Teachers' have been found to present lessons that are too much teacher centered as students remain passive recipients. Mathematics lessons have been found to be difficult and boring. It is therefore strongly felt that students' involvement during lessons must be enhanced to increase motivation hence interesting lessons. For effective classroom practice SMASSE team came up with ASEI condition to upgrade teaching and learning. To achieve the ASEI condition, SMASSE came up with PDSI approach to teaching and learning. Through conducting this study by use of LOG the researcher was able to establish the use of ASEI-PDSI in public secondary classrooms in Kisumu County.

Intervening variables were school background which was separated into two; school administration and school category. In Kisumu County there are public and private schools whose administration differ and affect teachers' quality of teaching mathematics hence affect outcomes of learning. To address this intervening variable the researcher used public schools only. The other intervening variable was school categories which refer to national, extra-county, county and sub-county schools, where students are admitted depending on their

performance in Kenya Certificate of Primary Education (KCPE). These categories come as a result of variation in entry behaviors of learners at KCPE, funding of schools by the government and school culture. To address this intervening variable, the researcher used sub-county schools only since the entry behavior of learners has no influence on teachers teaching.

The dependent variable in this study was teachers' quality of teaching mathematics which was determined in relation to how teachers prepare schemes of work and lesson plan; lesson presentation which involved teacher introduction of the lesson, lesson development, communication skills used by a teacher, use of ASEI-PDSI approach, use of teaching and learning resource materials, classroom organization & management and finally how the teacher concluded the lesson. The variables were measured using a tool called Lesson Observation Guide (LOG) where teachers' quality of teaching was scored as percentage depending on the score range of each variable in the LOG. The tool was adopted from the assessment tool used by Maseno University lecturers to assess undergraduate students of education during teaching practice though some amendments was done to suit this study. The study therefore used a Conceptual framework to establish the kind of interaction taking place in mathematics classrooms and established the relationship between teachers' background and their perception of SMASSE in service program on quality of teaching mathematics in public secondary schools in Kisumu County as shown in Figure 1.1.

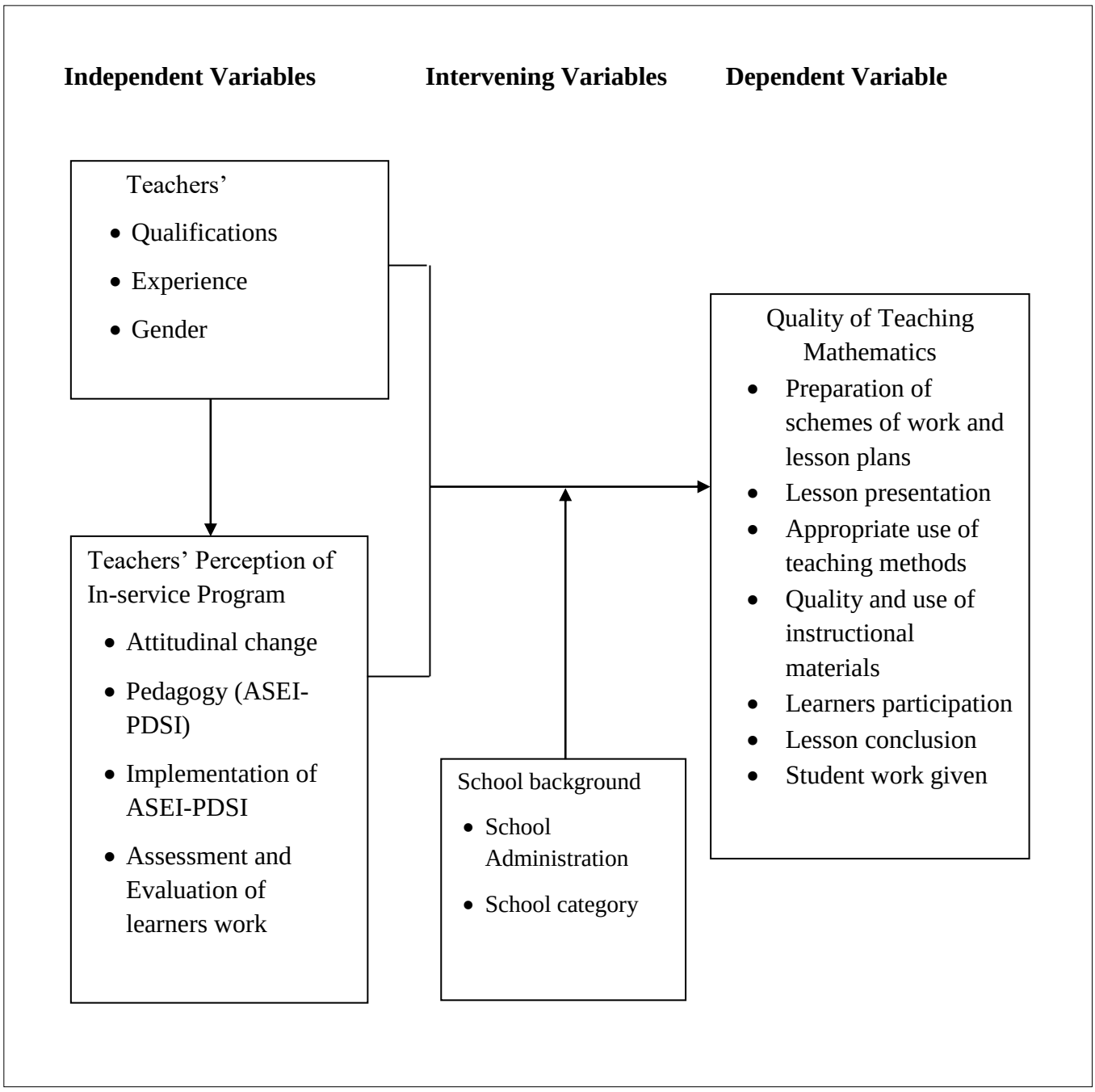

Figure 1.1: Conceptual Framework showing relationship between Teachers' background and perception of in-service program on one hand and quality of teaching mathematics on the other hand. Adapted from: Educational Production Function Model (Bowles, 1970)

1.12 Operational Definition of Terms

ASEI/PDSI Approach	Was used to refer to learner-centred pedagogy as demonstrated during in-service program.
Assessment and Evaluation of learners work	Was used to refer to teachers' perception of objectives of Cycle 4 of in-service program attended and as was measured on the Likert scale.
Attitudinal change	Was used to refer to teachers' perception of objectives of Cycle One of in-service program attended and as was measured on the Likert scale.
Implementation of ASEI/PDSI	Was used to refer to teachers perception of objectives of Cycle 3 of in service program attended and as was measured on the Likert scale.
In Service program	Was used to refer to Strengthening of Mathematics and Science in Secondary Education (SMASSE) program.
Lesson Observation Guide (LOG)	Was used to refer to a tool devised by the researcher to systematically measure quality of teaching mathematics in classrooms, which was adopted from the assessment tool from Maseno University used in assessing undergraduate students during teaching practice.
Lesson development	Was used to refer to logical presentation of content, relevance of content to class level, adequacy of content to lesson time, strategies and methods appropriate to content, use of teaching skills and mastery of content.
Lesson plan	Was used to refer to ASEI lesson Plan format as provided by the in service program.
Pedagogy (ASEI/PDSI)	Was used to refer to method of teaching mathematics using ASEI principles and PDSI approach which involves use of activities such as

	manipulative, intellectual, discussions and learning to be student- centred.
Quality of teaching mathematics	Was used to refer to scores attained by teachers on Lesson Observation Guide (LOG).
School background	Was used to refer to school administration and school category.
School administration	Was used to refer to administration done in either public or private schools.
School category	Was used to refer to school strata e.g. national, Extra County, county and sub county schools.
Teachers' background	Was used to refer to teachers' professional qualification, teaching experience and gender.
Teachers qualification	Was used to refer to teachers' professional qualification.
Teaching experience	Was used to refer to teachers' experience in teaching Mathematics. This was categorized as follows: below 3 years (novice); 3-5years (little experience); 6-10 years (medium experience); over 10 years (very experienced).
Gender	Was used to categorize teachers of mathematics as male or female.
Teachers' perception of in-service Program	Was used to refer to Mathematics teachers' opinion on in-service program guided by the objectives of the four cycles of SMASSE program.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter critically outlines the existing view points on the objectives of the study. The review is also borrowed from studies conducted on biology, physics and chemistry since the in-service was conducted for both mathematics and science teachers. It also borrowed information from elementary schools because it is the foundation of learning. Other subjects provided in education at different levels were used to provide literature. The literature is organized according to the objectives of the study.

In this study, teachers' background referred to teachers' professional qualification, teacher teaching experience and gender of the teacher. Specifically professional qualification was diploma, degree, masters or PhD in mathematics Education. Experience of teachers was categorized as (below 3years) novice, (3-5years) little experience, (6-10 years) medium experience and over 10 years experienced. Gender referred to either male or female teacher of mathematics. Again in this study, teachers' perception was used to refer to teachers' opinion on statements of objectives of the four cycles of SMASSE program which included attitudinal change, pedagogy (ASEI/PDSI), implementation (ASEI/PDSI) and assessment and evaluation of learners work.

2.2Influence of Teachers' Qualification on quality of teaching mathematics

A well-qualified teacher is one who was fully certified and holds the equivalent of a major in the field being taught (Darling-Hammond *et al*, 2001). The issue of teacher as a factor that affect students' performance has received a lot of attention of late and findings have been mixed and inconclusive. Related literature reveal that a number of teacher variables including

teacher qualification affect students learning outcomes (Abu & Fabunmi, 2005; Akinsolu, 2010; Akpo, 2012; Daso, 2013). Although the formal qualification of teachers is an important indicator for their knowledge and competence in teaching, it has limited utility in analyzing how well prepared teachers are for what they have to teach in classrooms. Availability of qualified teachers determines students' performance in schools (Akinsolu, 2010).Jaime (2008), examined whether years of teaching experience or academic qualification has an effect on overall achievement of students communication arts and mathematics. The study used descriptive statistics and factorial ANOVA. Results indicated that teacher degree level alone had no effect on students' achievement.

Maguswi (2011) conducted a research on factors contributing to under achievement in Zambian female students in O Level Physics examinations which found that lack of qualified teachers of Physics had a significant contribution. A related study was done in Nigeria by Adaramola and Obumanu (2011) who found that lack of qualified teachers' contributed to consistent poor performance of students in subjects like science, mathematics and technology. A study done by Akpo (2012) on impact of teacher related variables on students Junior Secondary Certificate (JSC) in mathematics results in Namibia used questionnaire, multi-correlation and regression analysis which found that teacher experience amongst others are related to students' academic achievement in JSC.

According to Adu and Olatundun (2007), teachers' background determines students' performance in secondary schools. Links between students' achievement and teachers' qualification has been established (Goldhaber & Brewer 2000; Mayer et.al. 2000). Data on post-secondary degree and certification status of teachers and their students' performance in mathematics and science was examined (Goldhaber & Brewer, 2000).The results showed a

positive relationship between degrees and students' performance in mathematics. Hanushek (2000) analysed results of 113 studies on the impact of teachers' qualification on students' academic achievement. Results showed that eighty five percent of the studies had no positive correlation between educational performance of the students and teachers' educational background. Although seven percent of the studies found a positive correlation, five percent found a negative impact. Umar et al. (2013) examined the effects of teachers' qualifications on performance in mathematics among secondary school students in Kaduna state. Purposive sampling was used to select 12 senior secondary schools from four inspectorate divisions in the state who participated in the study. In the second stage a random sample of 160 further mathematics students were finally selected across the four divisions. Two instruments were used; Teacher Self-Assessment Test with reliability index of .87 and a 30-item four option multiple choice further Mathematics Achievement Test was constructed by the researchers with Cronbach's alpha of .87 and a difficulty of item at ($.40 < p < .82$) were administered. Two research questions and one hypothesis was formulated to guide the study. The Analysis of Variance (ANOVA) revealed that significant difference existed between students' performance on account of their teachers' qualifications.

Oduh and Okanigbuan (2014) in their work emphasized the relationship between teachers' qualification and students' performance in mathematics, in Ikpoba-Okha L.G.A, Edo State. The study was a Correlation survey and was conducted using 25 private secondary schools randomly selected and a sample size of 50 mathematics teachers purposively selected from the area of study. The study was guided by four research questions and four null hypotheses. The instrument used for data collection was the Teachers' Qualification and Students' Mathematics Achievement Questionnaire (TQSMAQ) which was developed by the researchers. The instrument was validated and had a reliability coefficient of .983 using the

rho statistics. One of the findings of the study showed that the relationship between mathematics teachers' qualification and percentage of passes among students' in mathematics has a negative partial correlation of .245 which was less than the significance level .176. One of the study's conclusions was that the quality of mathematics teachers engaged by schools would either positively or negatively impact the performance of students in the subject. However, unlike in the research done by Oduh and Okanigbuan (2014) where the researchers used correlation design the present study will use both descriptive and correlation design; private schools were used as study population in the former study whereas the present study used public secondary schools; the tool used in collecting data in the former study was TQSMAQ questionnaire while the tools used in the present study was Mathematics Teachers Questionnaire (MTQ) with a Likert scale, and Lesson Observation Guide in order to enrich the research findings.

A study by Masau and Migosi (2015) looked into the extent to which teacher qualification influenced students' academic performance in Science, Mathematics and Technology (SMT) subjects. The study applied ex-post-facto survey research design while random sampling was used to select eight secondary schools in Kitui County. The sample size included 8 head teachers, 40 teachers of SMT subjects and 600 candidates who sat for the Kenya Certificate of Secondary Education (KCSE) in the year 2012. Data was collected using questionnaire and document analysis. It was analyzed using descriptive and inferential statistical tools. The study found that there was no significant difference in means between teacher qualification and students' performance in SMT subjects at form four level. The findings of the study further revealed that majority of the teachers of SMT subjects were trained graduates, most of them had attended in-service or refresher courses which resulted in slight improvement in the students' performance in SMT subjects.

Abe (2014) examined the effect of teachers' qualification on students' performance in mathematics whose results showed that a significant difference existed in the students taught by professional teachers and non-professional teachers. The researcher's suggestion was that teachers with certificate in education should be allowed to proceed with their education either through part time or study leaves likewise teachers without qualification should be advised to pursue their Post Graduate Diploma in Education. Some studies found that teachers' experience and educational qualifications significantly influenced students' academic achievement (Olaleye, 2011; Yara & Wanjohi, 2011; Asikhia, 2010; Ugbe & Ajim, 2009; Ankomah et al.,2005: Njeru & Orodho, 2003). So far studies done show that researchers have never reached a consensus on specific teacher background which influence students' academic achievement (Rivkin *et al*.,2005).

Dodeen *et al*. (2012) study focused on comparing mathematics teachers on qualification, practices and perception between Saudi and Taiwanese schools. Analysis of data in this study were responses of Mathematics teacher on the Teacher Background Questionnaire-8th Grade from Trends in International Mathematics and Science Study (TIMSS) in 2007. The Saudi sample consisted of 171 teachers while the Taiwanese sample consisted of 152 teachers. The comparison between the two countries revealed that some teachers' qualification and practices were related to students' scores. While Dodeen's study focused on two countries, the present study focused on a county within Kenya which has 47 counties in total, again the former study focused on a total of 323 teachers from the two countries, the current study used 70 mathematics in-service trained teachers who were teaching in sub- county secondary schools.

Heather *et al.* (2005) study was to establish whether and how teachers' mathematical knowledge for teaching contributes to gains in students' mathematical achievement. The researchers used linear mixed-model methodology in which first and third graders mathematical achievement gains over a year were designated to teachers, who in turn were assigned within schools. Findings found that teachers' mathematical knowledge was significantly related to students' achievement in both first grade and third grade after controlling for key student-and teacher-level covariates. While this study used grade one and grade three pupils in junior schools, the current study used both high school teachers and their students taking mathematics who were found in 7 sub-counties within Kisumu County and the methodology included descriptive and correlation designs. Further, ANOVA was used to analyze the significant differences in the level of quality of teaching mathematics among different levels of qualification and teaching experiences among teachers in public secondary schools.

Important factors that contributed to effective Mathematics teaching of upper secondary Mathematics teachers in Brunei came from the teachers themselves. The school administration impact teaching effectiveness to a minimal extent. In other words, effective Mathematics teaching must be accompanied by teachers' deep knowledge of the subject matter, their understanding of what optimizes students' learning, and their best instructional classroom practice. This finding also supports research by Stronge (2010), who has established that the quality of teachers is so extraordinarily important to the lives of students. Teachers do matter most when it comes to school improvement in terms of performance and student learning, and that, among multiple factors within schools, he assert that student success is influenced by teacher quality. Findings extracted from students in Stronge (2010)

study have also revealed that their teachers' teaching practice has a consistent positive effect on the affective domain of their mathematics learning.

The issue of teacher as a factor that affect students' performance has received a lot of attention and findings have been mixed and inconclusive. Some studies among others reveal that teacher qualification affect students learning outcome (Akpo, 2012; Daso, 2013). Some studies found that teachers qualification alone had no effect on students achievement (Jaime, 2008). Some studies found no significance difference in means between teacher qualification and students performance (Masau and Migosi, 2015).Some studies examined the effect between teachers qualification on students' performance in mathematics and results showed that significance difference existed between students taught by professional teachers and non-professional teachers (Abe, 2014). None of the studies reviewed looked at teachers' qualification in relation to their quality of teaching mathematics as they were observed in class. Given the above literature there was need to establish influence of teachers qualification on quality of teaching mathematics in secondary schools by observing them in class as they handled different topics .

2.3Influence of Teachers' Experience on quality of teaching mathematics

You (2009) describe experience as a long period of practice of over a period of ten or more years an individual who is skilled takes in developing an activity or mastering performance. Temitope and Olabanji (2015) in their study on influence of teachers' teaching experience on students' academic performance in mathematics and English language in public secondary schools in Ogun State, Nigeria revealed that teaching experience significantly influenced students' academic performance in the mentioned subjects as measured by their performance in the Senior Secondary Certificate Examination (SSCE). They established that schools

having more teachers with above 10 years teaching experience achieved better results than schools with many teachers having below 10 years' experience. A study by Rivkin *et al.* (2005) found that students taught by experienced teachers achieved better results than those taught by inexperienced teachers (below three years of teaching). Some studies found that years of teaching experience are a consistent predictor of higher test scores (Adeyemi, 2008). Others document a negative effect when a high proportion of inexperienced teachers are present in a school, it results to higher drop-out rates and lower achievement scores. While Temitope and Olobanji used results of SSCE to establish relationship between students' academic performance and teachers experience in the said subjects, they did not specify the categories of experience. Hence there was need for the current research to study influence of teachers experience using different categories but on quality of teaching mathematics as was observed using Lesson Observation Guide. .

Adeyemi (2008) examined teachers' teaching experience and students' learning outcomes in secondary schools in Ondo State Nigeria. The study used a correlational survey; the study population comprised all the 257 secondary schools that presented students for the Senior Secondary Certificate (SSC) examinations in the year 2003 in the State. A sample of 180 schools was drawn from the population using stratified random sampling technique. Instruments used in collecting data in the study were inventory and a semi-structured interview schedule. Data collected were analysed using the chi-square test, correlation analysis and t-test. The semi-structured interview was for selected principals and education officers whose responses were analyzed through content analysis. The findings revealed that teachers' teaching experience was significant with student' learning outcomes as measured by their performance in the SSC examinations. Schools that had teachers with five years and above teaching experience produced better results than schools that had more teachers with

less than five years teaching experience. The foregoing study did not observe teachers in class teaching mathematics which the current study did, while the former study instead used students' results from SSC examination and established teachers experiences through the principal's inventory. The results are in support of teacher experience as a factor which predicts students' performance in all subjects in secondary schools.

Darling-Hammond (2000) conducted a study which revealed that teaching experience is related to students achievement but he asserts that relationship may not be linear; students taught by teachers with less than five years of experience had lower levels of mathematics achievement but there was no significant difference in mathematics achievement among students whose teachers had more than five years' experience. According to Darling-Hammond (2000) the curvilinear effect could be as a result of experienced teachers whom do not continue to grow academically and learn and may get tired of their jobs. Contrary to the above findings, studies conducted by Martin *et al.* (2000) and Wenglinsky (2002) found that the number of years in teaching is not associated with students' achievement. These contrary findings could be due to the presence of very well prepared beginning teachers who were highly effective. Yara and Surumo (2012); Ayodele, (2012) in their studies found that a number of teacher variables including teacher years of experience , teacher academic qualification, teacher students ratio, and teacher development programmes had no significant influence on students' academic performance.

Yara and Wanjohi (2011) studied performance determinants of KCSE in mathematics in secondary schools in Nyamaiyo Division, Kenya. The research design used was descriptive, target population included Head teachers, mathematics teachers and all students from 13 public schools in Nyamaiyo Division. Purposive sampling was used to select 13 schools

which were categorized into day, boarding, single sex and co-educational schools. Intact classes were selected. Simple random technique was used to select 12 teachers and 151 students. Research instruments used were Mathematics Achievement Test, Students Questionnaires, Teacher Questionnaire and Head Teacher Questionnaire which were all designed by the researcher. Each of the instruments had two parts. Data analysis used was multiple regression, findings showed that teacher's experience is significant and can be used to predict students' performance in mathematics. The current study used proportionate sampling to select teachers from sub-county schools found within 7 sub-counties of Kisumu County, while the above study used purposive sampling. The current study used INSET Trained mathematics teachers who were drawn from category of sub-county schools to establish influence of experience on quality teaching. Findings from the study on experience were in agreement with the one for Yara and Wanjohi (2011).

Ogbonnaya (2007) studied the influence of teachers' background, professional development and teaching practices on students' achievement in mathematics in Lesotho. A self-report opinion scale instrument was used to collect data. Simple random sampling technique was used to select 40 teachers-18male and 22 female. Inferential statistics involved correlation and regression analysis at 0.01 and 0.05 at significant levels respectively were applied for data analysis. Findings indicated a significant positive relationship between students' academic achievement in mathematics and teachers background (teachers' qualification, subject major and years of experience from 6 years teaching). The findings suggested that if all mathematics teachers could have a degree, are specialized in mathematics or mathematics education and have five years teaching experience the students' achievement in mathematics is likely to improve. Musili (2015) investigated influence of teacher related factors on students' performance at KCSE in public secondary schools in Kibwezi Sub County whose

findings established that among teachers' variables investigated; professional experience had a great influence on students' performance. These teachers found their work to be more enjoyable, meaningful and therefore performed their teaching effectively. From the above literature search some studies are in support of teacher experience as influencing performance in mathematics at KCSE while others are against. None of the studies have looked at experience in terms of quality of teaching mathematics hence the need for the present study.

Quality of teaching does not relate solely on students achievement, to teaching approaches or to beliefs held about mathematics and its teaching and learning, but all of these. Quality teaching is undoubtedly the most important objective in school mathematics education (Seah, 2007).Quality teaching comes about with effective teaching. Some teachers are more effective than others in teaching and these differences have lasting effects on student learning (Rivkin *et al* .2005). At the heart of quality education there is quality teaching (Tarr *et al*. 2006). In the USA, the National Council for Teachers of Mathematics (2000) identified that the experiences teachers provide play a major role in determining the extent and quality of students learning. This has been supported by Stanford (2001). Quality teaching can be promoted as a result of factors like conditions in the school where the students are located; teachers' experiences and professional developments; the knowledge, beliefs and understanding of teachers; and what teachers do in their classroom (Ismail et al. 2015). Quality of trainers is crucial to quality teaching of mathematics by teachers, just as the quality of teachers is crucial to student learning (Knowles *et al.*2005). Significant differences exist between quality of teaching mathematics by teachers. A research conducted by Sullivan and McDonald (2002) found evidence that children from the same background had different experiences at school due to quality of teaching. In Finland, high levels of quality education and competence is based on its quality in teacher education. The government supports both

pre-service and in-service of teachers. This strengthens the quality of teaching and enhance student learning (Nyawira, 2015).

There is no standardized measure for quality of teaching a subject. Some studies look at it in terms of students' achievement in subject areas, others in terms of teaching approaches, while others view it in terms of effective teaching. In the current research, the researcher determined quality of teaching mathematics by using a lesson observation guide to rate their teaching following the constructs indicated in the lesson observation schedule.

Due to changes in curriculum, having qualified teachers in a school does not matter, but what matters is quality teachers who will deliver. The quality of teaching and learning need to be reflected in the quality of grades attained by the students at the end of the secondary course. In an increasingly competitive society the minimum entrance requirements into various institutions of higher learning has gone up. Attaining high grades at secondary level is therefore imperative. With new trends in education teachers have to keep abreast by implementing the changes in teaching whose training will be beneficial to students. The in-service providers in turn must provide quality INSET whose training will be beneficial to students (Ndirangu, 2006).

Pre-service training is not adequate to last teachers for their entire career. This is why teachers attend in-service courses to help them advance in knowledge; technology and curriculum hence update them on teaching methodologies. In the current study, the researcher established teachers' perception of SMASSE in service program by giving teachers a chance to give their views about the program by filling a Likert scale which was made using statements provided from objectives of the in-service program. The teachers perception of

the in service program informed the study on whether the teachers practice what they were trained on unlike in the study of Ndirangu who did not state whether the opinion of teachers was sought to find out the quality of INSET program teachers attended.

2.4 Influence of Teacher Gender on quality of teaching mathematics

Performances in mathematics test by women depend on whether they believe that mathematics-related gender differences are determined by genetic or social differences. Other theories, of special interest in this area, suggest that much depends on the gender of the teacher (Dee, 2006).A study conducted by Escardibut and Calepo (2013) on teacher gender and student performance in mathematics in primary schools in Catolina in Spain, using a Heckman two-step procedure, established that teacher gender affects students' results and are positively correlated with having a female teacher. The interaction term was not statistically significant hence teacher gender effect is the same for both male and female students. In the current study, interaction analysis showed that teacher qualification is important amongst female teachers with a Master's degree whom on average will have a higher quality of teaching than a female teacher with B.Ed. / PGDE and Diploma as was shown in Figure 4.6.

Society's fundamental interest in fairness and equal opportunity continues to bring about contentious debate over the root causes of gender differences in education outcomes. Researchers first began investigating gender differences in abilities and behaviour in 1880s. George Romans in 1887 declared that abilities were secondary sex characteristic attributed to brain size. Performances in mathematics test by women depend on whether they believe that mathematics-related gender differences are determined by genetic or social differences. According to University of British Colombia researchers (Dar-Nimrod & Heine, 2006) in a paper they published, explored on how women's mathematics performance is affected by

stereotypes that link female underachievement to either genetic or experiential causes. Their research suggests that women tend to perceive gender differences in mathematics to be innate or genetic, but when women consider such differences to be based on theories of nurture rather than nature they can improve their performance.

Other theories, of special interest in this area, suggest that much depends on the gender of the teacher (Dee, 2006). One of the theories asserts that the teacher's gender shapes communications between teacher and pupil, while another says the teacher acts as a gender-specific role model, in spite of what he or she says or does. According to this second theory, students are fully involved, behave more appropriately, and perform at a higher level when taught by same gender. Data used to test these theories have relied particularly on information about students in college, graduate school and teachers. These findings have resulted to mixed reactions which remain unresolved. The current study used data collected from secondary school teachers to establish teacher gender on quality of teaching mathematics.

Zogheib, Zogheib and Saheli (2015) found students gender as the most significant predictor of students' performance and the study also found significant correlation between instructor's gender and students' performance in the study of university students' achievement in mathematics. The sample in this study, consisted of 557 university students enrolled in a first year mathematics class (calculus I) at a Middle Eastern private university. The students were enrolled in the fall semester of 2013. Twenty three different classes were offered and taught by male and female instructors. The study established that teacher's gender does influence students' academic achievement. The current study was to establish if there is a statistically

significant difference in quality of teaching mathematics between male and female teachers using an independent sample t-test.

Dee (2010) in his study found that learning from a teacher of opposite gender had a detrimental effect on student academic progress and their engagement in schools. Sparks (2013) study found that female elementary school mathematics teachers gave boost to female pupils. However male pupil's performance was not affected by mathematics teacher gender. The difference in performance of students therefore is children's gender biases. In this respect Antecol (2011), in a study titled "Elementary school teachers have an impact on girls mathematics learning," found that children express the stereotype that mathematics is for boys not for girls as early as second grade and added that according to the study done by University of Washington researchers it was found that children applied the stereotype to themselves, boys identified themselves with mathematics whereas girls did not. This explains why so few women pursue science, mathematics and engineering careers. The missing knowledge gap is the influence of teacher gender on quality of teaching mathematics in public secondary schools in Kisumu County, in view of, Dee (2010), Sparks (2013) and Antecol (2011) findings in the United States.

Another study by Antecol, Eren and Ozbeklik (2012) in a study titled "The effect of Teacher Gender on students Achievement in primary schools" found that female students who were assigned to a female teacher without a strong mathematics background suffered from lower mathematics test scores at the end of the academic year. This negative effect however not only seems to disappear but it becomes positive for female students who were assigned to a female teacher with a strong mathematics background. Finally, they did not find any effect of having a female teacher on male students' test scores (mathematics or reading) or female

students' reading test scores. The former study looked at effect of teacher gender on students achievement in primary schools while the current study established the influence of teacher gender on quality of teaching mathematics in secondary schools which may result to students' achievement in the subject.

2.5 Combined Influence of teachers' qualification, experience and gender on quality of teaching mathematics

In Nigeria a study conducted by Adeogun (2001) established that the quality of any education system depends on the quality of teachers. Related literature shows the most important school based determining factor of students' performance as teacher quality (Harris & Sass, 2008; Aaronson *et al.,* 2007; and Rivkin *et al.*2005). Other scholars did similar studies on teachers' professional qualification and teaching experience and found that they were not significantly related to students' academic achievement (Musau *et al.* 2013; Kimani *et al.* 2013; Mbugua *et al.* 2012; Zamaro et al. 2009 & Rivkin *et al.*2005). On the same vein, Wenglinksy (2000) and Greenburg, *et al. (*2004) established that postgraduate qualifications at Masters or higher level were not significantly related to students' achievement. In the former studies cited above, teachers qualification was not categorized to establish which category influenced students achievement and this is what the current study endeavoured to address.

A study conducted by (Betts *et al.,* 2003) found teachers' years of experience positively correlate with students' achievement. According to Madsen and Cassidy (2005) research findings show that experienced teachers are more critical in their classroom teaching than teachers' who have just left college. The experienced teachers' gives learners materials which are interesting and meaningful. Furthermore their explanations and activities in class are straight forward and clear. Some studies done revealed that teachers' years of experience

positively correlate with teachers' performance in class hence students' achievement (Betts *et al.*2003).

A study conducted by Ottoboni, Boring and Stark (2016), revealed that students perceive courses taught by female teachers differently than courses taught by male teachers. The difference is female teachers are perceived to have a more positive attitude towards change but male teachers were perceived to be more knowledgeable in the field of science. Due to gender bias, male students have a traditional attitude towards female teachers and they hold them to a greater criterion that they do to males. Student performance may be affected by teacher gender when a demographically similar teacher is able to raise a student's academic motivation and expectations (Dee, 2006). Mathematics is a science subject and some gender-based science researchers have reported that both the 'feminists empiricists' and the Liberal feminists critic' seem to agree is that female in principles will produce exactly the same scientific knowledge as males provided that sufficient rigour is under taken in scientific inquiry (Howes, 2002; Sinnes, 2005). They also believe that initiatives that build on the assumption that females and males are equal in their approach to Science, and that inequality in Science and Science education is caused by political, educational and social factors external to Science, would be expected to focus on removing these external obstacles. There is need therefore to give girls and boys equitable opportunities and challenges.

It is no longer a matter of having qualified teachers in the school but quality teachers who will deliver. The quality of teaching and learning must be reflected in the quality of grades attained by the students at the end of the secondary education. In an increasingly competitive society the minimum entrance requirements into various institutions of higher learning has gone up. Attaining high grades at secondary level is therefore imperative. With new trends in education teachers have to keep abreast by implementing the changes in

teaching whose training will be beneficial to students. The In-service providers in turn must provide quality INSET whose training will be beneficial to students (Ndirangu, 2006).

As a contribution to the existing literature, the study looked at SMASSE in service program for teachers of mathematics and science in secondary schools in Kenya, whose inception was seen as an intervention to improve the quality and teaching of mathematics. From the current study, teachers who attended the in service had various qualification, teaching experience and were of different gender. This study established their perception of the in service as positive. As Ndirangu asserts that in service providers must provide quality INSET whose training will be beneficial to students. Equally, combined influence of teachers' qualification, experience and gender was also established in the current study.

2.6 Influence of Teachers' perception of in-service program on quality of teaching mathematics

In Service Education and Training (INSET) program includes all those activities which are designed for professional development and skill building of school teachers (Akhter et. al.2011). INSET is essential for professional improvement of teachers and it keeps teachers abreast of latest information. According to (Cimer *et al.* 2010), INSET programs play a crucial role in introduction and facilitation of changes and innovation to teachers. Since teachers are the students in in-service training, principles of adult education are relevant. Beliefs help shape how teachers perceive quality teaching of mathematics. Providers of professional development, be they local or from other countries need to be cognizant of such perceptions. A study done by Fajet *et al.* (2005) about teachers' perception of good teaching shows that they fall into two categories, professional competence and affective qualities. Under professional competence they identified sufficient content knowledge, ability to communicate knowledge clearly and others. Some of the affective qualities of good teachers

include patients, kindness, caring and enthusiastic. A similar study on perception of 30 mathematics teachers on the use of concrete materials in constructing mathematical meaning was conducted by Mutodi and Ngirande (2014).The study established that teachers (96.7%) believed that the use of concrete materials bridged the gap that separated how mathematics is taught and how mathematics is learned. The current study established teachers' perception of in-service program on implementation of ASEI/PDSI approach which involves use of resources for effective teaching and learning.

Ngesa (2013) examined factors influencing teachers' perceptions on effectiveness of SMASSE project on the teaching of mathematics in secondary schools in Westlands District, the study revealed that most teachers had a negative attitude towards SMASSE program which could be traced to the environment under which it was done and the benefits they receive from the project. A significant percentage of the teachers (33.3%) felt that SMASSE was not useful despite the fact that over 60% of the respondents indicated that SMASSE had affected their teaching since it enhanced their professional development. Furthermore, 80% of the respondents agreed that the themes and topics taught during SMASSE in-service program were relevant. However, over 50% of the HOD and 32% of the teachers indicated that the trainers did not communicate their content clearly. While Ngesa (2013) looked at factors influencing teachers' perceptions on effectiveness of SMASSE in service program which included the condition under which the study was conducted, the current study looked at teachers' perception of in service program in relation to objectives of the four cycles of SMASSE program. The researcher did this to establish influence of teachers' perception of in service program on quality of teaching mathematics in secondary schools by doing a correlation analysis.

Similarly, Massari (2012) investigated Kindergarten teachers' perceptions on in service training and impact on classroom practices which used a qualitative instrument with a structured questionnaire which was applied on 84 Kindergarten teachers. Qualitative analysis was used to collect data regarding the perception of teachers on professional development of teachers from Kindergarten which were structured on five issues categories of activities considered to be necessary for training programs: factors that influence the classroom practice; the level of teacher training program focused on specific aspects of educational practice and aspects that might influence the teachers' educational practice among others. Findings show that there is a significant difference between newly qualified teachers perception and those with more than 10 years' experience in the sense that the former focuses more on the visibility and status to the profession, while the latter category focuses its approach on professionalization. Whereas the above study used Kindergarten teachers' as the respondents the present study used secondary mathematics teachers, the current study used statements on teachers perception which were derived from the objectives of in-service program which they had attended, and both qualitative and quantitative methods were used to provide information on influence of teachers perceptions of in-service program on quality of teaching mathematics. The former study fell short of observing teachers in class to determine the impact of the in-service program on implementation of the activities learnt during the in-service program.

Wamalwa (2017) conducted a study that aimed at finding out factors that influence teachers' perception towards the implementation of Strengthening of Mathematics and Science in Secondary Education in Bungoma County, Kenya. A sample of 83 schools, 438 teachers of science and mathematics, and 3 SQASO were selected. Questionnaires, observation schedule and interview schedule were developed by the researcher after which were used in

collecting data while descriptive -statistics and percentages were used in the analysis of data. It was revealed that teachers would attend the INSET if motivated and hence result to implementation of SMASSE approaches. Based on the findings and conclusion, the study recommended that the national SMASSE office and the MoEST should consider the views of teachers on motivation when planning for INSET program to enhance effective implementation of ASEI-PDSI innovation. The current study was to establish the implementation of ASEI principles and PDSI approach through lesson observation of teachers in the classrooms.

Adult education tends to work best with clear applications rather than a theoretical focus (Cardemi, 2001; Knowles *et al.* 2005). Quality of trainers is crucial to teacher learning, just as the quality of teachers is crucial to student learning (Knowles *et al.* 2005). This calls into question the standard cascade model of training in low-income environments, in which both information and pedagogical ability may be diluted as a chief trainer trains a trainer, and so forth. From the training teachers should learn how to carry out formative evaluation so that they can effectively evaluate their own progress towards their teaching goals.

Due to new demands in teaching profession and changes in the society, it is the responsibility of INSET to provide efficient and effective in-service training that enables teachers to meet new demands (Gabrscek & Roeders, 2013). At the end of an INSET course teachers are expected to fully obtain and acquire intended knowledge , skills and attitude; apply them to practice; through their application this influences students learning and teachers achievement in those schools hence bringing required changes. However, an assessment of centrally designed in-service education programs in terms of outcomes shows that few perform satisfactorily (Mwangi & Mugambi, 2013). Improvements to such generic programs will

come from understanding the interaction between in-service education processes and school level factors. The question is how do teachers perceive INSET programs?

Ramatlapana (2009) investigated the perceptions of mathematics and science teachers in Botswana towards INSET provision by the department of Mathematics and Science In-service Education and Training Unit (DMSE- INSET). Data was collected from a sample of 42 senior Mathematics and Science teachers using structured interview with open- ended questions which were analyzed qualitatively. The findings show that teachers concerns included lack of impact of current in-service training program on the education system, no follow up activities to support the one-off workshop and they complained they encountered difficulty in implementation due to lack of time and scheduling constraints. As for implementation of content, teachers were not supported at that stage hence it posed a challenge being one of the dimensions of profession. They considered time spent at DMSE-INSET workshop as too short since a lot of material was covered and different topics were condensed into one workshop. The study also fell short of observing teachers in class to determine the impact of the in-service program on implementation of the activities learnt.

An investigation of Kindergarten teachers' perceptions of in-service training and impact on classroom practices (Massari, 2012) used a qualitative instrument with structured questionnaire and was applied on 84 Kindergarten teachers. Qualitative analysis was used to collect data regarding the perception on professional development of teachers from Kindergarten which were structured on five issues categories of activities considered to be necessary for training programs which were factors that influence the classroom practice; the level of teacher training program focused on specific aspects of educational practice and aspects that might influence the teachers' educational practice among others. Findings show

that there is a significant difference on teachers' perception between beginners and newly qualified teachers and those with over 10 years' experience in the sense that the former teachers' focus more on the visibility and status to the profession, while the latter category focuses its approach on professionalization. The above study used Kindergarten teachers' as the respondents, the present study used secondary mathematics teachers and a five-point Likert scale was used to provide quantitative data while structured questions was used to provide qualitative data which provided information on influence of teachers' perception of INSET program on quality of teaching mathematics.

Birjandi and Derakhan (2010) conducted a study in which they sought to explore the difference in perceptions between Iranian instructors and teachers regarding INSET in English as a Foreign Language on the present and ideal status of in-service programs. Their findings indicated that instructors and teachers had different views about these in-service programs. Though most teachers were satisfied with these programs, they were not motivated enough to attend to these programs. Most instructors were in favor of improvements in the educational plans and programs since they were not satisfied with the in-service programs. Teachers needed to be motivated to participate in these programs and the instructors were to address the needs of the teachers attending these programs. Motivation can influence teachers' perception of INSET and this can make teachers to attend the INSET without being coerced.

Matseliso and Loyiso (2010) conducted a study on South Africa's teachers' perspective on continuing professional development under a case study of the Mpumalanya secondary science initiative which revealed that many teachers expressed dissatisfaction with the professional development opportunities they get in schools and they insisted that most

effective development programs they have experienced were self-initiated. They further said many teachers' continuing professional development programs have yet to be implemented on the basis of understanding professional development from the perspective of participating teachers. While the former study looked at science teachers' perspective on continued professional development under a case study of a school in South Africa, the present study was to establish teachers' perception of in-service program by sampling 70 teachers found in the 165 sub-county secondary schools within Kisumu County. Further, the study by Matesliso and Loyiso did not determine the extent to which teachers' perception influence quality of teaching science which the present study was to confirm.

Rono (2018) conducted a study on perceptions to techniques of improving Mathematics and Science subjects under a case study of SMASSE Project on teaching and learning of Chemistry in secondary schools in Bomet District in Kenya. Descriptive survey was used with a sample of 50 respondents who used questionnaires to provide data. The respondents who were head teachers and chemistry teachers from public schools were selected using simple random sampling technique. Schools were stratified into boys, girls and mixed secondary schools thereafter a purposive random sampling was done in each subgroup. Findings showed a positive attitude towards chemistry though there was no significant output in KCSE as at the time of research.

In-service teacher training in school is likely to be most effective so that difficult problems faced in the local environment can be raised, and teachers can receive feedback on actual teaching. However, this will depend on the environment. In very difficult teaching environments, some degree of training outside the school may facilitate focus on the part of the trainees (Kraft & Papay, 2014). So far, the literature provided here has given information

by different researchers on findings about how INSET should be conducted and teachers' perception of INSET, but they have not given teachers perception of in-service program in relation to objectives of the INSET hence the need for the current study.

Quality of trainers is crucial to quality teaching of mathematics by teachers, just as the quality of teachers is crucial to student learning (Knowles *et al.*2005). Significant differences exist between quality of teaching mathematics by teachers. A research conducted by Sullivan and McDonald (2002) found evidence that children from the same background had different experiences at school due to quality of teaching. In Finland, high levels of quality education and competence is based on its quality in teacher education. The government supports both pre-service and in-service of teachers. This strengthens the quality of teaching and enhance student learning (Nyawira, 2015).

Mwangi and Atina (2016), conducted a study on effectiveness of SMASSE teacher training program on KCSE performance in mathematics and chemistry subjects which used sixteen schools selected by stratified random sampling method and gathered data using both qualitative and quantitative data. The study revealed that the program has not shown impact on performance of the two subjects. It has been noted by (Borg, 2006) that an effective INSET program has an influence on quality teaching. Ambasa *et al.* (2019), conducted a study on effect of ASEI/PDSI approach in teaching of science in primary schools science which revealed that teachers were not using ASEI/PDSI approach in teaching science in primary schools.

In Malawi, the government has an Integrated In-service Teacher Education Programme which has been designed to improve the quality of teaching and learning at all levels of the education system. Similarly SMASE/WECSA has been embraced to improve the quality of

teacher content mastery and pedagogical skills in mathematics and science education. Teacher Development and Management Strategy (TDMS, 2013), are in-service programmes that aims to address quality pedagogy and professional development to teachers.

Ndirangu *et al.* (2017) studied the level of implementation of ASEI/PDSI classroom practices in science subjects: A case of SMASSE project. In this study survey design was used on a sample of 68 head teachers, 147 science teachers and 16 trainers. Instruments for data collection were questionnaires, interviews and lesson observation schedules. The study established that majority teachers (75%) were partially implementers and only 5% were full implementers. The study concluded by saying that the level of implementation of ASEI/PDSI classroom practices was ineffective due to the heavy load teachers have. This means that quality of teaching mathematics is being compromised by teachers' heavy loads. While this study looked at SMASSE as a unit of study, the current study used both descriptive survey and correlational designs and the study area was one county that is Kisumu, out of the 47 counties in Kenya.

A study by Inyega and Inyega (2017) assessed the extent to which teachers' attitude towards chemistry teaching changed following a needs-and participatory-oriented in-service teacher education program in Kenya. The study used 36 randomly selected long experienced teachers from 36 schools who attended a ten-day in-service program in Kenya. Data was collected using validated questionnaire before the beginning of workshop session and at the end of the training session. Quantitative data was analyzed using descriptive statistics which involved arithmetic means, standard deviations, comparison of means was done using two-sample t-procedures, and effect size based on Cohen's guidelines. Findings showed that teachers appeared to have a positive change in attitude towards teaching objectives; teaching

strategies; lesson planning; ability to overcome teaching limitations; conducting practical work; and overall teaching of chemistry following in-service program focusing on teaching enhancement. In the study by Inyega and Inyega, teachers' experiences were not categorized and this was likely to impact on the findings, it was necessary for a separate study to be done using different categories of experience and this is what the current study endeavoured to address.

A study by Ameka and Nyakwara (2020) investigated the influence of SMASE training on performance of students in biology in public secondary schools in Nyamachae sub county, Kenya. Population sample included school principals and biology teachers. The study established that enhanced teaching and evaluation skills positively and significantly influence performance in Biology. It revealed that challenges faced by schools principals in managing the implementation of SMASE acquired skills in schools negatively and significantly influence the performance of biology and also found that the performance of biology after implementation of SMASE program has significantly improved compared to performance before implementation of SMASE program. In the former study teachers and school principals were used, while in the current study teachers, INSET trainers and SQASO were used to provide data. According to Ameka and Nyakwara, performance of biology has improved after implementation of SMASE program while in the current study, it was established that implementation of ASEI / PDSI during lesson observation was not well done as shown in Appendix VII on page 187

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the methodology of how the study was conducted by discussing the research design, area of study, population size, sample and sampling techniques, the instruments that were used to collect data, how validity and reliability of research instruments was determined, data collection procedures, ethical consideration and finally procedure of analyzing data.

3.2 Research Design

Both qualitative and quantitative research methods were used. Cohen and Manion (2006) state that a combination of methods compensates for inadequacies that an individual method might have. Krathwohl (2003) recommends the foregoing approach since it gives room for providing answers to a number of research questions thereby providing a more holistic picture on influence of mathematics teachers' background and perception of SMASSE in-service program on quality of teaching mathematics.

The designs used were descriptive survey design of a cross-sectional type of research and correlation design. Descriptive survey is a method of collecting information by interviewing or administering questionnaires to a sample of individuals (Orodho, 2003).This design was employed because it guarantees breathe of observation and also provides for accurate descriptive analysis of characteristics of a sample which can be used to make inferences about population (Fraenkel *et al,* 2012). This design can be used when collecting information about people's attitudes, opinion, habits or any of the variety of education or social issues (Orodho & Kombo, 2002).

Correlation design was also used in this study, which is one kind of the *ex post facto* research design. Kothari (2004) and Kerlinger (2000) describe an *ex post facto* as a research where the researcher has no control over the variables and can only report what has already happened or observe what is happening. Correlation design method also permits analyzing relationship among a large number of variables in a single study. It provides information concerning the degree of relationship between the variables being studied (Borg *et al*, 2007).This design was appropriate for this study since all the Mathematics teachers under study had already undergone the in service program and the researcher did not have the opportunity to manipulate the training conditions or activities. Correlation design was again appropriate for this study because it showed relationship between teachers' background and quality of teaching mathematics and also relationship between teachers' perception of SMASSE in service program and quality of teaching mathematics in public secondary schools in Kisumu County, Kenya.

3.3 Area of Study

Kisumu County is one of the new devolved administrative units of Kenya. Its headquarters is Kisumu city. It has 7 sub-counties namely: Kisumu Central, Kisumu East, Kisumu West, Seme, Nyando, Muhoroni and Nyakach with 7 sub-county directors of education respectively. It has a population of 1,155,574 (according to the 2019 National Census). The land area of Kisumu totals to 2085.9 Km^2. Kisumu County's neighbours are Siaya County to the West, Vihiga County to the North, Nandi County to the North East, and Kericho County to the East. Its neighbour to the South is Nyamira County and Homabay County to the South West. It lies within longitudes $34^o\ 20^{'}$ E and $35^o\ 20^{'}$ E and latitudes $0^o\ 20^{'}$ S and $0^o\ 50^{'}$ S. The County has a shoreline on Lake Victoria, which is the second largest fresh water lake in the world, occupying northern, western and a part of the southern shores of Winam Gulf. The

other outstanding physical features in the county are the overhanging huge granite rocks at Kisian, the geographical famous rice-growing Kano Plains, the famous sugar belt of Nyando and Muhoroni sub counties and the lake Islands of Ndere National Park and Kit Mikayi in Seme sub county which are tourist attractions.

SMASSE INSET program which provides in service course to Mathematics and Science teachers in the country has been implemented in the County and there are 4 training centres with 25 trainers and each centre has 6 trainers, and 1 trainer of trainers for the county.

The study area was selected purposely because performance in mathematics at KCSE is low in the county as compared with other counties within Nyanza region. Secondly the study area was selected because most of mathematics teachers in the county have attended the in-service program and therefore are in a position of giving information on influence of in-service program on quality of teaching mathematics in public secondary schools in Kisumu County.

3.4 Target Population

The study targeted Mathematics teachers who have attended SMASSE in-service program and are teaching in the 165 sub-county schools, INSET trainers and Sub-County QASO. The study population comprised of 234 teachers(County QASO Kisumu, 2017) who had attended SMASSE in service program and therefore were in a position to give their perception of in-service program attended and also their quality of teaching could be rated given that they had attended the in service program hence their teaching methodology has been updated. The study also used 25 INSET trainers and 7 sub-county QASO found within the 7 sub counties of Kisumu County. The population size was determined based on criterion reference selection. The criteria for participation was those who were involved in the training and implementation of in-service program in classrooms. The study used intact classes taught by

the various teachers. Teachers from sub county schools were used in the study to help control for influence of school categories whose students' performances are usually low at entry level during admission to Form 1.

3.5 Sample Size and Sampling Techniques

The general rule in the determination of a sample size is to use the largest sample possible (Kathuri & Pals, 1993; Mugenda & Mugenda, 2003). Kerlinger (1964) explains that a smaller sample size results into larger error than a larger sample. According to Gay (1976), the minimum size for descriptive survey research is 10% of the accessible population and for correlational design is 30%. Borg *et al*. (2007) cites a minimum of 30 subjects in correlational research. Green (1991) recommends the following formula: $N \geq 50 + 8(k)$, where k is the number of independent variables, for a sample size for multiple regression analysis. Therefore in Green's case the present study's sample size would be 66.To make the findings to be representative of the population, the researcher worked out the sample size using 30% of the target population. Therefore this study used 30% of the target population (234) of in service trained teachers which produced a sample of 70 in service trained teachers who used students whom they teach regularly in various classes and are found in sub county public secondary schools.

Piloting of Mathematics Teachers Questionnaire (MTQ) and Lesson Observation Guide (LOG) was done using 16 teachers not part of the sample size, representing 10% of the remaining target population. A saturated sample was used to select 22 INSET trainers and 6 SQASO. Saturated sampling is a method where the whole population is used as a sample (Koul, 2004). According to Mugenda and Mugenda (2003), where a population size is small it makes sense to use the entire population because it is manageable. The remaining 3 INSET

trainers and 1 SQASO representing 22% and 14% respectively were used in piloting in the 7 sub counties of Kisumu County. Table 3.1 provides the sample frame.

Table 3.1 Study Population and Sample Size

Respondents	**Study Population(N)**	**Sample (n)**	**Percentage (%)**
In service Trained teachers	234	70	30.0
INSET Trainers	25	22	88.0
SQASO	7	6	86.0

Proportionate simple random sampling technique was used to select a sample of 70 in service trained teachers from the population of sub county schools who are located within the 7 sub counties of Kisumu County. This was worked out by taking number of schools in a sub-county over the total number of sub county schools in Kisumu County then multiplied by the sampled teachers who were 70 in this case.

Table 3.2 provides proportionate samples of INSET Trained Teachers who were observed per sub-county.

Table 3.2: Proportionate sample of SMASSE Trained Teachers observed per sub-county

Sub counties	No of schools	No of SMASSE Trained teachers	Percentage (%)
Kisumu East	18	8	11.42
Kisumu West	22	9	12.86
Kisumu Central	10	4	5.71
Seme	22	9	12.86
Nyakach	41	18	25.71
Muhoroni	21	9	12.86
Nyando	31	13	18.58
Total	**165**	**70**	**100.00**

3.6 Instruments of Data Collection

Three tools for data collection were used. They were a questionnaire, lesson Observation Guide (LOG) and structured interview guides all of which were self-made by the researcher. These instruments were chosen and viewed as ideal for this study by the researcher and supported by Gray (2004). A questionnaire and LOG were prepared for in service trained Mathematics teachers; a key informant structured interview guide was for INSET trainers and SQASO which were used in triangulating information which was given by mathematics teachers from their questionnaire.

3.6.1 Mathematics Teachers' Questionnaire (MTQ)

Mathematics Teachers Questionnaire (MTQ) was used to collect data on teachers' background and their perception on objectives of in-service program. The teachers who used

this tool were in-service trained teachers. The in-service trained teachers' have undergone the initial training which is pre service either at diploma or degree level. Questionnaires are appropriate because they can be used to collect a lot of information from a large sample within a short period of time and ensures confidentiality. On the same note questionnaires ensure anonymity that give respondents freedom to respond without fear of victimization while allowing them to make suggestions.

The MTQ had 3 sections consisting of open and closed-ended items. Section 1 of the tool had 4 closed -ended items aiming at finding out background of teachers specifically their professional qualification, teaching experience and gender. Section 2 of MTQ was a Likert scale to measure perception of teachers towards the in-service program. The section had 20 statements. The statements were taken from the curriculum for the in service program.

Statements 1-5 covered attitudinal change. Statements 6-10 targeted pedagogy (ASEI /PDSI).Statements 11-15 focused on implementation of ASEI /PDSI and statement 16-20 targeted assessment and evaluation of learners. Teachers were to give their opinion on the 20 statements by ticking their views from a five point Likert scale. Some of the statements in the LIkert scale were positive while others were negative. The reversing of the statements were done to avoid response set. The MTQ is attached as Appendix 1 on page 176Section 3 had 2 open-ended questions asking general information on SMASSE in service program.

The MTQ was used to collect data on teachers teaching experience which was categorized as 1. (novice below 3 years), 2. (little experience of 3-5 years), 3.(medium experience of 6-10 years) and 4, (very experienced with over 10 years), Teacher professional qualification was

categorized as 1. Diploma, 2. B.Ed /PGDE, 3. Masters in Mathematics Education, and 4. PhD in Mathematics Education.

3.6.2 INSET Trainers' Interview Guide (ITIG)

INSET trainers interview guide was used to get information on quality of teaching mathematics, teachers' perception of SMASSE in service program and teachers' background in relation to quality of teaching mathematics. The ITIG is attached as Appendix II.

3.6.3 Lesson Observation Guide (LOG)

For the study to yield meaningful data, an observation guide using a graphic rating scale was developed for the purpose of rating teachers' quality of teaching mathematics. Kothari (2004) states that the rating scale is preferable in doing a classroom observation because it enables a researcher to get systematic and uniform information during the study. Secondly, Gall, Borg and Gall (2007) observe that, a rating scale is deemed appropriate because it is structured, closed ended and therefore requires less time and effort to complete. Frankael *et al*. (2012) further says that the instrument is quite specific in observing classroom activities and it gives room for recording unexpected classroom outcomes, it also allows room to explore issues that may be uncomfortable to the informant. It again helps to bridge the gap between what people say they do and what they actually do. The researcher used LOG as a tool to help establish mathematics teachers' quality of teaching and it also provided information on teachers' background and allowed the researcher to see what actually teachers do in classrooms.

The LOG had two sections. Section 1 was used to collect general information. Section 2 was used to collect information on quality of teaching mathematics as was observed by the

researcher. It was to find out information on two main areas which were preparation and presentation. Preparation of professional documents included schemes of work and ASEI-lesson plan. Lesson presentation involved introduction of the lesson, lesson development, communication skills by the teacher, use of ASEI-PDSI approach, use of resource materials in classroom in the process of teaching, classroom organization & management and teacher's conclusion of the lesson. The LOG was adapted from an assessment tool used by lecturers of Maseno University to assess undergraduate students during teaching practice. The LOG is attached as Appendix III.

3.6.4 SQASO Interview Guide (SIG)

SQASO Interview Guide (SIG) was used to obtain information on the INSET program since they were with teachers during in service training and they also interact with them in classrooms occasionally as they check on curriculum implementation and evaluation.

The SIG was used to collect information related to the in-service program and how it influences teachers' quality of teaching mathematics. The SIG is attached as Appendix IV.

3.7 Validity and Reliability of the Instruments

A research instrument is regarded as valid when it can measure what it is supposed to measure and it is regarded as reliable when it measures what it is supposed to measure consistently (Mulusa, 1990). Before the instruments were used, they were developed for enhancement of validity and reliability as explained below.

3.7.1 Validity

In this study two types of validity evidences were used basing on the research design and research instruments. These were Content and Face validity. Content validity occurs when the

instrument provides adequate coverage of the subject being studied while Face validity refers to what the instrument appears to measure. The researcher used the two evidences to assess validity of the instruments that were used in the study.

To assess content validity, the MTQ, ITIG, LOG and SIG were presented to experts in the field of education (Mugenda & Mugenda, 2003). They were requested to assess the concept the instrument was trying to measure. They were asked to determine whether the set of items would accurately represent the concept under study. Content validity of the instruments were then established after the two experts had evaluated the relevance of each item in the instruments to the objectives. To do this, the experts rated each item on the scale: very relevant (4), quiet relevant (3), somewhat relevant (2), and not relevant (1). Validity was determined using Content Validity Index (C.V.I). The C.V.I=Items rated 3 or 4 by both experts divided by the total number of items in the research instruments. This can be symbolized as $n_{3/4}$ /N. The content validity of the instrument was finally determined through piloting of the research instruments which first formed the first phase of the study. The instruments were accepted after each yielded a correlation coefficient of at least 0.70 and above (Kathuri & Pals, 1993). To confirm Face validity the same instruments which are MTQ, ITIG, LOG and SIG were presented again to two experts on the topic of research from School of Education for the purpose of checking face validity. Their independent advice was used in revising the instruments.

3.7.2 Reliability

The reliability of the MTQ, ITIG, LOG and SIG was established through test retest method as proposed by Kothari (2004) and application of Pearson Product Moment Correlation. To do this a pilot study was conducted using 16 teachers (not part of the study sample), representing

10 % of the total number of SMASSE In-service trained teachers found within sub county schools in Kisumu County, 3 INSET trainers and 1 SQASO (Krathwohl, 2003). The same MTQ, ITIG, LOG and SIG were administered twice to the same respondents within an interval of 2 weeks. The scores from the research instruments was correlated using Pearson Product Moment Correlation Coefficient. The formula is shown below:

Test- Retest Reliability: Pearson Correlation Coefficient

$$r = \frac{N\sum xy - (\sum x)(\sum y)}{\sqrt{[N\sum x^2 - (\sum x)^2][N\sum y^2 - (\sum y)^2]}}$$

Using the above formula by applying SPSS version 21, the instruments were accepted as reliable when each instrument yielded a correlation coefficient as follows: MTQ at 0.72, LOG at .78, ITIG at .81 and SIG at .82 which implied that there was a higher degree of reliability of the instrument (Mugenda & Mugenda, 2003). Necessary adjustment was made on the research instruments as was advised by experts and respondents. This was done to ensure the researcher gets the intended information from the instruments. The pilot study also helped to identify the problems the respondents encountered while filling the questionnaires and interview schedules.

3.8 Data Collection Procedures

A research authorization letter was obtained from School of Graduate Studies (SGS), Maseno University before embarking on the study. After which the proposal was presented to Maseno University Ethics Review Committee (MUERC) for approval. On obtaining a letter of approval from (MUERC), the researcher sought for a research permit from the National Commission for Science, Technology and Innovation (NACOSTI).The researcher presented the permit from NACOSTI to the County Director of Education Kisumu, who then wrote a letter concerning the research to be done in the county. The researcher then availed copies of

the letter from the County Director of Education in Kisumu which was presented to each of the 7 Sub-County Directors of Education in charge of the 7 sub-counties.

In order to administer the questionnaires effectively, a personal visit to all the sampled schools was done. The researcher explained the purpose of the research to the school principals and mathematics teachers and agreed on schedule of time when the research instruments was to be administered. To administer the questionnaires and to observe the 70 teachers in the classroom using the students' they teach regularly, the work was to take not less than 3 months since it was to involve observing teachers in class and at the same time consider the researcher's busy schedule at place of work. INSET trainers were interviewed in schools where they teach. SQASO were interviewed at their places of work. The information given by all the respondents in this study was used for data analysis.

3.9 Ethical Considerations

Researcher should operate within the ethics of respect for persons involved in the study by treating them fairly, sensitively and with dignity (Gardner, 2011). Respondents were protected in this research by the researcher who observed the ethical principles which included the need for participants to be informed on the use of data, confidentiality and the right to voluntary consent.

3.9.1 Informed Consent

On approval of the research proposal by the School of Graduate Studies (SGS), the University Senate, Maseno University Ethics and Review Committee (MUERC) and the National Council of Science Technology and Innovation (NACOSTI), permission to carry out the study was sought from the principals of the sampled schools after which mathematics

SMASSE trained teachers, INSET trainers and SQASO were also notified of the study. Thereafter all participants were requested to voluntarily agree to their participation through signing of a consent letter see Appendix V.

3.9.2 Confidentiality

To ensure confidentiality in research, sensitive information given in the research tools were kept in confidence by asking the respondents not to write their names on the tools which would not enable the researcher to identify them. They were also assured that the information collected would purposely be meant to support the study and not for any use. Furthermore respondents were notified of deductive disclosure of findings as neither participants nor institutions identifications were to be used in data analysis and drawing of recommendations.

3.9.3 Use of data

The researcher explained to all the respondents the process in which they would be engaged and why their participation was necessary. Data access and storage was entrusted with the researcher so that incase of leakage of sensitive information the researcher was to be held responsible. The researcher was again to explain to the respondents about the data which was collected and thereafter be organized in a form of thesis, which would be disseminated in journals, conferences and pamphlets for ease of access to all of them and to educational stakeholders.

3.10 Methods of Data Analysis

The data from MTQ, ITIG, LOG and SIG provided information which was first serialized, coded then keyed in Statistical Package for Social Sciences (SPSS) version 21, computer programme to provide analyzed results. Teachers' perception of in-service program was

measured using MTQ and was given score values with each of the five points on a Likert scale as follows: Strongly Agree (SA)-5, Agree (A)-4, Undecided (U)-3, Disagree (D)- 2, and Strongly Disagree(SD)-1, for all positively stated statements. For negatively stated statements, the scores were reversed as follows: Strongly Disagree (SD)-5, Disagree (D)-4, Undecided (U)-3, Agree (A)-2, and Strongly Agree (SA)-1. The scores were reversed to avoid response set. Arithmetic mean and percentages was done for every element on the Likert scale, thereafter; an average of the arithmetic means of the elements on the Likert scale was done.

On interpretation of the Likert scale, Kothari (2004) notes that in the analysis of the Likert scale data, mean scores of above 3.00 points towards the positive, mean scores of 3.00 is neutral while those below 3.00 points towards the negative. In the current study, the interpretation of the scores was as follows: a value of between 3.50 to 5.00 meant a positive perception; on the other hand, a value between 2.50 to 3.49 may have different meanings such as neither agree nor disagree, undecided or no opinion (Sullivan & Antony, 2013) in this study it meant undecided perception while a value between 1.00 to 2.49 meant a negative perception. The data was then presented in form of tables as Anais Brasileiros and Dermatologia (2014) have stated that tables reveal information which could be hidden in textual form much faster. Therefore data on perception was analyzed by using frequencies, means and percentages.

The MTQ was used again to provide information on teacher qualification, teacher experience and teacher gender. Teacher qualification was given dummy figures during analysis depending on the category. Diploma in Education-1, B.Ed/PGDE-2, M.Ed- 3, PhD in Mathematics-4.

From the same questionnaire, teachers professional experience was put in categories and also analysed using dummy figures as follows: below 3years (novice) - 1, experience of between 3-5years (little experience) -2, experience of 6-10 years (medium experience)-3 and over 10years (experienced)- 4. Gender being a dichotomous variable was either male or female. Male was denoted using zero (0) while female was denoted using one (1). During data analysis each construct within the LOG was scrutinized to find out which areas teachers were weak. After that percentage score for individual teacher was done depending on the scores assigned for each construct to be measured from the LOG. The mean for teachers performance was worked out and rated on the researcher made scale as follows: Very high quality- (70% and above), High quality-(60% - 69%), Average quality-(50% -59%), Low quality- (40% -49%) and Very low quality- (0 -39%).This grading scale was adapted from University of Nairobi grading system for undergraduates. The results of LOG is given in Appendix VII.

Quantitative data analysis involved the use of descriptive and inferential statistics. Descriptive statistics involved use of arithmetic mean, standard deviation, frequencies and percentages. These were presented in form of tables and box plots. Inferential statistics involved correlation analysis, regression analysis and ANOVA (one-tailed) to determine combine influence of teachers' qualification, experience and gender distribution on quality teaching of mathematics. To determine influence of teachers' perception of in-service program on quality of teaching mathematics, perception was analyzed using mean scores and percentages, while quality of teaching was measured in percentage using LOG for individual teachers score after which both correlation and regression analysis was run. Correlation analysis was used to predict the strength of linear relationship between independent variables and dependent variable, regression analysis was used to determine relationship between

dependent variable and independent variables. ANOVA (one-tailed) was used to analyze influence of gender on quality of teaching mathematics. Qualitative data was analyzed using responses to the open ended items in the questionnaires and from the interview with INSET Trainers and SQASO which was transcribed and organized in categories and reported as verbatim excerpts. Inferential statistics was used to draw conclusions and generalization for Kisumu County using information collected from 70 teachers teaching in sub county public schools.

CHAPTER FOUR
RESULTS ANALYSIS AND DISCUSSION

4.1 Introduction

Chapter Four presents the findings and discussions of the investigation that was undertaken with reference to the objectives and research questions as outlined in Chapter One. This chapter is divided into 3 sections which gives information on response rate, demographic information of respondents and information which corresponds to the objectives of the study. The objectives were to: establish influence of teachers' qualification on quality of teaching mathematics; establish influence of teachers' experience on quality of teaching mathematics; establish influence of teachers' gender on quality of teaching mathematics; determine combine influence of qualification, experience and gender on quality of teaching mathematics and determine influence of teachers perception of in-service program on quality of teaching mathematics.

The first part of every section in this chapter presents tabulated information highlighting findings on the relevance of each aspect related to objectives of the study. This is followed by discussions where several remarks from teachers, teacher trainers, SQASO together with findings from documentary evidence are quoted that gives meaning to the tables. Further, description from the lesson observation guide administered are also reported to triangulate the findings. Subsequently, the results from Pearson Product Moment Correlation analysis, multiple regression analysis, independent sample t-test and Analysis of Variance (ANOVA) are presented to demonstrate the influence of teachers' background and perception of in-service program on quality of teaching mathematics.

4.2 Response Rates

The study used a sample of 70 trained teachers, 22 INSET trainers and 6 SQASO. The researcher managed to observe all the 70 teachers in various classrooms, interview both 22 INSET trainers and 6 SQASO from the 7 sub-counties in Kisumu County. The response rate is shown in Table 4.1

Table 4.1: Response Rates

	Trained teachers	**INSET trainers**	**SQASO**	**Percentage**
Sample size	70	22	6	100
Respondents	70	22	6	100

Source: Field Data 2019-2020

From Table 4.1 it can be seen that 70 (100%) teachers were observed in class. For INSET trainers, 22 (100%) were interviewed and 6 (100%) SQASO were also interviewed. The numbers were sufficient for this study as supported by Mugenda and Mugenda (2003) who consider a respondent return rate of at least 70% as acceptable. The 100% return rate was partly realized because the researcher administered the questionnaires personally immediately after observing the teachers in classrooms and collected them on the spot. For INSET trainers and SQASO, the interview was done face to face.

4.3 Demographic Characteristics of Respondents

The main respondents in this study were teachers of mathematics teaching in secondary schools in Kisumu County. The study established their professional qualification, their experience in the teaching of mathematics and also their gender. This is shown in Table 4.2

Table 4.2: Demographic characteristics of Teachers

Respondents characteristics	Distribution	Frequency	Percentage
Qualification	Diploma	6	8.57
	B.Ed./PGDE	56	80.00
	Masters in Mathematics	8	11.43
Experience	Below 3 years	5	7.14
	3 – 5 years	17	24.29
	6 -10 years	26	37.14
	Over 10 years	22	31.47
Gender	Male	47	67.14
	Female	23	32.86

4.3.1 Teachers' Qualification

The study begun by finding out teachers' qualification in the teaching of mathematics in secondary schools in Kisumu County. This was established from MTQ which was attached as Appendix 1, and was triangulated by use of LOG attached as Appendix III which was used by the researcher during lesson observation in classrooms.

Table 4.2 indicates that majority of the teachers who were observed in class were 56(80.00%) and had B.Ed./PGDE degree out of a total number of 70 teachers. Very few teachers 6(8.57%) were Diploma holders and 8(11.43%) were Masters holders in mathematics who were observed in class teaching mathematics. None of the teachers had PhD in mathematics.

4.3.2 Teachers teaching Experience

The study sought to find out teachers' experience in the teaching of Mathematics in secondary schools in Kisumu County. This was established from MTQ which was attached as Appendix I, and was triangulated by use of LOG attached as Appendix III which was used by the researcher during lesson observation in classrooms. From Table 4.2 above, a large number 26(37.14%) teachers had experiences of between 6-10 years and was followed by 22(31.43%) teachers who had experiences of over 10 years. A few teachers 17(24.29%) had served in the teaching profession between 3-5 years. Very few teachers 5(7.14%) are the ones who had served between 0-below 3 years

4.3.3 Teacher Gender

The study sought to find out mathematics teachers' gender. This was also established from MTQ which was attached as Appendix l. Table 4.3 provides information on teacher gender. It is evident from the table that majority of teachers 47(67.14%) were male whereas female teachers were 23 (32.86%).

The distribution between teacher gender and their qualification was sorted out and presented in Table 4.3 as shown below.

Table 4.3: Teachers' gender and their qualifications.

	Qualification			
Gender	**Diploma**	**B.Ed./PGDE**	**Masters**	**PhD**
Male	3	38	6	0
Female	3	18	2	0

Table 4.3 indicates that the male teachers' with their academic qualification is as follows: 3 diploma holders, 38 B.Ed./PGDE, 6 Masters in mathematics education and none has a PhD in

Mathematics education. For female teachers their qualification is as follows: 3 diploma holders like the male teachers, 18 B.Ed./PGDE, 2 Masters holders in mathematics education and like their male counterparts none of them has a PhD in Mathematics education.

When association between gender and qualification was run using Chi- square the results are shown below: Chi-square = 1.0361, df = 2, p-value= 0.5957. The p-value is greater than 0.05 which is translated as meaning that there is no association between the two variables. The distribution between teacher gender and their experiences was sorted out and presented in Table 4.4.

Table 4.4: Teachers' gender and their teaching experiences

	Experience			
Gender	**Below 3yrs**	**3- 5yrs**	**6- 10yrs**	**Over 10yrs**
Male	5	12	14	16
Female	0	5	12	6

Table 4.4 indicates that male teachers in this study with teaching experience of below 3 years were 5, experience between 3-5 years were 12,while experience between 6-10 years were 14 and experience over 10 years were 16. For female teachers, there was no female teacher with experience below 3 years. Those with teaching experience between 3-5 years were 5, between 6-10 years were 12 and those with over 10 years' experience were 6.When association between gender and experience was run using Chi-square the results were as follows: Chi-square=4.933, df= 3 and p-value= 0.1768. The p-value is greater than 0.05, the interpretation is that there is no association between gender and experience.

4.4 Influence of Teachers' qualification on quality of teaching mathematics

Teachers' qualification on quality of teaching mathematics was sought. Data on teacher qualification was collected from LOG which was attached as Appendix III. Before ascertaining the relationship between teachers' qualification and quality of teaching mathematics, the study sought to establish quality of teaching mathematics in secondary schools in Kisumu County.

4.4.1 Quality of Teaching Mathematics in secondary schools

Data regarding quality teaching of mathematics (QTM) was obtained from Lesson Observation Guide (LOG), which was attached as Appendix III. The result was reported in form of percentage scores for individual teacher depending on the score given to each construct in the LOG as they were teaching different topics in mathematics at different levels of classes in secondary schools. The results are shown in Appendix VII.

Appendix VII reveals that all the teachers observed in class had prepared schemes of work in mathematics which had a mean of 2. On lesson plan, the mean was 2.64 out of a maximum score of 10. The results again revealed that 35 out of 70 teachers did not prepare lesson plans. Preparation of lesson plans is the most sensitive part of quality of teaching mathematics after making schemes of work. It is within the lesson plan where the teacher prepares for teaching - learning resources other than carrying the course book to class. It is also during the lesson plan where a teacher indicates how the implementation of ASEI-PDSI will be done. The fact that half of the teachers did not have lesson plans affected the use of ASEI-PDSI which had a mean of 2.27 out of a maximum score of 6, it also affected the use of learning resources which had a mean of 5.24 out of a maximum score of 15.

When descriptive statistics for the 70 teachers was worked out, it produced a minimum score of 48% and a maximum score of 75% with a mean of 59.04 and a standard deviation of 5.877 as shown in Table 4.5

Table 4.5: Results of Quality of Teaching Mathematics as provided by descriptive statistics n =70

Min	Max	Mean	SD
48	75	59.04	5.877

SD= Standard Deviation

The mean of 59.04 is an output which shows the input teachers showed during lesson observation as they were teaching mathematics in the various classes.

The distribution of scores obtained as percentage by individual teachers to show their quality of teaching mathematics was presented in Figure 4.1.

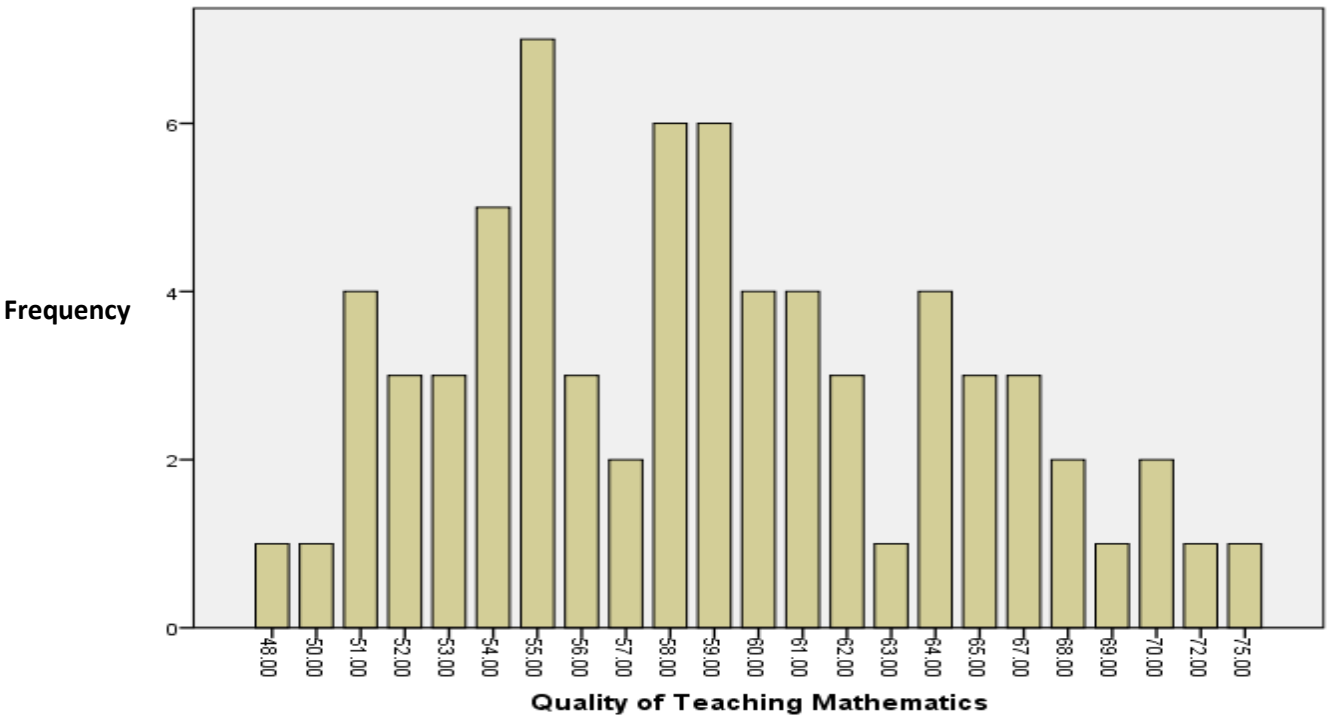

Figure 4.1: Teachers scores on Quality of Teaching Mathematics

Results from Figure 4.1 indicate that 1(1.4%) teacher scored 48% which was the lowest score. The highest score was 75% which was also attained by 1(1.4%) teacher. The second highest score was 72% which came from 1(1.4%) teacher. Those who scored between 50% and 59% were 41(58.6%) teachers. Those who scored between 60% and 69% were 25(35.7%) teachers while those who scored between 70% and above were 4(5.7%) teachers. When individual teacher's quality teaching of mathematics was rated it was established that only 4(5.7%) teachers showed a very high quality of teaching mathematics, 21(30%) teachers were rated as having high quality of teaching, 44 (62.9%) showed average quality of teachings while only 1(1.4%) teacher was rated as having low quality of teaching mathematics. This is shown in Table 4.6.

Table 4.6: Summary of scores obtained by teachers during lesson observation

Score	No. of teachers	Percentage	Rating
70 and above	4	5.7	Very High Quality
60 - 69	25	35.7	High Quality
50- 59	40	57.2	Average
40 - 49	1	1.4	Low Quality
0 -39	0	0.0	Very low Quality

Source of Rating scale: UoN

As shown in Table 4.6, majority of teachers 40((57.2S %) are the ones who were rated as having average quality of teaching mathematics. Only 4(5.7%) teachers are those who were rated as having very high quality of teaching mathematics. Only one teacher was rated as having low quality of teaching.

When the researcher analysed the results further from the LOG scrutinizing the various constructs that is preparation, the results revealed that all the teachers had prepared scheme of work in mathematics for the classes they taught. This is encouraging and could have been as a result of heads of subjects who enforce this as a requirement in the departmental office or as a result of teachers buying schemes of work from vendors in the street. Analysis on provision of lesson plans was also done, the study revealed that out of the 70 teachers, 35 teachers had no lesson plans during the observation and most of those who had were not following ASEI-Lesson plan format, use of learning resources is not effective and ASEI/PDSI approach is not embraced as shown in Appendix VII. If teachers cannot plan for the lessons they are to teach, it means they are planning to fail in conducting a successful lesson. Benjamin Franklin said "He who fails to plan, plans to fail" as reported by (Best, 1962).

A situational analysis carried out by CEMASTEA in 2009 revealed that only 10.7 percent of the teachers prepared lesson plans, while 72 percent indicated they rarely or never , prepared a written lesson plan. This means that teachers have not embraced the making of ASEI/PDSI lesson plan to date. Under lesson development, the areas that were not well performed were, use of ASEI/PDSI approach and use of resource materials. Observation revealed that 45 out of 70 teachers did not apply ASEI/PDSI approach. This is supported by a study conducted by Ambasa (2019), which also revealed that primary science teachers are not using the ASEI/PDSI approach in teaching science. Quality teaching is questionable since teachers are not implementing what they learnt during the in service program. This calls for a follow up by the CEMASTEA group. On resource materials, 46 out 70 teachers used the mathematics course books as the only resource. It is like teachers have not embraced the idea of improvisation of materials when there is need. This did not allow them to score high marks during the observation. This is shown in Appendix VII. From descriptive statistic it is

established that quality of teaching mathematics is at a mean score of 59.04. Using the grading scale adapted by the researcher in this study, teachers' quality of teaching mathematics in secondary schools in Kisumu County is of average quality.

To confirm these findings, INSET Trainers were interviewed to find out whether there is quality teaching of mathematics in schools, most them responded to "yes" and some of their remarks were noted as follows:

> *"There is improved psychomotor skills for application though cognitive skills for exams still not effective." IT 3*
> *"It has provided better approaches to teaching and learning". IT 6.*
> *"It has made teaching to be learner centred hence improving learner participation".IT 7.*
> *"Quality teaching is not only seen in results but also on how learners are motivated". IT 16.*

These remarks show that quality teaching is there but to some extent therefore the extent can be rated as average according to the rating scale used by the researcher. This performance may be as a result of teachers' undecided perception towards the objective on implementation of ASEI /PDSI of the in service program. This was established by the study during lesson observation in class. It may also have been as a result of them not using ASEI/PDSI approach, lack of lesson planning, some teachers not using learning resources. If teachers could embrace the objectives of in-service program more so Pedagogy (ASEI-PDSI) and implementation of (ASEI-PDSI) in their classroom teaching this could raise their quality of teaching mathematics.

In this study, diploma teachers were 6 and they performed at an average of 51.5% while B/Ed./PGDE teachers were 56 and they had an average performance of 58.7%. Teachers with a Master's degree were 8 and they had the highest average performance of 67.3%. The finding indicates that teachers with a Master's degree in Mathematics Education performed the best during the observation followed by teachers with Bachelors/ Post Graduate Diploma

in education and finally the diploma holders in that order. To ensure there was no biasness in a warding of scores in the LOG, the researcher observed the teachers while conducting their lessons in class for a period of forty minutes after which they were asked for their background information.

Kisumu County has majority of teachers with a qualification of B.Ed./PGDE, whose average performance was 58.7% during lesson observation which was used to establish quality of teaching mathematics. This should help determine students' performance in schools (Akinsolu, 2010). Related literature also reveals that teacher qualification affects students learning outcomes (Abu & Fabunmi, 2005; Akinsolu, 2010: Akpo, 2012; Daso, 2013). Therefore these teachers are in a position of improving students' performance since they have attended in-service program in mathematics and this is in line with Masau and Migosi (2015) findings. The results for teacher qualification on quality of teaching mathematics was summarized in Figure 4.2.

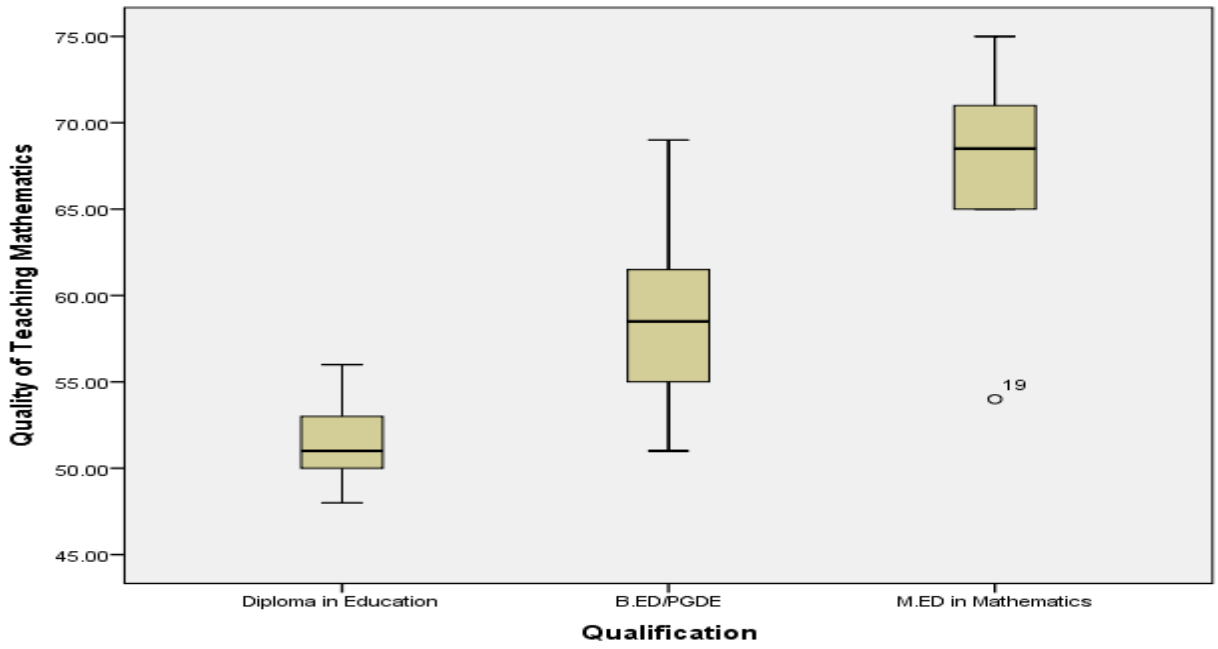

Figure 4.2: Teacher qualification on quality of teaching mathematics

Observing Figure 4.2 and referring to the boxplot for diploma teachers, the boxplot is moderately symmetrical as the box is almost in the middle of the whiskers and the median is only slightly below the middle of the box. This suggests that this data is very slightly negatively skewed. On average diploma teachers performed at a mean of 51.5. Considering this mean, it implies that diploma teachers can as well teach mathematics and help students perform well in mathematics.

The boxplot for B.ED/PGDE is symmetrical. This means that teachers in this category had their performance normally distributed without outliers. On average the teachers' performance in quality of teaching mathematics was at a mean of 58.7.

The boxplot for teachers with Master's degree was almost symmetrical with one outlier who is teacher number 19. This teacher had the lowest performance in quality of teaching mathematics within this category which was confirmed as 54% from Appendix VIII. The performance of teachers in this category on quality of teaching mathematics was 67.25.

4.4.2 Relationship between teacher qualification and Quality of Teaching Mathematics

After determining teacher qualification and their performance on quality of teaching mathematics, it was necessary to establish influence of teachers' qualification on quality of teaching mathematics. In order to establish influence of teacher qualification on quality of teaching mathematics in secondary schools in Kisumu County, data on teacher qualification and quality of teaching mathematics was analyzed as shown in Appendix VIII on page 189. The mean scores on level of quality of teaching mathematics for the three categories of qualification of teachers was done using descriptive statistics and the results are presented in Table 4.7.

Table 4.7: Descriptive Statistics on level of quality of teaching mathematics given teachers' qualification (n=70)

Qualification	*N*	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Diploma in Education	6	51.5000	2.73861	1.11803	48.6260	54.3740
B.ED/PGDE	56	58.6786	4.62054	.61745	57.4412	59.9160
M.ED in Mathematics	8	67.2500	6.36396	2.25000	61.9296	72.5704
Total	**70**	**59.0429**	**5.87659**	**.70239**	**57.6416**	**60.4441**

From Table 4.7, it is evident that the difference in mean scores of quality of teaching mathematics between the different categories of qualification of teachers was relatively large ranging from 51.5 to 67.3. Teachers who had Diploma in Education had the least mean score of quality of teaching mathematics (*M*=51.5; *SD*=2.7), while those with M.ED in Mathematics had the highest mean score of quality of teaching mathematics (*M*=67.3; *SD*=6.4).

The finding is in line with Goldhaber & Brewer (2000) who examined the effect of teachers' certification status and their students' performance in mathematics and science in secondary schools whose results showed a positive relationship between degrees and students' performance in mathematics. Similarly, this was alluded by Mayer et al.(2000) who also established links between students achievement and teacher qualification.

The above finding contrasts with that of Oduh and Okanigbuan (2014) who found a negative partial correlation of .245 on relationship between mathematics teachers qualification and

percentage of passes among students in mathematics. The study concluded by noting that the quality of mathematics teachers engaged by schools would either positively or negatively impact the performance of students in mathematics.

4.4.3ANOVA showing statistical differences in quality of teaching mathematic given different categories of qualification

For Analysis of variance (ANOVA) to be run, a test on homogeneity of variances was first checked to establish the appropriateness of the teachers' qualification data for the use of ANOVA test. The test of homogeneity of variances indicates that the data met the required assumption for the test as shown in Table 4. 8.

Table 4.8: Test of Homogeneity of Variances on Quality of Teaching Mathematics

Levene Statistic	df1	df2	Sig.
1.395	2	67	.255

The Levene test for homogeneity of variances, which tests whether the variance in scores is the same for each of the three groups, was not significant (Sig. value = .255). This suggests that the assumption of homogeneity of variance was not violated. It was therefore assumed that variances were equal across groups of different qualifications, an indication that the data was suitable for use of ANOVA. The Levene's result was sufficient for ANOVA to be used, therefore a model in the form $\bar{x}_1 \neq \bar{x}_2 \neq \bar{x}_3$ was necessary where $\bar{x}_1$=51.5,$\bar{x}_2$=58.7 and $\bar{x}_3$=67.3.ANOVA was then computed to establish whether there was any statistically significant difference in quality of teaching mathematics given different categories of qualification among public secondary school teachers. In the ANOVA, dependent variable for the study was quality of teaching mathematics, measured in continuous scale, while the

independent variable was teachers' qualification which was measured in categorical scale. Teachers' qualification was divided into three categories (category 1: Diploma in Education; category 2: B.ED/PGDE and category 3: M.ED in Mathematics).

ANOVA test was run to show the level of quality of teaching mathematics within the various teachers' qualifications as shown in Table 4.9.

Table 4.9: ANOVA; Level of quality of teaching mathematics given teachers' qualification

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	887.657	2	443.829	19.888	.000
Within Groups	1495.214	67	22.317		
Total	**2382.871**	**69**			

From Table 4.9, it is evident that there was a statistically significant difference in the level of quality of teaching mathematics among the three different levels of qualifications among public secondary school teachers [F (2, 67) = 19.888, p =.000<.05]. The fairly large F ratio shown in the results confirm that there was higher variability between the teachers' qualification categories caused by the independent variable than there was within each teachers' qualification category (error term). A significant F value suggests that there was sufficient evidence to reject the null hypothesis, which assumed that the population means were equal. On the other hand, the effect size, was calculated using *eta* squared which indicate that the differences were fairly small. The *eta* squared value being .373, which in Cohen and Cohen's (1988) terms was considered a small effect size. The general interpretation of effect size was as follows: small (d = 0.2), medium (d = 0.5), and large (d = 0.8) based on benchmarks suggested by Cohen (1988).

ANOVA test established that there was a significant difference in level of quality of teaching mathematics among the various level of qualification groups, the test did not show which of the groups differed significantly in quality of teaching mathematics. Thus, *post-hoc* test analysis was further performed to establish the groups that differed significantly, as shown in multiple comparisons results in Table 4.10.

Table 4.10: Multiple Comparisons: Level of quality of teaching mathematics given teachers' qualification (N=70)

Dependent Variable: Quality of Teaching Mathematics							
	(I) Qualification	(J) Qualification	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Diploma in Education	B.ED/PGDE	-7.17857*	2.02927	.002	-12.0425	-2.3146
		M.ED in Mathematics	-15.75000*	2.55128	.000	-21.8651	-9.6349
	B.ED/PGDE	Diploma in Education	7.17857*	2.02927	.002	2.3146	12.0425
		M.ED in Mathematics	-8.57143*	1.78552	.000	-12.8511	-4.2917
	M.ED in Mathematics	Diploma in Education	15.75000*	2.55128	.000	9.6349	21.8651
		B.ED/PGDE	8.57143*	1.78552	.000	4.2917	12.8511

*. The mean difference is significant at the 0.05 level.

From Table 4.10, Tukey HSD *post-hoc* test which is a stepwise multiple comparison procedure was used to identify scores of quality of teaching mathematics that were significantly different from each other given the differences in teacher qualification. This test is often used whenever a significant difference between two or more sample means has been detected by ANOVA. The *post-hoc* test results showed that the level of quality of teaching mathematics significantly differed among the categories. In particular, teachers with a qualification of Masters in Mathematics Education's quality of teaching mathematics was significantly different (Sig. level <.05) from those teachers with qualification of Diploma in Education [Mean Difference = 15.75; *SE* =2.55] and also those teachers with qualification of

B.ED/PGDE [Mean Difference =8.57; *SE*= 1.79]. Equally, there was a statistical significant difference in the level of quality of teaching mathematics between the group of teachers with qualification of Diploma in Education and those with qualification of B.ED/PGDE [Mean Difference=7.17; *SE*= 2.03; *p*=.002]. The finding is in line with Umar *et al.*(2013) study who found significant difference which existed between students' performance on account of their teachers qualification. Similarly, Abe (2014) examined the effect of teachers' qualification on students' performance in mathematics and also found significant difference which existed between students who were taught by professional teachers and nonprofessional teachers. In contrast, Masau and Migosi (2015) found that there was no significant difference in means between teacher qualification and students' performance in science, mathematics and technology. Based on the results, teachers' qualification has a significant influence on quality of teaching mathematics among secondary school mathematic teachers, with higher qualification resulting into higher quality of teaching mathematics than those with a lower qualification.

Sub-County Quality Assurance and Standard Officers (SQASO) were interviewed to find their opinion on whether teachers' qualification contribute to quality teaching of mathematics. The following statements were noted:

> *"Yes, it is grounded on the level of education especially when genuine character is expressed and applied". SQASO 1.*
> *"Yes, it depends on the teacher imparting information in an organized way to the learners". SQASO 3.*
> *"Yes, if only the teacher is willing to accept change". SQASO 4.*
> *"Yes, understanding of concepts depends on academic level". SQASO 6*

These excerpts imply that teachers' qualification may contribute to quality of teaching mathematics hence students' performance in mathematics. The findings contrast with those studies done by Musau *et al*.2013; Kimani *et al*.2013; Mbugua *et al*.2012 who found that teacher qualification and experience were not significantly related to students achievement. In

other words, even if teachers are more qualified this may not contribute to students' achievement at KCSE. There may be other factors such as students' attitude, students' background and also school factors which may intervene hence interfere with students' achievement. Wenglinksy (2000); Greenburg, Rhodes and Stancavage, (2004) found that postgraduate qualification at Master or higher level were not significantly related to students' achievement. However, most of the previous studies looked at teacher qualification in terms of students' achievement in mathematics. The results of the current study was to establish influence of teachers' qualification on quality of teaching mathematics which was established by analysis of variance.

4.5 Influence of Teaching Experience on Quality of teaching mathematics

Influence of teachers' teaching experience on quality of teaching mathematics was sought. Data on teacher experience was collected from Mathematics Teachers Questionnaire (MTQ) which was attached as Appendix I and confirmed by Lesson Observation Guide (LOG) which was attached as Appendix III. Before ascertaining the relationship between teaching experience and quality of teaching mathematics in secondary schools in Kisumu County, it was first investigated by exploring whether differences in teachers' experience among secondary school teachers significantly influenced their quality of teaching mathematics. The mean quality of teaching mathematics for various teachers' experience is presented in the descriptive statistics in Table 4.11.

Table 4.11: Descriptive Statistics on level of quality of teaching mathematics given teachers' experience (n=70)

Experience	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Below 3 Years	5	56.8000	3.56371	1.59374	52.3751	61.2249
3-5 Years	17	56.3529	5.23141	1.26880	53.6632	59.0427
6-10 Years	26	57.1923	4.67349	.91655	55.3046	59.0800
Over 10 Years	22	63.8182	5.38637	1.14838	61.4300	66.2064
Total	**70**	**59.0429**	**5.87659**	**.70239**	**57.6416**	**60.4441**

From Table 4.1, it is evident that the difference in mean scores of quality of teaching mathematics between the different years of experience was fairly large ranging from a low of 56.8 to a high of 63.8. Teachers with teaching experience of below 3years performed at an average score of 56.8, while teachers with experience of between 3-5 years performed at average score of 56.4. At an experience of between 6-10 years they performed better than the two groups mentioned and their performance was at an average score of 57.2. With experience of over 10 years, these teachers' performance was the highest at an average score of 63.8. This has been illustrated in Figure 4.3.

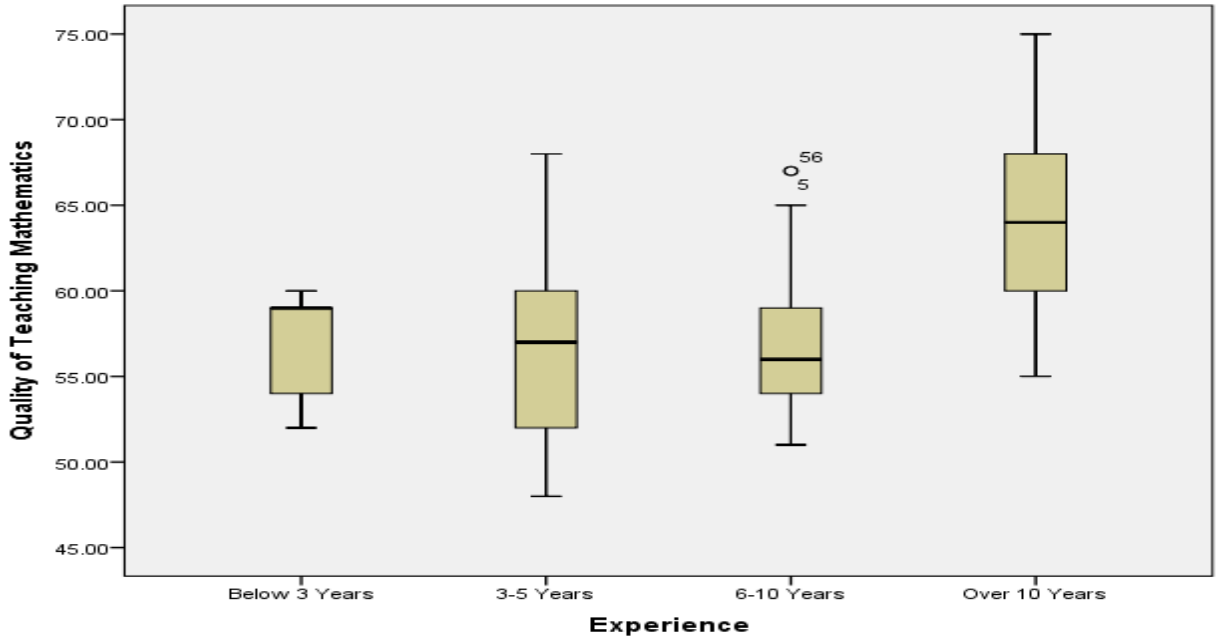

Figure 4.3: Teachers' teaching experiences and quality of teaching mathematics

From Figure 4.3, the boxplot for teachers with experience of below 3 years shows that the median score is at the top of the box. This suggests that the data is heavily negatively skewed. The conclusion is that, on average teachers with experience of below 3 years performed at an average of 56.8. The boxplot for teachers with experience of 3-5 years is moderately symmetrical as the box is almost in the middle of the whiskers and the median is slightly above the middle of the box. This can be interpreted that the data is very slightly skewed. On average, this category performed at an average of 56.4 which was lower than the performance of teachers with experience of below 3 years on quality of teaching mathematics. The boxplot showing teachers with experience of 6-10 years illustrates that there were two teachers who performed far much better than the rest of teachers in this category. These were teacher number 5 and teacher number 56 who both managed to score 67% which was the highest score from this category. Teachers with experience of over 10 years had their performance in quality of teaching mathematics normally distributed as shown by the boxplot. On average

these teachers quality of teaching had an average mean of 63.8 which was the best among the four categories,

The findings of this research on teaching experience on quality of teaching mathematics shows that teachers with experience of above 10 years performed best and is in agreement with Temitope and Olabanji (2015) whose study established that schools having more teachers with above 10 years' experience achieved better results than schools having many teachers with below 10 years' experience. Therefore schools in this study who have teachers with experience of over 10 years are likely to make their students to perform well in mathematics (Musili, 2015). Contrary to the findings one teacher with experience of below 3 years performed well during lesson observation and scored 60% as indicated in Appendix VIII. This was considered as high performance according to the study. This high performance by this individual diploma teacher could be due to the presence of very well prepared beginning teachers who were highly effective.

When SQASO were asked during the interview to give their opinion on whether a teacher's experience determine quality of teaching the following remarks were noted:

> *"Yes, the more experienced a teacher is, the more likely is the teacher to teach well" .SQASO 1.*
> *"Yes, those who have taught for long have mastered the teaching methodology". SQASO 2.*
> *"Yes, teaching goes with experience". SQASO 3.*
> *"Yes, having taught for many years it is like repeating the same content year in year out". SQASO 4.*
> *"Yes, to some extent depending on the teachers attitude towards the learner being taught in class". SQASO 5.*
> *"Yes, an experienced teacher is capable of manipulating the various methods of teaching in class for better understanding of learners". SQASO 6.*

Further, more data was gathered from INSET trainers during interview to give their opinion on whether teaching experience contributes to quality teaching of mathematics especially after attending the in-service program. The following statements were made:

> *"Yes, integrating experience with SMASSE yields better results". IT 1*
> *"Yes, experienced teachers are more knowledgeable and can effectively implement the INSET ideas in schools". IT 2*
> *"Yes, experience helps the teacher to understand the best approach to various concepts especially after attending INSET". IT 7*
> *"Yes, experience added to in-service training contributes to quality teaching". IT 9*

The above statements by SQASO, INSET trainers and findings from a study by Akpo (2012) revealed that teaching experience is related to students' academic achievement. Given data of teachers on their teaching experience, it shows that Kisumu County has a large number 48(68.57%) teachers with experience of over 6-10 years and therefore they are capable of making students to perform in mathematics unless they have formed a negative attitude towards the subject may be due to learners entry level or school environment.

4.5.1 Relationship between teacher experience and Quality of Teaching Mathematics using Analysis of Variance (ANOVA)

After determining teachers teaching experience and their performance on quality of teaching mathematics, it was necessary to establish influence of teachers' experience on quality of teaching mathematics. In order to establish influence of teacher experience on quality of teaching mathematics, data on teacher experience and quality of teaching mathematics was used as shown in Appendix VIII. Further, a one-way Analysis of Variance (ANOVA) was computed to establish whether there was any statistically significant difference in quality of teaching mathematics among public secondary school teachers given their differences in years of experience. One-way Analysis of Variance was suitable because of the nature of the variables; the dependent variable for the study was quality of teaching mathematics, was

measured in continuous scales, while the independent variables (teachers' experience) was measured in categorical scale. Experience was divided into four categories according to the teachers' years of experience in the teaching of mathematics (category 1: 0- below 3 Years; category 2: 3-5 Years; category 3: 6-10 Years; category 4:Over 10 Years). The suitability of data was first checked to establish its appropriateness for the use of ANOVA test. The test of homogeneity of variances indicates that the data met the required assumption for the test as shown in Table 4.12.

Table 4.12: Test of Homogeneity of Variances on quality of teaching mathematics

Levene Statistic	df1	df2	p- value
.366	3	66	.778

Table 4.12 shows Levene test for homogeneity of variances, which tests whether the variance in scores is the same for each of the four groups, was not significant (p-value = .778). This suggests that the assumption of homogeneity of variance was not violated, and this was an indication that the data was suitable for use of ANOVA. The Levene's test results was sufficient for ANOVA to be used, therefore a model in the form $\bar{x}_1 \neq \bar{x}_2 \neq \bar{x}_3 \neq \bar{x}_4$ was necessary where $\bar{x}_1$=56.8,$\bar{x}_2$=57.4, $\bar{x}_3$=58.7 and $\bar{x}_4$=61.2.After this, ANOVA test was run to show the level of quality of teaching mathematics given teachers experience as shown in Table 4.13.

Table 4.13: ANOVA showing level of quality of teaching mathematics given teachers' experience

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	738.878	3	246.293	9.888	.000
Within Groups	1643.994	66	24.909		
Total	**2382.871**	**69**			

From Table 4.13, it is clearly shows that there was a statistically significant difference in the level of quality of teaching mathematics among the four different levels of experience among sub-county public secondary school teachers [F (3, 66) =9.888, p =.000<.05]. The relatively large F ratio established indicates that there was more variability between the teachers' experience categories (caused by the independent variable) than there was within each teachers' experience category (error term). A significant F test implied that the null hypothesis, which assumed that the population means were equal, was rejected. Based on the findings, it was established that there was a statistically significant influence of teachers experience on quality of teaching mathematics among teachers from sub-county public secondary school in Kisumu County, with over 10 years' experience resulting into a better quality of teaching. This finding is in line with Temitope and Olabanji (2015) study, who found that teachers teaching experience had an influence on students' academic performance in mathematics and English language in public secondary schools in Ogun state, in Nigeria. However, Temitope and Olabanji looked at students' academic performance in relation to teachers experience while the current study looked at teachers experience in relation to quality of teaching mathematics. Contrary, Martin *et al*.(2000) and Wenglinsky (2000) found that the number of years in teaching is not associated with students' achievement.

However, the effect size which was calculated using *eta* squared confirmed that the differences were fairly small. *Eta* squared was calculated by dividing the Sum of squares between groups (738.878) by the Total sum of squares (2382.871). The resulting squared value was .310, which in Cohen and Cohen's (1988) terms would be considered a small effect size. The effect size was interpreted as follows: small (d = 0.2), medium (d = 0.5), and large (d = 0.8) based on benchmarks suggested by Cohen (1988).

Although it was concluded from the ANOVA test that there was significant difference in level of quality of teaching mathematics among teachers varied years within experience categories, it did not show which of the groups differed significantly. Hence, *post-hoc* test analysis was further performed to find out the groups that differed significantly, as shown in multiple comparisons results in Table 4.14.

Table 4.14: Multiple Comparisons: Level of quality of teaching mathematics given teachers' experience (N=70)

Dependent Variable: Quality of Teaching Mathematics

	(I) Experience	(J) Experience	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Below 3 Years	3-5 Years	.44706	2.53910	.998	-6.2453	7.1394
		6-10 Years	-.39231	2.43718	.999	-6.8160	6.0314
		Over 10 Years	-7.01818*	2.47266	.030	-13.5354	-.5010
	3-5 Years	Below 3 Years	-.44706	2.53910	.998	-7.1394	6.2453
		6-10 Years	-.83937	1.55669	.949	-4.9423	3.2636
		Over 10 Years	-7.46524*	1.61166	.000	-11.7131	-3.2174
	6-10 Years	Below 3 Years	.39231	2.43718	.999	-6.0314	6.8160
		3-5 Years	.83937	1.55669	.949	-3.2636	4.9423
		Over 10 Years	-6.62587*	1.44577	.000	-10.4365	-2.8152
	Over 10 Years	Below 3 Years	7.01818*	2.47266	.030	.5010	13.5354
		3-5 Years	7.46524*	1.61166	.000	3.2174	11.7131
		6-10 Years	6.62587*	1.44577	.000	2.8152	10.4365

*. The mean difference is significant at the 0.05 level.

From Table 4.14, Tukey HSD *post-hoc* test is a stepwise multiple comparison procedure used to identify sample means that are significantly different from each other was applied. The test is often us whenever a significant difference between two or more sample means has been detected by ANOVA, as was in the present study. The post-*hoc* test results showed that the level of quality of teaching mathematics for teachers with over 10 years of experience was significantly different from those with below 3 years of experience [Mean Difference= 7.02; *SE*= 2.47; P< .05] and from teachers with experience of between 3-5 years [Mean Difference= 7.47; *SE*=1.61; p < .05] and those of between 6-10 years experience [Mean Difference = 6.63; *SE*=1.45; p<.05]. However, there was no statistical significant difference in the level of quality of teaching mathematics between the category of teachers with below 3 years of experience and those with 3-5 year experience [Mean Difference = .45; *SE*=2.54; p = .999]. Based on the study findings teachers' years of experience has a significant influence on quality of teaching mathematics among mathematics teachers in secondary school with experience of over 10 years resulting to higher quality of teaching.

The finding above is in agreement with studies conducted by Yara and Wanjohi (2011); Adeyemi, (2008); Ogbonnya (2007). The finding implies that experience is an important factor that influences quality of teaching mathematics. In a similar study, Temitope and Olabanji (2015) found that teachers teaching experience had an influence on students' academic performance in mathematics and English language. They established that schools having more teachers with above 10 years teaching experience achieved better results than schools with many teachers having below 10 years' experience. However, the above authors studied influence of teachers' teaching experience in relation to students' academic achievement but the current study looked at influence of teachers' teaching experience in

relation to quality of teaching mathematics. Through quality of teaching, teachers are able to influence students' performance in mathematics.

Experienced teachers are in a position of handling different topics in mathematics using appropriate methods hence may have some impact on students' achievement in mathematics. Similarly, Darling-Hammond (2000) study also revealed that teaching experience is related to students achievement but asserts that relationship may not be linear. The curvilinear effect could be as a result of experienced teachers who do not continue to grow academically and may be tired of their profession. Further, Ogbonnaya (2007); Adeyemi (2008); Yara and Wanjohi (2011) are in support of the findings and asserts that experience could be used to predict students' performance in mathematics. Having establish that Kisumu County has most teachers with experience of over 6 years, they are in a position of improving students' performance in mathematics.

However, the findings contrast with that of Martin *et al*.(2000) and Wenglinsky (2000) who found that experience is not associated with students achievement. Similarly, Yara and Surumo (2012); Ayodele (2012) both found that a number of teacher variables including teacher experience, teacher academic qualification, teacher student ratio and teacher development had no significant influence on students' academic performance. These contrary findings on experience could be due to the presence of very well prepared beginning teachers who are highly effective and are capable of improving students' performance in mathematics.

4.6 Influence of teacher Gender on quality of teaching mathematics

The study first established teachers' quality of teaching mathematics. In this study the highest score of 75% on quality of teaching mathematics came from a male teacher. Out of 47 male

teachers 17(39.5%) scored between 60% and 69% whereas 29(67.4%) teachers scored between 50% and 59% and they were a sizeable number. Two male teachers who scored the lowest had 51%. For female teachers the highest score attained in teaching mathematics was 72% which gives 3(13.1%) teachers scoring between 70% and above. Out of 23 female teachers 9(39.1%) scored between 60% and 69% whereas 10(43.5%) teachers scored between 50% and 59%, the least score was 48% by 1(4.3%) teacher who was in the category between 40% and 49% . This is shown in Figure 4.4.

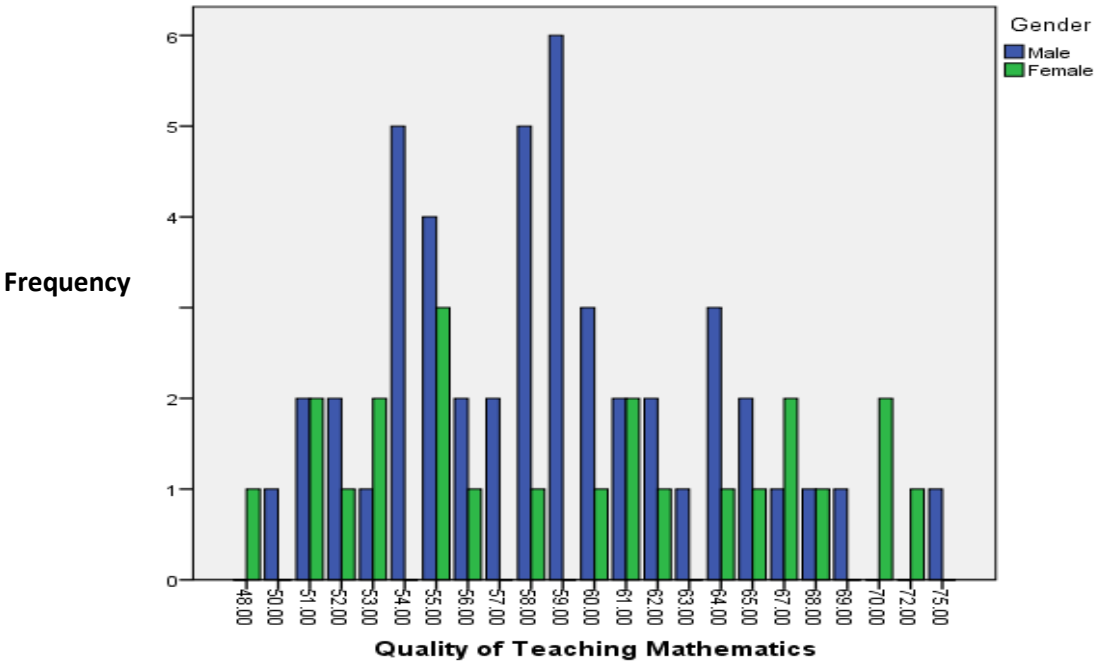

Figure 4.4: Teachers performance in quality of teaching mathematics by gender.

The mean percentage score for quality of teaching mathematics for male teachers was 58.79, SD=5.171, while for female teachers was 59.74, SD=7.117. On average female teachers' quality of teaching was higher than that of male teachers by 0.95 and this is shown in Table 4.15

Table 4.15: Teachers' quality of teaching mathematics by gender

Gender	Number of teachers	Mean	Std Deviation
Male	47	58.79	5.171
Female	23	59.74	7.117

From Table 4.15, it is evident that the mean performance for female teachers' quality of teaching was higher than that of male teachers. The teachers' quality of teaching mathematics by gender was also observed from the box plot; however there was a male teacher who did very well as shown in Figure 4.5.

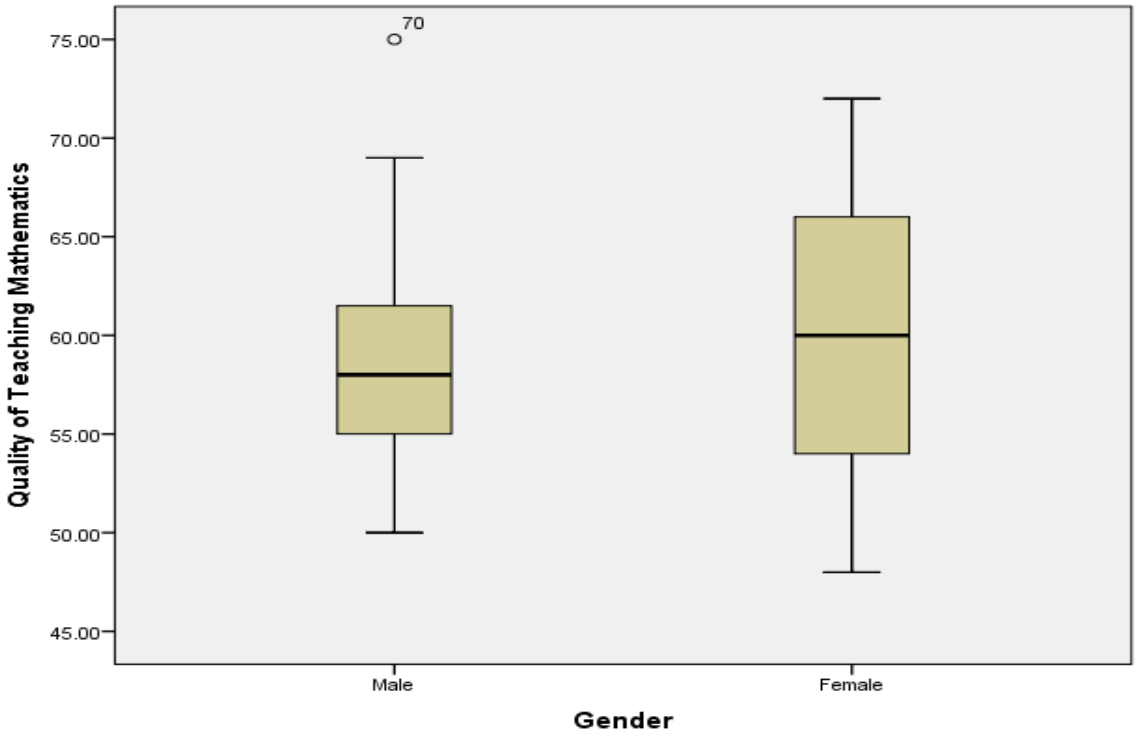

Figure 4.5: Teacher Gender and quality of teaching Mathematics

The boxplot for male is moderately symmetrical as the box is almost in the middle of the whiskers and the median is almost slightly below the middle of the box. This suggests that

the data is very slightly positively skewed. From this plot, teacher number 70 had the highest score of 75%. The boxplot for female teachers is symmetrical and this shows that the data from observation on quality of teaching mathematics was normally distributed. The lowest performance for females was below 50% and the highest performance was above 70%.The difference in teacher gender performance as was produced by descriptive statistics shows difference in mean and this was established by independent sample t-test to be insignificant showing that both gender can teach mathematics. It is not what scientist of the 1887 believed in that women had small brains and therefore could not perform in mathematics. According to a publication by Dar-Nimrod and Heine(2006) it says that women's mathematics performance is affected by stereotypes that link female underachievement to either genetic or experiential causes.

When SQASO were interviewed to give their opinion on whether gender determines quality of teaching mathematics, they gave the following statements:

> *"No, it depends on the teacher's approach of teaching". SQASO 1*
> *"No, it depends on an individual teacher's attitude towards the subject". SQASO 2.*
> *"No, it depends on the teacher's content knowledge and experience in the subject". SQASO 3*
> *"No, it depends on a teacher's background in mathematics and also attitude towards the learners". SQASO 4.*
> *No, all teachers are capable of teaching mathematics so long as they have the interest and knowledge of the subject". SQASO 5.*
> *"No, regardless of gender, it is an individual teacher's decision to make learners perform". SQASO 6.*

These excerpts imply that gender does not influence quality of teaching which results to students' achievement in mathematics.

4.6.1 Gender qualification and interaction analysis on quality of teaching mathematics

Interaction analysis according to this study shows that teacher qualification is only important amongst female teachers that is a female teacher with a Masters' degree, on average will have a higher quality of teaching than a female teacher with B.Ed./PGDE and diploma. This is as shown in Figure 4.6.

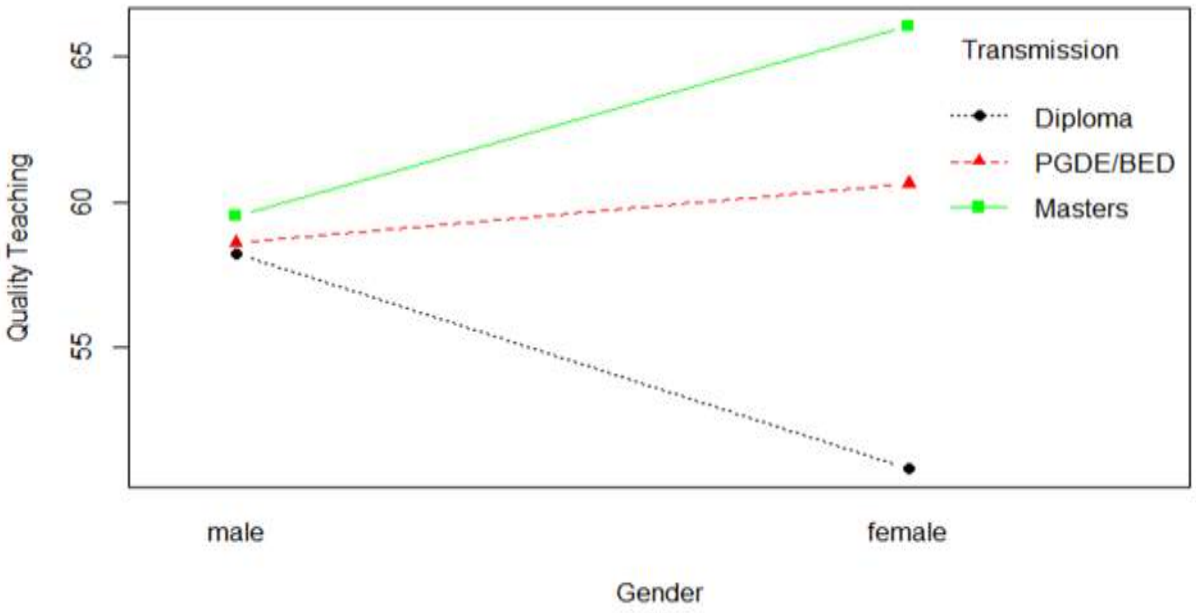

Figure 4.6: Interaction analysis of gender on quality of teaching mathematics

Apparently, male teacher qualification did not affect quality of teaching as established in the interaction analysis since their performance during lesson observation had no serious differences.

4.6.2 Relationship between Quality of Teaching Mathematics and teacher Gender using independent sample t-test

After determining teacher gender and their performance on quality of teaching mathematics, it was necessary to establish influence of teachers' gender on quality of teaching mathematics. In order to establish influence of teacher gender on quality of teaching

mathematics, data on teacher gender and quality of teaching mathematics was produced from Appendix VIII. Independent Sample t-test was run to show whether gender is significant in quality of teaching mathematics which produced group statistics as shown in Table 4.16 and independent sample t-test as shown in Table 4.17.

Table 4.16: Teacher gender group statistics

Gender	No. of teachers	Mean	Std Deviation	Std Error Mean
Male	47	58.79	5.171	.754
Female	23	59.74	7.117	1.484

Table 4.16 shows that the number of male teachers was more than that of females teachers by 24 and the mean difference in quality of teaching mathematics between female teachers and male teachers was 0.95. Table 4.17 shows independent sample t-test showing Levene‘s Test for Equality of variance.

Table 4.17 Independent Sample t-test

	Levene's test for equality of variance		t-test for Equality of means					95% Confidence	
	F	**Sig**	**t**	**df**	**Sig(2-tailed)**	**Mean difference**	**Std Error Difference**	**lower**	**upper**
Equal Variance assumed	6.526	.013	-.637	68	.526	-.952	1.494	-3.933	2.030
Equal Variance not assumed			-.572	33.755	.571	-.952	1.665	-4.336	2.432

The results from Table 4.17shows independent sample t-test which was run to determine if there were significant differences in quality of teaching mathematics between male and female teachers. Independent sample t-test indicates that although there is difference in means in quality of teaching mathematics between female (m= 59.74, SD = 5.171) and for male (m =58.79, SD =5.117), the difference was not statistically significant [t = -.572, p = .571]. However from the above independent sample t-test results, there is an indication that equality of variance was not assumed (p =.526) hence the interpretation was made on the basis of non-equality of variance. Homogeneity of variance was violated as assessed by Lavene's Test for Equality of variances (p=0.13) for separate variances. Based on the findings of the study it was established that gender of the teacher does not significantly influence quality of teaching mathematics.

Female teachers teaching mathematics act as role models to girls. In this case girls being taught mathematics by a female teacher should learn from them and reason out that mathematics is not only for males. Mathematics is a science subject and some gender- based Science researchers have reported that both the "feminist empiricists" and the "liberal feminists' critic" seem to agree is that female in principles will produce exactly the same scientific knowledge as males provided that sufficient rigour is undertaken in scientific inquiry (Howes, 2002; Sinnes, 2005). The highest performance in mathematics was confirmed by results produced by one of the girls secondary school who topped in Mathematics in KCSE examination in Kenya in 2009 (Mutiembi, 2010).

The finding is in contrast with Zogheib *et al.* (2015) who found significant correlation between instructor's gender and students' performance in the study of university students' achievement in mathematics. Similarly, Sparks (2013) found that female elementary school

teachers gave boost to female pupils. This may not be applicable in high school given that the students' sense of reasoning is more developed at this level as they are interested in teachers content knowledge while at elementary schools, pupils see teachers to be like their parents especially girls when they are being taught by female teachers.

4.7 Combined influence of teachers' qualification, experience and gender on quality of teaching mathematics

Academic qualification was in terms of diploma or degree obtained by teachers in mathematics, while teaching experience referred to number of years a teacher has taught mathematics in secondary school after undergoing pre-service training. The teaching experience was categorized as follows: below 3 years (novice); 3-5 years (little experience); 6-10 years (medium experience), over 10 years (very experienced).Finally gender referred to either male or female teacher. Analysis of LOG confirms that teachers with a Master's degree performed the best with an average score of 67.3%. On teachers' experience, those with experience of over 10 years performed best with an average score of 63.8%, on gender the average score of female teachers was 59.74 while for the male teachers average score was 58.79.

4.7.1 Relationship between Teachers' qualification , experience and gender on quality of teaching Mathematics

The study sought to investigate the overall combined influence of teachers' qualification, experience and gender on quality of teaching mathematics. A multiple regression analysis was used to establish a linear model that could be used to estimate the optimal level of quality of teaching mathematics among public secondary school teachers given various aspects of their demographic background. Academic qualification was measured in three categories

(Diploma in Education, B.ED/PGDE and M.ED in Mathematics), while teaching experience referred to number of years a teacher has taught mathematics in secondary school after undergoing pre-service training and was categorized as: below 3 years (novice); 3 -5 years (little experience); 6-10 years (medium experience), over 10 years (very experienced) and finally gender referred to either male or female teacher. The dependent variable was quality of teaching mathematics, measured in continuous variable. Given that, academic qualifications and teachers' experience were in categorical form with more than two attributes, the two variables were first converted into dummy variables. This was necessary to make interpretation of the results meaningful. The priori significant level was set at .05, such that if the *p*-value was less than 0.05, the null hypothesis would be rejected and conclusion reached that the three combined teacher demographic background has statistically significant influence on quality of teaching mathematics. If the *p*-value was greater than or equal to 0.05, it would be concluded that a significant difference does not exist.

Multiple regression analysis was run to show the Coefficients of multiple determination on combined influence of qualification, experience and gender on quality of teaching mathematics as shown in Table 4.18.

Table 4.18:The Coefficient of multiple determination on Influence of Teacher Qualification, Experience and Gender on Quality of Teaching Mathematics

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.688[a]	.474	.424	4.46182	1.967

The model summary reveals that teachers' qualification, experience and gender explain 42.4%, as signified by the Adjusted R^2=.424, of the variation in the quality of mathematics in public secondary schools in Kisumu County. This implies that about 42.4% of the cases of disparity in quality of teaching mathematics among secondary schools in Kisumu County is explained by differences in teachers' qualification, experience and gender. The remaining 57.6 % can be attributed to other factors such as school background, student factors and students' background. Equally, Analysis of Variance was conducted to establish whether these variables combined is a significant predictor to the quality of teaching mathematics, as shown in Table 4.19.

Table 4.19: ANOVA- Influence of Teacher Qualification, Experience and Gender on Quality of Teaching Mathematics

	Sum of Squares	df	Mean Square	F	Sig.
Regression	1128.677	6	188.113	9.449	.000[b]
Residual	1254.194	63	19.908		
Total	**2382.871**	**69**			

Dependent Variable: Quality of Teaching Mathematics

Predictors: (Constant), M.ED in Mathematics, 6-10 Years, Gender, 3-5 Years, B.ED/PGDE, Over 10 Years

Table 4.19 on ANOVA output provides the results of a test of significance for *R* and *R* square using the *F* statistic. In this analysis, the p value is well below .05 ($p < .001$) and therefore, it was established that *R*, R^2, and Adjusted R^2 for the multiple regression was conducted to predict quality of teaching mathematics in public secondary schools. Based on the linear combination of teachers' qualification, experience and gender combined is statistically significant, F (6, 63) =9.449, p<.05. This suggests that the knowledge on teachers'

qualification, experience and gender combined can be significantly used to predict the level of quality of teaching mathematics among teachers teaching in public secondary schools.

This finding is in line with Ogbonnaya (2007) who found significant positive relationship between students' academic achievement in mathematics and teachers qualification, subject major and experience of over 6 years, although Ogbonnaya studied students achievement in mathematics, the study did not combine gender and did not also find out quality of teaching mathematics by INSET trained teachers. Studies by Musau *et al*.(2013); Kimani *et al*. (2013); Mbugua *et al*. (2012) found contradicting results when they studied teachers professional qualification and teaching experience on students' academic achievement which were not significantly related, these studies did not as well include gender.

Table 4.20 shows the values of the coefficient of the regression model.

Table 4.20 Regression Coefficients- Influence of Teacher Qualification, Experience and Gender on Quality of Teaching Mathematics

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	50.760	2.805		18.095	.000	45.155	56.366
Gender (Female)	.131	1.206	.011	.109	.914	-2.279	2.542
3-5 Years (Moderate)	.580	2.324	.043	.250	.804	-4.065	5.225
6-10 Years (High)	.812	2.247	.067	.361	.719	-3.679	5.302
Over 10 Years (Very high)	5.141	2.300	.409	2.235	.029	.545	9.737
B.ED/PGDE (High)	6.040	1.972	.414	3.063	.003	2.100	9.980
M.ED in Mathematics (Very High)	11.808	2.734	.644	4.320	.000	6.345	17.270

Dependent Variable: Quality of Teaching Mathematics

Y= Quality of teaching mathematics

X_1 = Gender (Female)

X_2= Teaching experience (3-5 years)

X_3=Teaching experience (6-10 years)

X_4=Teaching experience (over 10 years)

X_5= Teacher qualification (B.ED/PGDE)

X_6=Teacher qualification (M.ED in Mathematics)

From Table 4.20, the multiple regression model is shown below as follows:

$Y= 50.760 + .131\ X_1 + .580\ X_2 + .812\ X_3 + 5.141\ X_4 + 6.040\ X_5 + 11.808\ X_6$ ……..(1)

The result indicates, first, that the intercept is statistically significant as indicated by unstandardized coefficient of 50.760 (*SE*=2.805) units in quality of teaching mathematics when all independent variables have a value of zero. Then, moving through the equation, holding teachers' qualification and experience constant, the regression coefficient for the

gender dummy variable, with male as the reference group is .131, which means that female teachers recorded .131 units improvement in quality of teaching mathematics more than their male counterparts when each of them increase their effort by one unit. However, the p-value for gender is not statistically significant (p = .914) indicating that even if female teachers improve on quality of teaching mathematics than their male counterparts, when each of them improve their teaching by one unit, the difference in improvement on quality of teaching mathematics is not statistically significant. On teachers' teaching experience, with teachers of low experience (below 3 years) as reference group, the results of the analysis show that teachers who are very highly experienced (over 10 years) has a coefficient of 5.14 (SE=2.3). The p-value for this coefficient is statistically significant (p=.029), meaning that when very highly experienced mathematics teachers improve their effort by one unit, the quality of teaching mathematics improves by 5.14 units more than the amount by which the low experienced teachers (below 3 years) would improve with when they increase their effort by the same magnitude. However, there was no statistical significant difference in improvement in quality of teaching mathematics among other levels of experience.

On teachers' qualification, using Diploma in education as a reference group, the results of the survey show that teachers who are very highly qualified (M.ED in education) has a coefficient of 11.808 (SE=2.743). The p-value for this coefficient is statistically significant (p=.000), meaning that when very highly qualified mathematics teachers improves their effort by one unit, the quality of teaching mathematics improves by 11.808 units more than the amount by which the low qualified teacher (Diploma in education) would improve with when they increase their effort by the same magnitude. However, there was statistical significant difference in improvement in quality of teaching mathematics among teachers with a level of qualification of B.ED/PGDE.

The unstandardized coefficients for teachers' qualification with masters in mathematics education and teachers with experience of over 10 years if combined would determine teachers' quality of teaching mathematics hence improvement in students achievement in mathematics. This is in contrast with other studies done on teachers professional qualification and teaching experience who found that they were not significantly associated with students achievement (Kimani *et al*.2013; Mbugua *et al*.2012).The contrary results show that researchers have not reached a consensus on which variable is the most significant and can influence quality of teaching mathematics . Similarly, there was another contrary finding by Martin *et al.*(2000) and Wenglinsky (2002) who found that the number of years in teaching is not associated with students' achievement. Those teachers who make students perform well and are not experienced could be as a result of effective training they got when they were in college.

The results is in line with a study done by Obumanu (2011) who found that lack of qualified teachers' contributed to consistent poor performance in mathematics, science and technology. A large number 26 out of 70 teachers in Kisumu county had teaching experience of between 6 -10 years, while another number of teachers 22 had experience of over 10 years. This finding is also in line with studies done by Adeyemi (2008); Yara and Wanjohi (2011) and Temitope and Olabanji (2015) who found that teachers experience influence students' academic performance. In other words, schools having more teachers with over 10 years teaching experience are in a position to achieve better results from students. If teachers could use their teaching experience in teaching mathematics in secondary schools there would be quality results from students hence majority being admitted direct to the university (Betts *et al*.2003; Rivkin *et al.* 2005).

4.8 Influence of teachers' perception of in-service program on Quality of Teaching Mathematics.

Teachers' perception of in-service program on quality of teaching mathematics was sought. Data on teacher perception was collected from MTQ which was attached as Appendix I. Before ascertaining the relationship between teachers' perception of in-service program quality of teaching mathematics, the study sought to establish teachers' perception of in-service program in secondary schools in Kisumu County.

4.8.1 Teachers perception of in-service program

This study endeavored to establish the perception teachers had towards in-service program which included attitudinal change, Pedagogy (ASEI-PDSI), implementation of ASEI-PDSI and assessment and evaluation of learners work. A Likert scale in the MTQ, section 2 was used to obtain information on teachers' perception. Teachers' were to choose one of the options: Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly Disagree (SD).This was done to 70 teachers. The mean for perception teachers had towards in-service program was worked out by adding all respondents' mean obtained from the five statements for each construct and the sum divided by five since they were five statements and every teacher responded to all of them. Individual teachers who attained mean of between 3.50 to 5.00 were considered to have a positive perception towards the in-service program while those who got a mean of between 2.50 to 3.49 were considered to have undecided perception for the in-service program. Teachers who had mean between 1.00 to 2.49 were considered to have presented a negative perception towards the in- service program (Kothari, 2004).

4.8.2 Teachers perception of in-service program on Attitudinal change

Mathematics teachers showed their perception towards in-service program on attitudinal change by responding to statements 1 to 5 in the Likert scale as shown in Table 4.21 which was drawn from Appendix 1.

Table 4.21: Teachers perception of in-service program on attitudinal change

	Statements	SA, no.,%	A, no., %	U no., %	D no., %	SD no., %	Mean	Perception
1.	SMASSE INSET has enabled change teachers attitude towards mathematics	8 (11.4)	48 (68.6)	8 (11.4)	3 (4.3)	3 (4.3)	3.71	Positive
2.	I am not able to determine the causes of acquired attitude	7 (10)	44 (68.6)	3 (4.3)	14 (20.0)	2 (29.0)	2.46	Negative
3.	Negative attitude towards mathematics has no effect on teaching and learning.	1 (1.4)	1 (1.4)	3 (4.3)	23 (32.9)	42 (60.0)	4.45	Positive
4.	I now understand attitude formation may result from observation.	13 (18.6)	42 (60.0)	8 (11.4)	6 (8.6)	1 (1.4)	3.86	Positive
5.	As a teacher I form an attitude towards mathematics due to entry behavior of learners.	6 (8.6)	17 (24.3)	3 (4.3)	27 (38.5)	17 (24.3)	3.41	Undecided
	Overall Mean						**3.58**	**Positive**

Key

SA-Strongly Agree, A-Agree, U-Undecided, SD-Strongly Disagree, D-Disagree, no., number of respondents not in bracket, %-number of respondents as a percentage in bracket.

It is evident from Table 4.21 that 8 (11.4%) teachers are those who strongly agreed that SMASSE INSET has enabled change learners attitude towards mathematics while a 48(68.6%) teachers are those who agreed with the statement. Only 3 (4.3%) strongly disagreed with the statement. The number of teachers 8(11.4%) were undecided with the statement. When analysis of the teachers responses was done on statement 1, it produced a mean of 3.71.Given the mean of 3.71, the responses of teachers is positive. This means that learning can be enhanced if both the teachers and students have a positive attitude.

On statement 2, 7(10%) teachers strongly agreed that they were not able to determine the causes of acquired attitude and 44(62.8%) teachers are those who agreed with the statement. A number of 14(20%) teachers are those who disagreed with statement 2. Only 3(4.3%) teachers are those who were undecided. When analysis of statement 2 was done, it produced a mean of 2.46.Response to statement 2 is negative. It means that although the teachers have attended the in-service program, still they cannot determine causes of acquired attitude which should not be the case hence confirming their negative perception.

On statement 3, a considerable number 42(60%) teachers are those who strongly disagreed that negative attitude towards mathematics has no effect on teaching while another number 23(32. 9%) teachers disagreed with the statement. A teacher (1.4%) is the only one who strongly agreed with the statement. A small number 3(4.3%) were undecided. When analysis of statement 3 was done, it produced a mean of 4.45.Response of teachers' statement 3 is positive. From their response, it means that both the students and teachers negative attitude has an effect on learning and teaching which may affect performance in the subject. Although a study conducted by Third International Mathematics and Science Study (TIMSS) revealed that while Japanese students outperformed students from many other countries in

mathematics, they displayed relatively negative attitude towards mathematics (Mullis, 2000). Teachers response to statement 3 is in support with a quote which says, “No matter where you are, your dreams are valid and that the only disability in life is bad attitude” (Lupita, 2014).

On statement 4, a small number 13(18.6%) teachers and 42(60%) teachers are those who strongly agreed and agreed respectively that they understand attitude formation may result from observation while a small number 6 (8.6%) teachers and 1(1.4%) teacher disagreed and strongly disagreed with the statement. A number of 8(11.4%) teachers were undecided. When analysis was done on statement 4, it produced a mean of 3.86. Response to statement 4 is positive, this is so since teachers are able to understand that attitude formation may be as a result from observation. Students may learn attitude by observing people around them that is their classmates, those ahead of them in other classes or people they live with at home.

On statement 5, a number of 17(24.3%) teachers are those who agreed that as teachers they form an attitude towards mathematics due to entry behavior of learners. While 27(38.5%) teachers are those who disagreed with the statement. When analysis of statement 5 was done, it produced a mean of 3.41.Response of teachers to statement 5 was undecided, this means they are neither positive nor negative on the statement about formation of attitude towards mathematics which comes as a result of entry behavior of learners.

Overall mean for the perception of teachers towards in-service program on attitudinal change was worked out by adding all respondents’ scores obtained from the perception scale in relation to statements that addressed the objective of in service program towards attitudinal change and divided by three hundred and fifty. Based on the results which produced a mean

of 3.58, it showed that teachers were positive about the in-service program on attitudinal change. The overall mean could be interpreted as meaning that teachers attended the in-service therefore they are familiar with issues to do with attitudinal change.

To confirm these findings, qualitative data from teachers was collected when they were asked to write the strength of the in service program they attended in mathematics. The following verbatim remarks on in service program were noted:

> *"The in service program has helped to improve learners attitude towards mathematics".* (Teacher 13).
> *"It has helped change the attitude of both teachers and students in mathematics".* (Teachers 34)
> *"It has enabled teachers to change their perception of teaching mathematics". (Teacher 37*).

From the above statements, it shows that the in service program has changed teachers' attitude towards the teaching of mathematics. From the training teachers should be able to change students' attitude to be positive towards the learning of mathematics. This is supported by (Gabrscek & Roeders, 2013) who stated that it is the responsibility of INSET providers to provide efficient and effective in service training that enables teachers to meet new demands in their work places. This should be so, because at the end of INSET course teachers are expected to fully obtain and acquire intended knowledge, skills and attitude, apply them to practice, through their application this influences students learning and teachers achievement in those schools hence bringing required changes both attitude and performance in mathematics.

When SQASO were interviewed to describe teachers' perception of INSET program on attitudinal change towards mathematics as they observe them in class, they gave the following statements:

"They like the program because it gives them a free day from school". SQASO 1.

"Most of them are negative about it hence are not serious". SQASO 2,
"Others have a neutral perception since they are coerced to attend the in-service program". SQASO 5.

The above excerpts imply that teachers are negative about the in-service program until some of the teachers do not value it instead see it as a free day to go and relax.

INSET Trainers were also asked to describe mathematics teachers' perception of INSET program and they gave the following statements:

"Some teachers are positive while others are not''. IT 1
"They are positive though they complain of syllabus coverage". IT 6
"Most of the teachers are undecided". IT 4
"Some of them are negative since performance of students at KCSE has not improved". IT 16

These statements given by the INSET Trainers imply that some of the teachers are positive though the degree of positivity has not been expressed, while others are undecided about the program and this has been expressed by a good number of the trainers and some are negative due to lack of impact on students improved performance. These statements express teachers' negative perception of SMASSE in service program. Ngesa (2013) studied factors influencing teachers perception on effectiveness of SMASSE project on teaching of mathematics in secondary schools in Westland District, Kenya which revealed that teachers had a negative attitude towards the in-service program. The factors studied included environment under which the in-service program was conducted and benefits that teachers receive after attending the program, but did not look at teachers' perception in relation to the objective of the in-service program on attitudinal change. Therefore this was the gap that the study sought to fill.

4.8.3 Teachers perception of in-service program on pedagogy (ASEI/PDSI)

Mathematics teachers showed their perception towards in-service program on pedagogy (ASEI-PDSI) by responding to statements 6 to 10 in the Likert scale as shown in Table 4.22 which was drawn from Appendix 1.

Table 4.22: Teachers perception of in- service program on pedagogy (ASEI-PDSI).

	Statement	SA no.,%	A no.,%	U no.,%	D no.,%	SD no.,%	Mean	Perception
6.	I am able to identify key elements of ASE-PDSI since I attended the INSET program	14 (20.0)	41 (58.6)	9 (12.8)	6 (8.6)	0 (0.0)	3.90	Positive
7.	I practice activity-based teaching because I understand ASEI-PDSI condition.	11 (15.7)	41 (58.6)	10 (14.3)	8 (11.4)	0 (0.0)	3.80	Positive
8.	I do not allow students to evaluate my lesson though it is part of ASE-PDSI approach.	2 (2.8)	18 (25.7)	9 (12.9)	28 (40.0)	13 (18.6)	3.46	Undecided
9	Since attending SMASE INSET I use team teaching method in teaching my lesson.	24 (34.3)	28 (40.0)	10 (14.3)	8 (11.4)	0 (0.0)	3.97	Positive
10	**I feel SMASE INSET program has not simplified the teaching of secondary maths through ASEI-PDSI approach**	**18 (25.7)**	**37 (52.9)**	**4 (5.7)**	**8 (11.4)**	**3 (4.3)**	**3.84**	**positive**
	Overall Mean						**3.79**	**Positive**

Key

SA-Strongly Agree, A-Agree, U-Undecided, D-Disagree, SD-Strongly Disagree, no., number of respondents not in bracket, %-number of respondents as a percentage in bracket.

From Table 4.22, a large number 41(58.6%) teachers agreed that they are able to identify key elements of ASEI-PDSI since they attended the INSET program while a minority 6(8.6%) teachers disagreed with the statement. A minority 6(8.6%) were undecided on the statement. When analysis of statement 6 was worked out it produced a mean of 3.90. The mean shows that teachers had a positive perception towards statement 6. Teachers perception on this statement contradicts the results established from Lesson Observation Guide (LOG) on use of ASEI/PDSI which had a mean of 2.27 out of a maximum score of 6 as shown in Appendix VII.

On statement 7, a large number 41(58.6%) teachers agreed that they practice activity- based teaching because they understand ASEI/PDSI condition while minority 8(11.4%) teachers disagreed with the statement. A minority 10(14.3%) were undecided. When analysis of statement 7 was worked out, it produced a mean of 3.80. This mean was interpreted as teachers having a positive perception towards the statement. This was in contrary with teachers performance during lesson observation as established in Appendix VII.

On statement 8, a sizeable number 18 (25.7%) teachers agreed that they do not allow students to evaluate their lessons though it is part of ASEI-PDSI approach, a sizeable number 28(40%) disagreed respectively with the statement. When analysis of statement 8 was done, it produced a mean of 3.46.This mean was interpreted as teachers being undecided on this statement. This was supported by results from LOG which established that most teachers had no lesson plans which when analyzed produced a mean of 2.64 out of a maximum of 10 as shown in Appendix VII.

On statement 9, sizeable number 28(40%) teachers agreed that since they attended the INSET program they use team teaching method in their lesson while a minority 8(11.4%) teachers disagreed with the statement. When analysis of statement 9 was done it produced a mean of 3.97.This mean was interpreted as teachers having a positive attitude towards the statement. This is in contrast with results from LOG which established that teachers do not use resource materials whose mean was worked out and produced a mean of 5.24 out of a maximum of 15 as shown in Appendix VII.

On statement 10, a large number 37(52.9%) teachers are those who agreed that SMASSE INSET program has not simplified the teaching of secondary mathematics through ASEI/PDSI approach. A minority 8(11.4%) teachers are those who disagreed on the statement. When analysis of statement 10 was worked out, it produced a mean of 3.84 which was interpreted as positive. Though the statement is positive, most of the teachers did not use ASEI-PDSI method during lesson observation as was established by the results of LOG in Appendix VII on page 187.

Overall mean for the perception of teachers towards in-service program on pedagogy (ASEI-PDSI) was worked out by adding all respondents' scores obtained from the perception scale in relation to statements that addressed the objectives and was divided by three fifty. Based on the results which produced a mean of 3.79 it was established that teachers were positive about the in-service program on Pedagogy (ASEI/PDSI). The overall mean could be interpreted as meaning that teachers' perception on ASEI / PDSI is positive which is contrary to what they do in class. This contrary opinion was supported by the verbatim remark they said "ASEI / PDSI approach *will not allow syllabus coverage due to many activities*". This

remark means that teachers still have issues to do with pedagogy (ASEI/PDSI) and they still need some assistance to overcome the obstacle.

When SQASO were interviewed on whether teachers' use ASEI/PDSI approach, all of them 6(100%) said 'no' and stated reasons that teachers give as to why they do not use the approach:

> *"Lack of materials to make the resources''. SQASO 1*
> *"ASEI/PDSI requires more time hence interfering with completion of syllabus''. SQASO 2*
> *"It requires too many activities which cannot be accomplished within 40 minutes''. SQASO 3*

These excerpts confirm that ASEI/PDSI has not fully been embraced in secondary schools in Kisumu County from the statements given to SQASO by the teachers, during routine lesson observation in classrooms.

To again confirm perception of teachers on pedagogy (ASEI/PDSI), qualitative data from the same teachers was collected when they were asked to write the weakness of SMASSE in-service program they attended in mathematics. The following verbatim remarks on the in-service program were noted:

> *"ASEI-PDSI approach will not allow syllabus coverage due to the many activities". Teacher 11*
> *"The training span for the in- service program is short therefore the pedagogy ASEI-PDSI training should be incorporated in diploma colleges and University level for education students". Teacher 13*

To confirm further the idea of teachers not using ASEI/PDSI principle, Kwamboka (2012) conducted a study on application of ASEI/PDSI in secondary schools in the then Nakuru County which revealed that the principles of ASEI/PDSI were yet to be fully realized.

INSET trainers were also interviewed on whether teachers apply ASEI/PDSI in class, the following statements were noted:

> *"There are challenges with implementation of ASEI/PDSI", IT 15*
> *"It depends on availability of materials to be used sin handling a particular topic".IT 13*
> *"To some extent since it requires a lot of time". IT 9*

These statements by INSET trainers confirm that there is partial use of ASEI/PDSI approach in schools within Kisumu County. Therefore the statements given by the teachers themselves contradicts their positive perception of pedagogy (ASEI/ PDSI).What teachers say is not what they do in class as was established by the observation done in class by the researcher.

4.8.4 Teachers perception of in-service program on implementation of ASEI/PDSI

Mathematics teachers showed their perception towards in service program on implementation of ASEI/PDSI by responding to statements 11 to 15 in the Likert scale as shown in Table 4.23 which was drawn from Appendix 1.

Table 4.23: Teachers' perception of in-service program on Implementation of ASEI- PDSI

	Statements	SA no.,%	A no.,%	U no.,%	D no.,%	SD no.,%	Mean	Perception
11.	I accept that scheming is an important planning tool for teaching.	42 (60.0)	28 (40.0)	0 (0.0)	0 (0.0)	0 (0.0)	4.60	Positive
12.	I believe that I must use teaching learning materials to arouse interest in learners.	47 (67.1)	23 (32.9)	0 (0.0)	0 (0.0)	0 (0.0)	4.67	Positive
13.	My school administrator should provide materials to be used in improvising teaching learning resources.	37 (52.9)	25 (35.7)	2 (2.9)	5 (7.1)	1 (1.4)	4.31	Negative
14	I am not able to identify criteria for selection of teaching learning resources.	28 (40.0)	23 (32.8)	7 (10.0)	9 (12.9)	3 (4.3)	2.08	Negative
15.	I take too long in preparing ASEI-PDSI lesson plan.	7 (10.0)	32 (52.9)	12 (17.1)	11 (15.7)	3 (4.2)	2.51	Undecided
	Overall Mean						**3.11**	**Undecided**

Key

SA-Strongly Agree, A-Agree, U-Undecided, D-Disagree, SD-Strongly Disagree, no.-number of respondents not in bracket, %- number of respondents as a percentage in bracket.

Analysis of Table 4.23 above shows that, a large number 42(60%) teachers strongly agreed and also 28(40.0%) teachers agreed that they accept scheming is an important planning tool for teaching and no teacher disagreed with the statement, given these response, teachers perception towards responses to statement 11 was analyzed and produced a mean of 4.60. This mean shows that teachers had a positive perception towards statement 11. The response has been supported by lesson observation guide whose results are in Appendix VII which established that all teachers who were observed teaching mathematics had schemes of work for the classes they taught.

On statement 12, a large number 47(67.1%) teachers said they believe they must use teaching learning materials to arouse interest in learners, a sizeable number 23(32.9%) teachers agreed with the statement. None of the teachers disagreed or strongly disagreed with the statement. When analysis of teachers' responses to statement 11 was done it produced a mean of 4.67.This mean showed that teachers had a positive perception towards the statement. On this statement when teachers were observed in class teaching mathematics, the lesson observation results on Appendix VII, it was noted that 20 teachers did not have teaching resources a part from the mathematics course book. Furthermore, when mean for teaching resources was worked out to show how teachers' performed in this area, it was found to be 5.24 out of 15 which the maximum score was. Therefore the response to statement 12 contradicts what was observed in class.

On statement 13, a large number 37(52.9%) teachers strongly agreed that their school administrators should provide materials to be used in improvising teaching and learning resources while a sizeable number 25(35.7) teachers simply agreed with the statement. A minority 5(7.1%) disagreed and another minority 1(1.4%) strongly disagreed with the

statement. When analysis of statement 13 was done it produced a mean of 1.68. This mean shows that teachers' perception towards the statement is negative. Interpretation of this statement is that teachers feel it is not their responsibility to provide for the teaching learning materials which should be done by heads of schools through the imbursement of funds by the ministry of education in Kenya. Farrant (2004), says the most common excuse made by teachers for not using teaching resources are "they are difficult to obtain and expensive to buy".

On statement 14, a sizeable number 28 (40%) teachers strongly agreed that they are not able to identify criteria for selection of teaching learning resources while another sizeable number 23(32.8%) teachers simply agreed with the statement. A minority 3(4.3%) teachers strongly disagreed and another minority 9(12.9%) teachers disagreed with the statement. when analysis of statement 14 was done, it produced a mean of 2.08.This mean shows that teachers perception towards the statement is negative. It can be interpreted as meaning that, due to lack of knowledge on the criteria for selection of teaching learning resources the teachers have decided not to use the resources in their teaching which was confirmed from Appendix VII where the LOG established that the mean on use of resources was 5.24 out of a maximum of 15.

On statement 15, a sizeable number 32 (52.9%) teachers agreed that they take too long in preparing ASEI-PDSI lesson plan while a minority 7(10.0%) strongly agreed with the statement. A minority 12(17.1%) teachers were undecided while another minority 11 (15.7%) teachers disagreed with the statement. When analysis of statement 15 was done it produced a mean of 2.51. This mean was interpreted as teachers being undecided on the statement. The undecided perception has been confirmed by results of LOG which established that 35

teachers did not prepare lesson plans. Furthermore, when mean was worked out on this area under lesson plan, it was 2.64 out of a maximum of 9. Armstrong et al. (2010) assert that in order to provide quality experiences for all learners, lessons must be planned and prepared properly for quality teaching and learning. In this study 36 out of 70 teachers did not make a lesson plan.

Overall mean score for the perception of teachers towards in service program on implementation of ASEI-PDSI was worked out by adding all respondents' scores obtained from the perception scale in relation to statements that addressed the objective towards implementation of ASEI-PDSI and divided by three hundred and fifty. Based on the results which produced a mean of 3.63 it showed that teachers were positive on implementation of ASEI/PDSI of in- service program. The overall mean could be interpreted as meaning that although teachers are for the idea of implementation of ASEI / PDSI, but because of time factor, they are not able to do so since they want to clear the syllabus.

The teachers had the following to say on implementation of ASEI /PDSI when qualitative data was used:

> *"Many resource materials are needed during the lesson which is not available instead I end up conducting the lesson without the materials to support the topic making mathematics to be more abstract to the learners". Teacher 68*
>
> *"Some activities are not applicable since they require a lot of time and we are competing to clear the syllabus by term two". Teacher 55*
>
> *"Lack of follow up on implementation of INSET program in schools to ensure the activities are applied in classrooms". Teacher 42*

Further data was gathered from mathematics INSET trainers (IT) interview on implementation of ASEI-PDSI approach. The following statements were made:

> *"Most teachers conduct lessons without lesson plans". IT 1*

"Lesson planning is done to some extent though not much". IT 2
"Many teachers still do not understand how to make ASEI/PDSI lesson plan due to cycles being widely separated".IT 10
"They do apply ASEI/PDSI approach though it is not effectively done". IT 14
There are challenges with implementation of ASEI-PDSI one of them being lack of support from the school administrator". IT 15

From SQASO interview the following statements were noted in support of the neutral perception of teachers on implementation of ASEI-PDSI as follows:

"Lack of materials to use and also lack of interest to make the resources" and also, "the teachers are after the completion of syllabus while ASEI-PDSI requires a lot of time". SQASO 4
"Teachers rarely use learning resources in class because they do not make lesson plans which will indicate the resource material to be used". SQASO 2

This finding is in agreement with Ndirangu *et al.* (2017) who studied the level of implementation of ASEI/PDSI classroom practices in science subjects: A case of SMASSE project which revealed that ASEI/PDSI has partially been implemented.

The above statements by both INSET trainers and SQASO confirms the undecided teachers' perception of in-service program on implementation of ASEI-PDSI. Some of the statements are in agreement with a study conducted by Ramatlapana (2009) in Botswana to investigate perceptions of mathematics and science teachers towards INSET provision, whose findings showed that teachers concern was lack of support during implementation of content.

4.8.5 Teachers perception of in-service program based on assessment and evaluation of learners work

Mathematics teachers showed their perception towards the objective of in service program on assessment and evaluation of learners work by responding to statements 16 to 20 in the Likert scale as shown in Table 4.24 which was drawn from Appendix 1

Table 4.24: Teachers perception of in-service program based on assessment and evaluation of learners work

	Statement	SA no.,%	A no.,%	U no.,%	D no.,%	SD no., %	Mean	Perception
16.	Though I attended SMASE INSET l cannot distinguish between assessment and evaluation.	0 (0.0)	8 (11.4)	7 (10.0)	32 (45.7)	23 (32.9)	4.00	Positive
17.	I do not prefer peer assessment to help me improve quality of learning and empower students	15 (21.4)	45 (64.3)	0 (0.0)	5 (7.1)	5 (7.1)	3.79	Positive
18.	It is possible to use project method assessment in mathematics.	1 (1.4)	11 (15.7)	3 (4.3)	35 (50.0)	20 (28.6)	2.30	Negative
19.	For assessment to be reliable, the scoring applied should be consistent with the purpose.	13 (18.6)	56 (80.0)	0 (0.0)	1 (1.4)	0 (0.0)	4.21	Positive
20.	As I construct classroom tests, I consider objectives of the syllabus, academic level of learners and length of test.	39 (55.7)	30 (42.9)	1 (1.4)	0 (0.0)	0 (0.0)	4.47	Positive
	Overall Mean						**3.75**	**Positive**

KEY

S A- Strongly Agree, A- Agree, U-Undecided, D-Disagree, SD-Strongly Disagree, no., number of respondents, %- number of respondents as percentage in bracket

Analysis of Table 4.24 on statement 16, shows that a sizeable number 32(45.7%) teachers disagreed with the statement that though they attended SMASE INSET they cannot distinguish between assessment and evaluation and also another sizeable number 23(32.9%) teachers strongly disagreed with the statement. A minority 8(11.4%) teachers agreed with the statement while a minority 7(10.0%) were undecided. When analysis of statement 16 was worked out, it produced a mean of 4.00.This mean was interpreted as meaning that teachers had a positive perception towards the statement. Since majority 55(78.6%) disagreed and strongly disagreed with the statement, this means that they are able to distinguish between assessment and evaluation having attended the in-service hence being positive.

On statement 17, a large number 45(64.3%) teachers agreed that they do not prefer peer assessment to help improve quality of learning and empower students while a minority 15(21.4%) teachers strongly agreed with the statement. A minority 5(7.1%) teachers strongly disagreed with the statement. Analysis of statement 17 produced a mean of 3.79. This was interpreted as teachers had a positive perception towards the statement. This means that teachers can improve quality of learning and empower students on their own without the help of other teachers.

On statement 18, a large number 35 (50%) teachers disagreed with the statement which said that it is possible to use project based assessment in mathematics while another a sizeable number 20(28.6%) teachers strongly disagreed with the statement. A minority 11(15%) teachers agreed with the statement and only a minority of 1(1.4%) agreed with the statement. When analysis of statement 18 was done, it produced a mean of 2.30.This was interpreted as meaning that teachers had a negative perception towards the statement. This means they feel

it is not possible or practical to use project method in teaching mathematics and therefore they do not use.

On statement19, majority 56(80%) teachers agreed that for assessment to be reliable the scoring applied should be consistent with the purpose while a minority 13(18.6%) strongly agreed on the statement. A minority 1(1.4%) teacher disagreed with the statement. When analysis of statement 19 was done, it produced a mean of 4.21. This was interpreted to mean that teachers had a positive perception towards the statement. It means teachers are concerned about scoring of assessment of learners work which should be consistent with the purpose of assessment.

On statement 20, a considerable number 39 (55%) teachers strongly agreed that as they construct classroom tests, they consider objectives of the syllabus, academic level of learners and length of test and also another sizeable number 30(42.9%) agreed with the statement. None of the teachers disagreed or strongly disagreed with the statement. Analysis of statement 20 produced a mean of 4.47. This mean of 4.47 was interpreted as meaning that teachers had a positive perception towards the statement. In other words teachers do as the statement says.

Overall mean for the perception of teachers towards the in-service program on assessment and evaluation of learners work was worked out by adding all respondents' scores obtained from the perception scale in relation to statements that addressed assessment and evaluation of learners work. The obtained sum was divided by three hundred and fifty. Based on the results which produced a mean of 3.75. It showed that teachers were positive on assessment and evaluation of learners' work as provided during in-service program. This could be interpreted as meaning that teachers are doing what they got from the training therefore the

in-service training has had an impact on the way they assess and evaluate learners in classrooms. To confirm the teachers positive perception on assessment and evaluation of learners' work, qualitative data from teachers statements were used which gave statements as follows:

> *"Some assessment methods and teaching methods are difficult to be applied in classrooms". Teacher 32*
> *"Improvement should be done on project based assessment in mathematics Teacher 26*
> *"Most of the assessment methods are not easy to be applied in classroom situation within a lesson". Teacher 56*

The statements are contradicting the positive perception teachers showed on assessment and evaluation of learners work. They are positive about the in service program but from the excerpts it seems they have difficulties which need to be addressed.

The study used box plots to show perception of teachers towards attitudinal change; Pedagogy (ASEI-PDSI); Implementation of ASEI- PDSI and assessment and evaluation of learners work from the in-service program as shown in Figure 4.7.

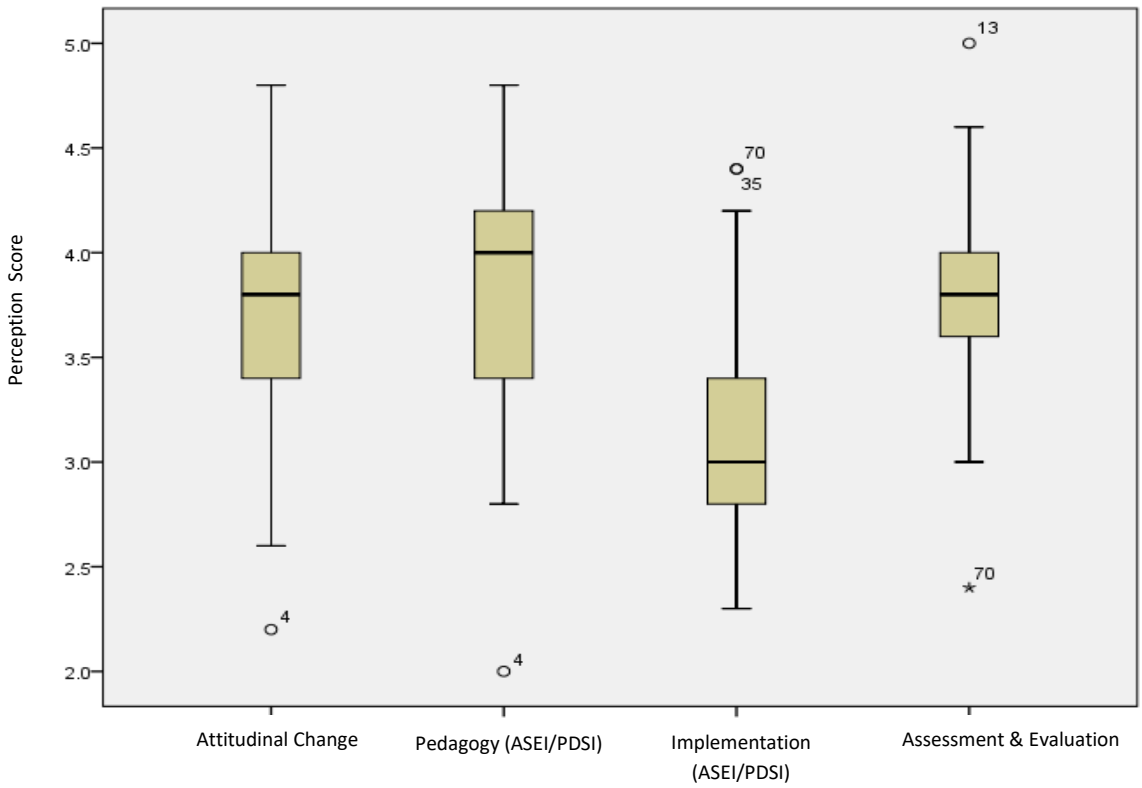

Figure 4.7: Perception of teachers of in-service program

Analyzing the output of Figure 4.7, mathematics teachers' perception towards attitudinal change as shown from the boxplot is negatively skewed to the left and teacher number 4 has the lowest mean score of below 2.5. From the boxplot within this category, the mean is above 3.5 and this has been rated as positive.

The boxplot on teachers' perception towards pedagogy is also negatively skewed to the left. From the length of the two whiskers, it is evident that the scores on perception of teachers within this category was very much spread out. A teacher number 4 in this category had a mean of below 2.00. The overall mean perception for this category was above 3.5 which was rated as positive.

In box plot representing implementation (ASEI-PDSI), the boxplot is positively skewed to the right with the upper whisker very long. This shows that most of the teachers had scores of above 3.00 but below 3.50. From this category 2 teachers' numbers 35 and 70 had perception

scores of over 4.00 while the lowest score was slightly below 2.5. The overall mean for this category was below 3.5 and was rated as undecided.

In boxplot representing evaluation assessment of learners work, the boxplot is symmetrical, meaning that it has a normal distribution. From this category, teacher number 13 had the highest score approaching 5.0 while teacher number 70 had the lowest score of below 2.5. The overall mean score for this category was above 3.5 which was rated as positive.

Teachers overall perception rating was also presented in Figure 4.8.

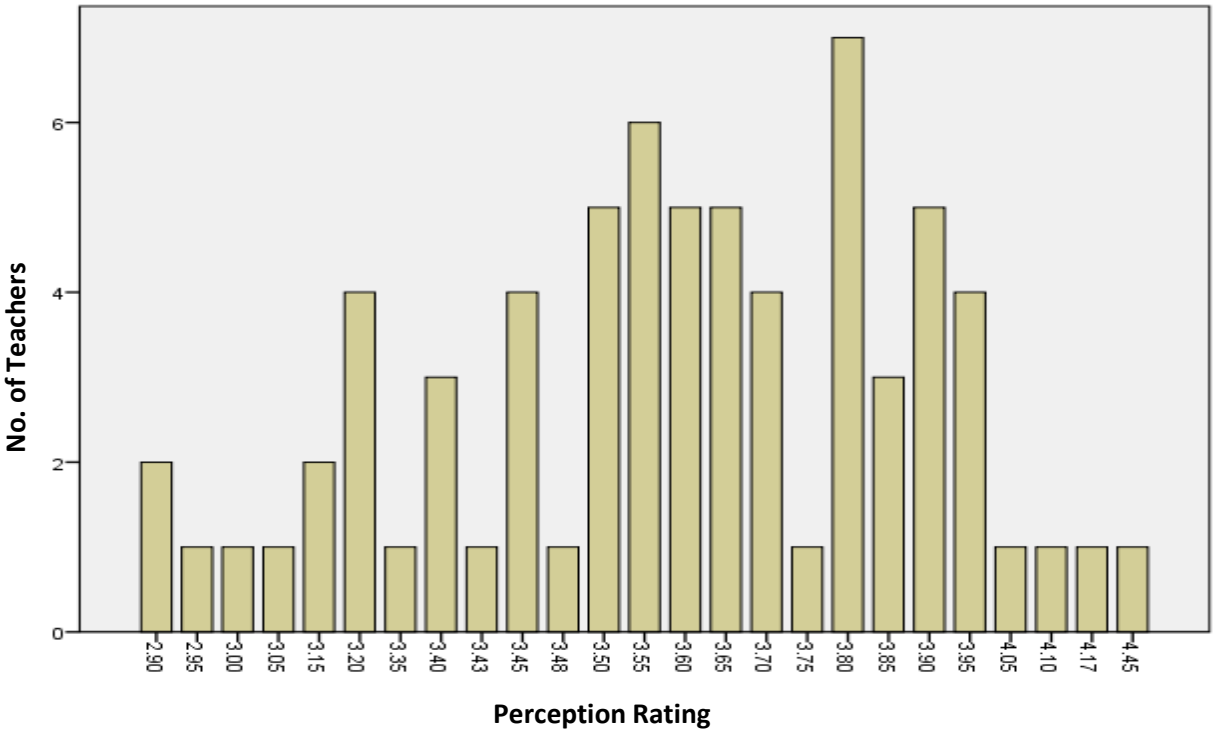

Figure 4.8: Teachers' Perception Ratings

From Figure 4.8, only 2 (2.9%) teachers had perception of 2.90 which according to this study is considered to be undecided. Those teachers who had a score between 2.90 and 2.95 were 3(4.3%) and were also considered to be undecided about the objectives of in-service. A large number of teachers 18 (25.7%) had perception scores between 3.0 and 3.48 which was still

considered as being undecided according to this study. Teachers who had perception scores between 3.50 and 4.45were 49(70.0%) were the ones the study considered to have a positive perception towards the in-service program. The highest score was 4.45 and this came from 1(1.4%) teacher. A score of 3.80 had many teachers 7(10%) as compared with the rest of the scores.

Overall perception of mathematics teachers towards the in- service program is presented in Table 4.25.

Table 4.25: Teachers' overall perception of objectives of in-service Program

Constructs	**Mean score**	**Teachers' Perception**
Attitudinal change	3.58	positive
Pedagogy(ASEI-PDSI)	3.79	positive
Implementation (ASEI-PDSI)	3.11	undecided
Assessment &Evaluation of learners	3.75	positive
Overall	**3.56**	**Positive**

From Table 4.25, teachers' perception towards the in-service program was gauged using four constructs which were attitudinal change, pedagogy (ASEI/PDSI), implementation (ASEI/PDSI), and assessment and evaluation of learners work. The teachers' scores from the constructs showing their perception was worked out and results produced as shown. It was established that mathematics teachers' perception on attitudinal change, pedagogy (ASEI / PDSI) and assessment and evaluation of learners work were positive a part from implementation of ASE / PDSIS where teachers were seen to be undecided.

Based on the results on teachers perception of SMASSE in-service program, it is confirmed that teachers are positive about the in-service program they attended in order to help improve performance in mathematics in secondary schools in Kisumu County, Kenya. The positive perception of teachers means they view the in service program as very important but due to the many activities involved in the implementation of ASEI / PDSI and given that the syllabus has to be cleared they are not able to implement the activities. These reasons came from the teachers excerpts when they were asked to provide information on whether they like SMASSE INSET program.

4.8.6 Relationship between quality of teaching mathematics and teachers' perception of in-service program using Correlation analysis

The strength of linear relationship between dependent variable that is Quality of teaching mathematics and independent variable teachers' perception of in-service program which had four constructs from the objectives of the in-service program was measured using correlation analysis. Information on quality of teaching mathematics was obtained from LOG which is attached as Appendix III and the results are attached as Appendix VII, while information on independent variable which is perception and had four constructs from objectives of INSET Program that was Attitudinal change, Pedagogy (ASEI-PDSI), Implementation of ASEI-PDSI and assessment & evaluation of learners work was obtained from MTQ section 2 and results are attached as Appendix VIII. The two results were analyzed by running a bivariate correlation whose results produced correlation coefficients as shown in Table 4.26.The study sample was 70 teachers.

Table 4.26: Correlations Coefficients between Quality of Teaching Mathematics and Teachers perception of in- service program

n =70

		Y_1	X_1	X_2	X_3	X_4
Y_1	Pearson Correlation	1.000				
X_1	Pearson Correlation	-.002	1.000			
X_2	Pearson Correlation	.320**	.309**	1.000		
X_3	Pearson Correlation	.715**	.032	.122	1.000	
X_4	Pearson Correlation	.083	.244**	.205	.124	1.000

** Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2 tailed)

Key

Y_1 = Quality of Teaching Mathematics (QTM)

X_1 = Attitudinal change

X_2 = Pedagogy (ASEI/PDSI)

X_3 = Implementation of ASEI/PDSI

X_4 = Assessment and Evaluation of Learners work

Referring to Table 4.26, the variable X_3 had the highest correlation coefficient of .715 with quality of teaching mathematics in secondary schools. The variable that had the second highest association with quality of teaching mathematics was variable X_2 which had a correlation coefficient of .320, Variable X_1 and X_4 had correlation coefficients of -.002 and .083 respectively. Variable X_2 andX_3 were both significantly associated with the dependent

variable at .01 level (2-tailed) except for variable X_1 and X_4 which were insignificant. The result reveals that the most significant variable in this case is variable X_3 which is implementation of ASEI/PDSI. The findings imply that implementation of ASEI/PDSI approach of the in-service program is significant in quality of teaching mathematics. From the results, teachers need to implement the activities of in-service program they have attended. For them to do so, they require the support of school administrators and fellow teachers as reported by (Ramatlapana, 2009). The results are again in agreement with Garbrscek and Rodgers (2013) who noted that, if teachers at the end of INSET program can obtain and acquire intended knowledge, skills and attitude; apply them to practice; through their application this will influence students learning and teachers' achievement in those schools hence bringing required changes.

4.8.7 Relationship between teachers' Perception of in-service program and Quality of Teaching Mathematics using regression analysis

This study was to find out the relationship between dependent variable which is Quality of Teaching Mathematics and independent variable which is teachers' perception of in-service program. To address this, a linear regression showing the relationship between Quality of teaching mathematics as dependent variable and perception of teachers which had four constructs from objectives of the in-service program which included attitudinal change, Pedagogy (ASEI/PDSI), Implementation (ASEI/PDSI) and assessment and evaluation of learners work was run.

Linear regression was used to analyze the data in the study, and the regression analysis equation was specified here as:

$Y_1 = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + €_1$……(2)

Where, b_0 is the intercept

$b_1, b_2, \ldots b_4$ are respective regression coefficients for $X_1, X_2, \ldots X_4$

Y_1= Quality of teaching mathematics

X_1 = Attitudinal change

X_2 = Pedagogy (ASEI- PDSI)

X_3 =Implementation of ASEI-PDSI

X_4 =Assessment & Evaluation of learners work

$€_1$ is error term of the regression equation

Quality of teaching mathematics was measured by using the results from the Lesson Observation Guide (LOG) which was obtained as teachers were observed in class teaching mathematics. The independent variables were four constructs from the objectives of the in-service program which were measured using a five point Likert scale from MTQ. From the four constructs the first independent variable was attitudinal change which is denoted by (X_1) in the regression equation (3) above. This variable was measured by focusing on statements 1 to 5 in MTQ on section 2 of teachers' perception of in-service program on attitudinal change which is shown in Table 4.21. The second independent variable was teachers' perception of in-service program on pedagogy (ASEI-PDSI) which was denoted by (X_2)in the regression equation. This was measured by focusing on statement 6 to 10 as shown in Table 4.22. The third variable was teachers' perception of in-service program on implementation of ASEI-PDSI which was denoted by (X_3) and was measured using statements 11 to 15 as shown in Table 4.23. Finally the fourth variable was to provide teachers perception of in-service

program on assessment and evaluation of learners' work which was denoted as (X_4)and was measured using statements 16 to 20 as shown in Table 4.24. Data used was collected from Appendix 1.

In positive statements, Strongly Agree had a score of 5, Agree had a score of 4, Undecided had a score of 3, Disagree had a score of 2 and Strongly Disagree had a score of 1.For negative statements the scores were reversed so that Strongly Agree had a score 1, Agree had a score of 2, Undecided had a score of 3, Disagree had a score of 4 and Strongly Disagree had a score of 5. The scores were reversed to avoid response set. An individual teacher had to tick on one of the responses for each statement. A summation of the scores of the ticks was done for each individual teacher to be able to score either a minimum value of 5 or a maximum value of 25 on each construct.

This was done by running a regression analysis with quality of teaching mathematics whose results were obtained using LOG and attached as Appendix VII with results of perception of in-service program attached as Appendix VIII. Regression results are presented in Table 4.27 showing Coefficient of Multiple Determination.

Table 4.27: The Coefficient of multiple determination

R	***R* Square**	**Adjusted *R* Square**	**Std Error of the Estimate**
.760	.578	.552	4.123

Table 4.27 gives a model summary which reveals that teachers' perception explain 55.2%, as signified by the Adjusted R^2=.552, of the variation in the quality of teaching mathematics in public secondary schools in Kisumu County. This implies that about 55.2% of the cases of

disparity in quality of teaching mathematics among secondary schools in Kisumu County is explained by differences in teachers' perception. The remaining 44.8 % can be attributed to other factors such as school background, student factors and students' background. At the same time, regression analysis was run and enter method was used to show variables which were important in the model. The result is given in Table 4.28 showing the coefficients of the important variables.

Table 4.28: Regression Coefficients for Perception of Teachers in service program

	Unstandardized Coefficients		**Standardized Coefficients**		
	B	**Std Error**	**Beta**	**t**	**sig**
Constant	27.009	6.053		4.462	.000
X_1	-1.334	1.145	-.101	1.165	.248
X_2	2.833	.887	.275	3.195	.002
X_3	8.829	1.057	.689	8.445	.000
X_4	-.479	1.184	-.043	-.404	.687

Dependent Variable: Quality of teaching mathematics

Key

X_1= *A*ttitudinal change

X_2 =Pedagogy (ASEI-PDSI)

X_3= Implementation of ASEI-PDSI

X_4 = Assessment and evaluation of learners work

In Table 4.28, the coefficients of the estimated regression model in the regression analysis are represented by the unstandardized coefficients. The results suggest that out of the four independent variables only two of the independent variables were significant as shown by regression coefficients. These variables were Pedagogy (ASEI-PDSI), (X_2) and Implementation of ASEI-PDSI (X_3). Teachers' perception of in-service program on

attitudinal change (X_1) and assessment and evaluation of learners work (X_4) were not significant as shown by their p-values which were greater than .05.

The linear regression model is shown below as follows:

Y_2=27.009 -1.334X_1 +2.833X_2+8.929X_3-.479X_4 …….. (3)

This means that for every one unit increase in pedagogy (ASEI-PDSI), quality of teaching mathematics improves by 2.833 units and for every one unit increase in implementation of ASEI-PDSI quality of teaching mathematics improves by 8.929 units.

The significance of the model was demonstrated by the p-value of analysis of variance in the regression model in Table 4.29 which had a p-value of 0.000, indicating that the two independent variables had significant effect on the dependent variable which is quality of teaching mathematics.

Table 4.29: ANOVA Table for Multiple Regression Model

	SS	***df***	***MS***	***F***	**Sig**
Regression	1516.395	4	379.099	22.282	.000
Residual	1105.905	65	17.014		
Total	**2622.300**	**69**			

Predictors: (Constant), X_1, X_2X_3, X_4

Dependent Variable: Quality of Teaching Mathematics

Table 29 on ANOVA output provides results of test of significance for R and R^2 using the F statistics. In this analysis the value of p<.05 and therefore it was established that R, R^2 and adjusted R^2 for the multiple regression that was conducted to predict quality of teaching

mathematics in public secondary schools based on linear combination of teachers perception on the four constructs that is attitudinal change, pedagogy, Implementation and assessment and evaluation is statistically significant $F(4,65) = 22.282$, $P<.05$.This suggests that the knowledge on teachers perception from the four constructs can be significantly used to predict the level of quality of teaching mathematics in public secondary schools. Therefore teachers can perform better in teaching of mathematics if they could embrace the activities of the in-service program and be able to implement them in classes. In this study teachers complained about lack of time to enable them implement the content of in-service program in class and also lack of regular follow up activities to support the program as was established in a similar study by (Ramatlapana, 2009). Concerning time, it could be due to teachers work load which could be sorted out by the teachers' employer by recruiting more teachers to reduce the work load, if this can be done teachers may be able to implement the program. A follow up of the in-service activities should be done by the quality assurance and standards officers within the sub- counties to advice teachers and assist them where possible since this is their role.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a summary and conclusions of the findings of this research basing on the research questions, the theoretical framework that guided the evaluation process and the discussion made in Chapter Four. The chapter also makes recommendation for future researches that are in formed by the findings and limitations of the current study. The following research questions that guided the study have been responded to:

i. What is the influence of teachers' qualification on quality of teaching mathematics?
ii. What is the influence of teachers' experience on quality of teaching mathematics?
iii. What is the influence of teachers' gender on quality of teaching mathematics?
iv. What is the combined influence of teachers' qualification, experience and gender on quality of teaching mathematics?
v. What is the influence of teachers' perception of in service program on quality of teaching mathematics?

5.2 Summary of the Findings

The summary of the findings of the study was presented according to the objectives of the study:

5.2.1 Influence of teachers' qualification on quality of teaching mathematics

Before ANOVA test was run to establish the influence of teachers' qualification on quality of teaching mathematics, test on homogeneity was first checked to establish appropriateness of teachers' qualification which confirmed that the data met the requirement. ANOVA test was then run to show the level of quality of teaching within various teachers qualification which produced [F (2, 67) = 19.888, P = .000 <.05]. The post-hoc test analysis was further

performed to find out the groups that differed significantly as produced by ANOVA. Tukey HSD Post-hoc test results showed that the level of quality of teaching mathematics significantly differed among the categories. In particular, teachers with Masters in Mathematics Education (*M*=67.3; *SD*=6.4) scored significantly higher (Sig. level < .05) scores than those with Diploma in Education (*M*=51.5; *SD*=2.7) and those with B.ED/PGDE (*M*=58.7; *SD*=4.6). Equally, there was a statistical significant difference in the level of quality of teaching mathematics between the group of teachers with Diploma in Education and those with B.ED/PGDE [Mean Difference=7.17; *SE*=2.03; *p*=.002].

5.2.2 Influence of teachers' experience on quality of teaching mathematics

Results on teaching experience established that out of the 70 teachers, 5 of them have an experience of below 3 years, 17 teachers have experience of between 3-5 years, 26 teachers have experience of between 6-10 years and 22 teachers have experience of over 10 years.

Teachers with experience of below 3years performed at an average of 56.8%, while teachers with experience of between 3-5 years performed at average of 56.4%. Those with experience of between 6-10 years performed better than the two groups mentioned and their performance was at an average of 57.2%. With experience of over 10 years, these teachers' performance was the highest with an average of 63.8%.

Before ANOVA test was run to establish influence of teachers experience on quality of teaching mathematics, a test on homogeneity was first checked to establish the appropriateness of teacher data whether it met the requirement. Then ANOVA test was run to show the level of quality of teaching mathematics within various teachers teaching experiences which produced values such as [F (3,66) =9.888, P = .000< .05]. This result clearly shows that there was a statistically significant difference in the level of quality of

teaching mathematics among the four different levels of experience among sub-county public secondary school mathematics teachers. The relatively large F ratio established indicates that there was more variability between the teachers' experience categories (caused by the independent variable) than there was within each teachers' experience category (error term). A significant F test implied that the null hypothesis, which assumed that the population means were equal, was rejected.

5.2.3 Influence of teacher's gender on quality of teaching mathematics

When teachers were observed in class, the highest score was 75% which came from a male teacher. The lowest score for male teachers was 51%. The highest performance score for female teachers on quality of teaching mathematics was 72%. The lowest score from a female teacher was 48%.

When independent sample t-test was run to determine if there was significant difference in quality of teaching mathematics between male and female teachers. The test indicated that although there is difference in means in quality of teaching mathematics between female (m = 59.74, SD=5.171) and for male (m=58.79, SD = 5.117), the difference is not statistically significant [t=-.572, p=.571]. Based on the results of independent t-test, it was established that gender does not significantly influence quality of teaching mathematics in secondary schools.

5.2.4 Combined Influence of teachers qualification, experience and teacher gender on quality of teaching mathematics

Teachers' background on quality of teaching mathematics was done with reference to teacher teaching experience, teacher qualification and teacher gender. Multiple regression analysis

was run to show the Coefficients of multiple determination on combined influence of qualification, experience and gender on quality of teaching mathematics. The model revealed that teachers qualification, experience and gender explain 42.4% as signified by the Adjusted R^2 = .424 of the variation in quality of teaching mathematics in secondary schools in Kisumu County. This implies that 42.4% of the cases of disparity in quality of teaching mathematics is explained by differences in teachers' qualification, experience and gender. ANOVA output provided the results of a test of significance for *R* and *R* square using the *F* statistic. In this analysis, the p value was below .05 ($p < .001$) and therefore, it was established that *R*, R^2, and Adjusted R^2 for the multiple regression was conducted to predict quality of teaching mathematics in public secondary schools. Based on the linear combination of teachers' qualification, experience and gender is statistically significant, F (6, 63) =9.449, $p<.05$. This result imply that the knowledge on teachers' qualification, experience and gender combined can be significantly used to predict the level of quality of teaching mathematics among teachers teaching in public secondary schools.

5.2.5 Influence of teachers perception of in service program on quality of teaching mathematics

The overall perception of mathematics teachers towards in-service program had a mean of 3.56 which was interpreted to mean that the teachers were positive about the in-service program they attended. After establishing teachers' perception of in-service program, the strength of linear relationship between dependent variable that is quality of teaching mathematics and independent variable which was teachers' perception of in-service program which had four constructs was measured using correlation analysis to determine relationship between the two main variables. Of the four variables of teacher perception, X_3which is implementation of ASEI-PDSI had the highest correlation coefficient of 0.715with quality of

teaching mathematics. The variable that had the second highest association with quality of teaching mathematics was variable X_2which is Pedagogy (ASEI-PDSI) which had a correlation coefficient of 0.320. Variable X_1which is attitudinal change had a negative correlation coefficient of .002 and variable X_5which is assessment and evaluation of learners work had correlation coefficient of .083. Variable X_1 had the least association with quality of teaching mathematics. Implementation of ASEI/PDSI and Pedagogy (ASI/PDSI) were significantly associated with the dependent variable which is quality of teaching mathematics at 0.01 level (2-tailed) except for variables; attitudinal change and assessment and evaluation of learners' work which were insignificant.

Again, regression statistics was run to determine the relationship between teachers perception of in-service program on quality of teaching mathematics. The model found that the amount of variance shared in common between teachers perception of in service program on quality teaching mathematics was 55.2%. When enter method was used to show variables which were important, the coefficient of estimated regression in the regression analysis represented by unstandardized coefficients suggested that out of the four variables of perception only two variables were significant. The two independent variables that is Pedagogy (ASEI-PDSI) and Implementation of ASEI PDSI had significant effect on quality teaching of mathematics. Out of the two variables, the most significant variable is implementation of ASEI/PDSI.

5.3 Conclusions

Conclusions based on the findings of the study were made in order to find answers to research questions as follows:

5.3.1What is the influence of teachers' qualification on quality of teaching mathematics.

Test on homogeneity established appropriateness of teachers' qualification which confirmed that the data met the requirement. ANOVA test showed the level of quality of teaching within various teachers' qualification. Tukey HSD post-hoc test analysis which was performed to find out the groups that differed significantly as produced by ANOVA revealed that the level of quality of teaching mathematics significantly differed among the teachers categories of qualification. In particular, teachers with Masters in Mathematics Education scored significantly higher than those with Diploma in Education and also those with qualification of Bachelors in Education /Post Graduate Diploma in Education. In conclusion, there was statistically significant difference in quality of teaching mathematics among mathematics teachers in public secondary schools in Kisumu County given their differences in qualification with higher qualification that is teachers with Masters in Mathematics Education influencing quality of teaching mathematics most.

5.3.2What is the influence of teachers' experience on quality of teaching mathematics?

Test on homogeneity established the appropriateness of data on teachers teaching experience which met the requirements. The ANOVA test showed the level of quality of teaching mathematics within various teachers teaching experiences. Tukey HSD post hoc test analysis established categories of teachers experience which differed significantly. ANOVA revealed that the level of quality of teaching mathematics was significantly different among teachers' categories of teaching experience. In particular, teachers with experience of over 10 years scored significantly the highest than the categories of teachers with experience of below 3 years; between 3-5 years; and between 6-10 years. It was concluded that there was statistically significant difference in quality of teaching mathematics amongst mathematics

teachers in public secondary schools in Kisumu County given their differences in experience with teachers having over 10 years' experience influencing quality of teaching mathematics.

5.3.3What is the influence of Teacher's Gender on quality of teaching mathematics?

Independent sample t-test was run to determine if there was significant difference in quality of teaching mathematics between male and female teachers. The test indicated that although there is difference in means in quality of teaching mathematics between female (m = 59.74, SD=5.171) and for male (m=58.79, SD = 5.117), the difference is not statistically significant [t=-.572, p=.571]. Based on the results of independent t-test, it was concluded that gender does not significantly influence quality of teaching mathematics in secondary schools.

5.3.4What is the combined influence of teachers' qualification, experience and gender on quality of teaching mathematics?

Teachers background was divided into 3 categories; experience, qualification and gender. Multiple regression analysis produced Coefficients of multiple determination on combined influence of qualification, experience and gender on quality of teaching mathematics which revealed that teachers qualification, experience and gender explain 42.4% as signified by the Adjusted R^2 = .424 of the variation on quality of teaching mathematics in secondary schools. ANOVA output provided the results of a test of significance for *R* and *R* square using the *F* statistic. In this analysis, the p value was below .05 ($p < .001$) and therefore, it was established that *R*, R^2, and Adjusted R^2 for the multiple regression was conducted to predict quality of teaching mathematics in public secondary schools. Based on the linear combination of teachers' qualification, experience and gender was statistically significant. It was concluded that the knowledge on teachers' qualification, experience and gender combined

can be significantly be used to influence quality of teaching mathematics in public secondary schools.

5.3.5What is the influence of teachers' perception of in service program on quality of teaching mathematics?

The overall perception of mathematics teachers towards in-service program had a mean of 3.56 which was interpreted to mean that the teachers were positive about the in-service program they attended. Pearson Correlation indicated that there was a positive relationship between two variables of perception which are pedagogy (ASEI-PDSI) and implementation of ASEI/PDSI. Regression analysis also showed the significance of the same variables that is pedagogy (ASEI/PDSI) and implementation of (ASEI/PDSI) to be important. In conclusion, teachers were positive about the in-service program and among the four constructs of perception, implementation of ASEI/PDSI influences quality of teaching mathematics most.

5.4 Recommendations

5.4.1 Influence of Teachers Qualification on quality of teaching mathematics

Teachers' qualification had statistical significant difference in quality of teaching mathematics among teachers in public secondary schools given their differences in qualification. It was established that teachers holding Master in mathematics Education Degree had better scores in quality of teaching mathematics. These teachers need to be appointed as INSET trainers by CEMASTEA to enable them use their knowledge and skills during SMASSE training to help teachers improve quality of teaching mathematics in secondary schools.

5.4.2 Influence of Teachers Experience on quality of teaching mathematics

There was statistically significant difference in quality of teaching mathematics amongst mathematics teachers in public secondary schools though there was no significant difference between teachers with experience of below 3 years and those with 3-5 years, with teachers having experience of over 10 years resulting into better quality of teaching mathematics. These teachers with over 10 years' experience should be appointed by the teachers service commission as heads of mathematics departments to ensure there is quality of teaching the subject .

5.4.3 Influence of Teacher Gender on quality of teaching mathematics

Based on the results of independent t-test, it was concluded that gender does not significantly influence quality of teaching mathematics in secondary schools. Therefore majority of female teachers with a combination of mathematics to be posted to boyschools by the Teachers' Service Commission to demystify the theory that mathematics is for males.

5.4.4 Combined influence of qualification, experience, gender on quality of teaching mathematics

The linear combination of teachers' qualification, experience and gender was statistically significant. Therefore those teachers who are more qualified and are more experienced in the teaching of mathematic should be appointed as SQASO by the Ministry of Education to be specifically in charge of quality of teaching mathematics in various sub counties.

5.4.5 Influence of teachers perception of in-service program on quality of teaching mathematics

The overall perception of mathematics teachers towards in-service program was positive. Out of the four constructs of in service program, implementation of ASEI/PDSI was the most significant construct. Therefore implementation of ASEI / PDSI should be done by teachers through supervision by SQASO and School heads to provide materials to be used in class during the lesson.

5.5 Suggestions for Further Research

Basing on the findings of the current study, the following suggestions are made for further research and practice:

i. The current study employed the use of a questionnaire with a Likert scale to determine the perception of teachers towards SMASSE INSET program; future studies should include use of focused group discussions.
ii. The current study observed teachers in class to establish quality of teaching mathematics. Future studies should use SMASSE trained teachers teaching form 4 classes to establish their perception of in-service program and relate with their students' performance in KCSE mathematics results.
iii. A study to be conducted specifically to establish the extent of implementation of (ASEI-PDSI) in mathematics classroom.
iv. Future studies to purposively compare performance of teachers who have attended SMASSE in service program with those who have not attended the program to establish quality of teaching mathematics between the two groups.

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APPENDICES

Appendix I: Mathematics Teachers' Questionnaire (MTQ)

Dear teachers,

This questionnaire has been developed for purposes of an academic study. You have been selected to participate in the study by helping in filling up the questionnaire. Your confidentiality will be safe guarded and guaranteed. Therefore feel free to ask clarification on any item you may not understand.

Section 1: Background information (Tick the appropriate box)

1. Have you attended SMASSE INSET? Yes ( ) No. ( )
2. Please indicate your gender. Male ( ) Female ( )
3. For how many years have you been teaching mathematics since you attained your professional certification? A. Below 3years ( ) B. 3-5 years ( ) C. 6-10 years ( ) D. over 10 years ( )
4. Indicate your highest level of professional qualification in mathematics education.

   Diploma in Education ( )

   B. Ed / PGDE ( )

   M. Ed in mathematics ( )

   Ph. D in mathematics Education ( )

Section 2: Teachers' perception of objectives of in-service program

Below is a list of 20 items related to SMASSE In service Education and Training (INSET). You will find that you agree with some statements and disagree with others. Under each statement, five possible answers are provided. Of the five choices offered, select the one which best represents your opinion about SMASSE INSET program you attended. There is no right or wrong answer, all answers are correct.

If you strongly agree with a statement place a tick (√) against STRONGLY AGREE (SA); if you only agree slightly, place a tick against AGREE (A). For a statement you disagree with completely tick against STRONGLY DISAGREE (SD), and for an item you disagree with only slightly, tick against DISAGREE (D). There may be items for which you are not sure. In that case tick against UNDECIDED (U).

Statement		**Responses**				
		SA	A	U	D	SD
	Example: SMASSE has changed teachers attitude towards mathematics.	√				
1.	SMASSE INSET program has enabled change learners attitude towards mathematics.					
2	Am able to determine the causes of acquired attitude.					
	Negative attitude towards mathematics has no effect on teaching and learning.					
4.	I now understand attitude formation may result from observation.					
5	As a teacher I form an attitude towards mathematics due to entry behavior of learners.					
6.	I am able to identify key elements of ASEI-PDSI since I attended the INSET program.					
7.	I practice activity-based teaching because I understand ASEI-PDSI conditions.					
8.	I do not allow students to evaluate my lesson though it is part of ASEI-PDSI approach of teaching mathematics.					
9.	Since attending SMASSE INSET l use team teaching method in teaching my lessons.					
10.	I feel SMASSE INSET program has not simplified the teaching of secondary mathematics through ASEI-PDSI approach.					
11.	I accept that scheming is an important planning tool for teaching.					
12	I believe that I must use teaching learning materials to arouse					

	interest in learners.					
13.	My school administrator should provide materials to be used in improvising teaching learning resources.					
14.	I am not able to identify criteria for selection of teaching learning resources.					
15.	I take too long in preparing ASEI- PDSI lesson plan					
16	Though I attended SMASSE INSET I cannot distinguish between assessment and evaluation.					
17	I do not prefer peer assessment to help me improve quality of learning and empower students.					
18.	It is possible to use project based assessment in mathematics.					
19	For assessment to be reliable, the scoring applied should be consistent with the purpose.					
20	As I construct classroom tests, I consider objectives of the syllabus, academic level of learners and length of the test.					

Section 3: General information on SMASSE INSET

21. Do you like SMASSE INSET? Yes ( ) No. ( )

Give reasons for your answer …….

……

22. What is your general opinion of SMASSE INSET in mathematics in terms of :

a). Strengths ……..…….

…….

…….

b). Weakness …….

……

……

Appendix II: INSET Trainers Interview Guide (ITIG)

This questionnaire has been developed for purposes of an academic study. You have been selected to participate in the study by responding to the questions in the questionnaire. Your confidentiality will be safeguarded and guaranteed. Therefore feel free to ask for clarification on any item you may not understand.

1. In your opinion does a teacher's experience contribute to quality teaching of mathematics after attending the INSET program? Yes ( ) No. ( )

b). Explain your response……

…….

2. As a trainer, is there quality of teaching mathematics in your school amongst the teachers who have attended SMASSE INSET Program? Yes ( ) No. ( )

b). Explain your response ……

…….

3. In general, how would you describe mathematics teachers' perception of INSET for those who have attended SMASSE INSET Program?.....

4. As INSET trainer you advocate for ASEI-PDSI approach to teaching of mathematics, is it being practiced in classrooms? Yes ( ) No. ( )

b) Explain your response……

……

5. As INSET trainer, do you think teacher's academic qualification contributes to quality of teaching mathematics? Yes ( ) No. ( )

b).Explain your response……

……

6. In your opinion, does teacher's gender contribute of teaching mathematics in secondary school? Yes ( ) No. ( )

b). Explain your response……..

……..

7. As a trainer, does teachers perception towards INSET attended contribute to quality teaching? Yes ( ) No. ( )

b). Explain your response……..

8. In your opinion, has SMASSE INSET program improved quality of teaching mathematics in secondary schools? Yes ( ) No. ( )

b). Explain your response ……..

Appendix III: Lesson Observation Guide (LOG)

Section I: General information

Sub-County: … ……Form …….Time:……

Topic:……Sub-Topic ……..……...

Date ……. Teachers' Background: a).Gender……..

b). Qualification……..c).Teaching experience……..

d). No. of students……..

Section 2: Rating of teachers' quality of teaching mathematics.

CRITERION OF ASSESSMENT	**PERFORMANCE**	
	MARKS DISTRIBUTION	
	Mark range	**Score**
1.**PREPARATION (T/Marks 12)**		
a) Scheme of work: Availability of scheme of work & relevance from current syllabus	0-2	
b) ASEI-Lesson Plan Format(T/ Marks 10)		
i) Rationale for the lesson: needs of subject area, student, society	0 -3	
ii) Objectives (SMART): any three features of lesson objectives	0- 3	
iii) Prerequisite Knowledge/ skills: at least two skills	0-2	
iv) References: use of at least two different textbooks	0-2	
2.**PRESENTATION (T/Marks 80)**		
a) Introduction: Use of at least 5 learners' experiences and link with current lesson.	1-5	
b) Lesson development		
i).Logical presentation of content: depends on flow of information	1-5	
ii).Relevance of content to class level: Use of varied recommended text books.	1-5	
iii) Adequacy of content to lesson time: use of time appropriately	1-5	
iv)Strategies and methods appropriate to content(at most 5	1-5	
v)Use of teaching skills: motivation, reinforcement, questioning, stimulus variation, verbal exposition	1-5	
vi)Mastery of content	1-5	
c) Communication (T/Marks 6)		
i)Verbal communication: fluency, audibility and use of	1-3	

appropriate language.		
ii) Nonverbal communication: appropriate use of gestures, eye contact and body movement	1-3	
d)Use of ASEI-PDSI Approach (T/Marks 6)		
i)Use of activities: manipulative, intellectual, discussions	0 -3	
ii)Learning is student-centered: learners, not involved, partly involved, fully involved	0 -3	
e) **Use of resource materials (T/Marks 15)**		
i) Attractiveness of resource materials: not attractive, attractive, very attractive	1-3	
ii) Originality and creativity of resource materials: improvised, modified, new use	1-6	
iii) Appropriateness of resource material: moderately suitable, suitable, very suitable	1-3	
iv)Innovativeness of resource material: not original, partly original, original,	1-3	
f) Classroom organization & Management (T/Marks 20)		
i) Control of learners in class: not noisy, no rudeness, no disobedience	1-3	
ii) Knowledge of learners by names	1-2	
iii) Learner participation: individual, group, whole class	1-5	
iv)Use of groups in doing work (same ability, mixed ability, social grouping, age grouping, sex grouping)	0 -5	
v) Provision for individual differences (physically, temperamentally, intellectually)	0 -3	
vi) Teacher / Learner rapport(friendly, not friendly)	0 -2	
g) Conclusion (T/Marks 6)		
i) Closure skills: review, questions	0 -2	
ii) Concluding activities, evaluation	0 -2	
iii). Assignment: relevant and adequate	0 -2	
Total Marks: 100%		

Appendix lV: SQASO Interview Guide (SIG)

The purpose of this interview is to provide information related to SMASSE INSET program and how it influences quality of teaching mathematics .Kindly provide information to the following questions.

1. How is the attendance of mathematics teachers to the INSET program in your sub county? Low ( ) Moderate ( ) High ( )
   Explain …….
2. ASEI-PDSI approach has been advocated by SMASSE INSET, is it contributing to quality of teaching mathematics? Yes ( ) No. ( )
   Explain …….
3. From your observation in classes, are teachers' using: a). instructional materials?
   Yes ( ) No. ( )
   b). ASEI – PDSI approach of teaching? Yes ( ) No. ( )
   If no, what reasons are teachers giving?.....
   ……..
4. From your own observation, what is the teachers' perception of INSET program?.
   ……
5. Do you agree that teachers perception of INSET can influence quality of teaching mathematics? Yes ( ) No. ( )
   Explain ……..……..
6. From your classroom assessment, does teacher's academic background contribute to quality teaching of mathematics? Yes ( ) No. ( )
   Explain …….
7. Does teacher's experience contributes to quality of teaching mathematics?
   Yes ( ) No ( )
   Explain …….
8. Does teacher gender determine quality of teaching mathematics? Yes ( ) No, ( )
   Explain …….

Appendix V: Respondents Consent Letters

Secondary school Head Teachers' Consent Letter

Your school has been chosen to participate in a research on "Influence of Mathematics Teachers' background and perception of in-service program on quality of teaching mathematics in public secondary schools in Kisumu county''. Teachers from department of Mathematics and the students they teach will participate in order to assist in completion of the study. If you approve of your school's participation, I will thereafter proceed to contact the respective teachers for their involvement. In case of any clarifications, feel free and ask. All information given will be used purposely for this research and be kept in confidence. If you accept the consent to participation of Mathematics teachers and students, please sign in the space provided below.

Signature _____ Date _____

Sub-county _____

Mathematics Teachers Consent Letter

You are requested to participate in research aimed at finding out influence of teachers' background and perception of INSET program on quality teaching of mathematics in public secondary schools in Kisumu County, Kenya. To collect the information you will fill a questionnaire and a lesson observation guide will also be used. The information you provide will be used purely for research purpose and will be kept in confidence.

If you accept to provide the information, please sign in the space provided below.

Signature _____ date _____

Name of Sub County _____

SQASO Consent Letter

I am a post graduate student at Maseno University; I want to carry out research that aims at establishing influence of Teachers' background and perception of INSET program on quality of teaching mathematics. I am interested in your opinion concerning matters related to SMASSE in-service which will be collected using an interview guide. Your response will be kept in confidence and used purposely for this study.

If you accept to be interviewed, please sign in the space provided below.

Signature _____ Date _____

Name of sub-county _____

Mathematics Teacher In-Service Trainers Consent Letter

I am a post graduate student at Maseno University who wants to carry out research which will establish influence of teachers' background and perception of in-service program on quality of teaching mathematics in public secondary schools in Kisumu County. Your view will be of importance to this research since you played a key role in the program. Your responses will be kept confidential and used only for the purpose of the study. Kindly take a few minutes and respond to the interview schedule.

If you accept, please sign in the space provided below.

Signature_____ Date_____

Appendix VI: ASEI lesson Plan Format

Preliminaries

Class: …… Number of students:…….. Date: ……. Time:……..……

Topic: ……Sub-Topic:…….

Rationale for the lesson: ……

Objectives: (SMART)…….

Prerequisite Knowledge/Skills:……

Teaching and Learning Resources:……

References: ……

Lesson flow

Stage/time allocation	**Teaching /Learning Activities**	**Teaching /Learning points**	**Remarks**
Introduction			
Lesson Development			
Conclusion			
Evaluation			
Assignment			

Appendix VII: Results of Teachers' Quality of Teaching Mathematics using LOG

	Professional Records		Lesson presentation							Score
S/No	Scheme of works	L/Plan	Intro.	L/dev	Comm	Use of ASEI	L/Resource	C/org	Conc.	%
	2	10	5	30	6	6	15	20	6	100
1.	2	0	4	20	4	2	7	10	5	54
2.	2	4	4	20	5	2	7	14	6	64
3.	2	9	4	23	4	4	6	13	5	70
4.	2	0	4	21	5	3	7	7	2	51
5.	2	8	4	20	5	4	7	11	6	67
6.	2	0	4	23	4	4	6	11	6	60
7.	2	0	4	22	4	2	7	11	6	58
8.	2	6	4	22	5	4	8	11	3	65
9.	2	0	4	23	5	2	8	9	6	59
10.	2	8	2	18	6	2	9	15	3	65
11.	2	4	4	24	6	2	4	13	6	65
12.	2	7	4	25	5	4	7	12	6	72
13.	2	4	5	24	5	4	7	12	6	69
14.	2	6	4	20	4	4	10	16	4	70
15.	2	8	3	24	4	4	0	11	6	62
16.	2	8	3	20	3	1	8	10	6	61
17.	2	0	3	21	5	2	8	11	6	58
18.	2	8	3	17	4	3	7	14	4	62
19.	2	0	3	19	5	2	6	13	6	54
20.	2	5	4	23	5	2	8	13	6	68
21.	2	0	4	23	6	4	11	8	6	54
22.	2	2	3	19	6	0	5	15	3	55
23.	2	2	4	20	5	0	7	12	3	55
24.	2	4	4	25	4	2	0	12	6	59
25.	2	4	4	21	6	4	0	11	6	58
26.	2	4	4	18	6	2	7	9	6	58
27.	2	4	3	20	5	2	6	10	3	55
28.	2	6	4	20	3	6	8	10	5	64
29.	2	8	5	22	4	0	0	16	5	60
30.	2	0	4	19	5	2	9	13	4	58
31.	2	0	3	20	3	4	4	12	4	52
32.	2	0	4	20	6	2	4	14	6	58
33.	2	0	4	22	6	4	7	17	6	68
34.	2	0	4	22	4	2	0	13	4	51
35.	2	0	2	24	4	3	9	9	6	59
36.	2	5	4	22	5	3	8	9	5	63
37.	2	6	2	19	3	3	0	10	6	51
38..	2	4	3	21	4	1	3	14	3	55
39.	2	0	4	21	4	0	0	13	4	48
40.	2	0	3	21	4	1	9	12	3	55

41.	2	0	3	21	3	3	10	10	4	56
42.	2	4	3	21	4	3	0	14	6	57
43.	2	0	3	21	5	3	8	11	6	59
44.	2	0	3	22	3	1	8	10	4	53
45.	2	5	3	24	5	2	5	13	3	62
46.	2	0	3	24	4	1	9	11	5	59
47.	2	0	4	22	6	2	0	11	4	51
48.	2	0	3	21	4	0	9	10	3	52
49..	2	0	2	22	3	3	0	12	6	50
50.	2	4	3	21	3	0	5	14	4	56
51.	2	0	3	24	3	3	9	10	4	58
52.	2	0	3	24	3	1	8	9	5	55
53.	2	0	4	26	5	3	0	14	6	60
54.	2	0	4	24	5	2	0	13	6	60
55.	2	4	4	24	4	2	0	15	5	56
56.	2	0	3	24	3	2	12	10	6	67
57..	2	0	3	22	4	2	0	13	6	52
58.	2	0	4	26	3	2	0	6	5	57
59.	2	5	4	24	5	1	0	5	5	61
60.	2	4	4	23	5	0	0	5	6	59
61.	2	0	3	25	6	1	0	11	6	54
62.	2	5	3	23	4	1	7	14	5	64
63.	2	7	4	21	5	2	0	14	6	61
64.	2	0	3	25	4	2	7	13	5	61
65.	2	0	3	23	5	2	0	15	5	55
66.	2	0	3	22	5	2	5	12	3	54
67.	2	0	3	19	4	2	8	11	4	53
68.	2	0	3	23	4	2	5	11	3	53
69.	2	5	3	23	5	2	9	13	5	67
70.	2	8	4	21	5	5	9	5	6	75
Mean	**2**	**2.64**	**3.49**	**21.90**	**4.47**	**2.27**	**5.24**	**11.73**	**4.93**	**59.03**

Key

L/Plan	-	Lesson plan
Intro	-	Introduction
L/dev	-	Lesson Development
Comm	-	Communication
Use of ASEI	-	Use of ASEI/PDSI
L/Resources	-	Learning Resources
C/org	-	Classroom organization
Conc	-	Conclusion

Appendix VIII: Results of Teacher Background, Perception and Quality of Teaching Mathematics

Gender	Experience	Qualification	Attitude	Pedagogy	Implementation	Assessment &Evaluation	Perception	QTM
0	2	2	3.50	4.00	2.80	3.60	3.48	54.00
0	4	2	3.60	4.20	3.20	3.20	3.55	64.00
1	4	3	3.60	4.00	4.00	3.60	3.80	70.00
0	3	1	2.20	2.00	2.80	4.60	2.90	51.00
1	3	2	3.20	3.40	3.20	3.80	3.40	67.00
0	1	2	3.40	4.80	3.00	4.40	3.90	60.00
0	4	2	3.60	2.80	3.00	3.40	3.20	58.00
0	3	2	3.60	3.80	3.40	4.00	3.70	65.00
0	3	2	3.80	4.20	3.20	4.60	3.95	59.00
0	4	3	4.80	3.40	3.80	4.40	4.10	65.00
1	4	3	3.40	4.20	3.40	4.60	3.90	65.00
1	4	3	3.80	4.20	3.60	4.00	3.90	72.00
0	4	2	4.80	3.80	4.20	5.00	4.45	69.00
1	4	3	4.00	4.60	3.68	4.40	4.17	70.00
0	4	2	3.20	4.00	4.00	4.00	3.80	62.00
1	4	2	3.00	3.40	3.40	3.00	3.45	61.00
0	3	2	4.40	4.40	3.00	4.40	4.05	58.00
0	4	2	3.20	4.00	3.20	3.60	3.50	62.00
0	3	3	3.60	2.80	3.00	3.40	3.20	54.00
1	2	2	3.80	4.00	3.00	3.80	3.65	68.00
1	4	2	3.40	4.40	3.00	3.60	3.60	64.00
0	4	2	3.80	4.20	2.30	3.30	3.43	55.00
1	3	2	3.80	2.80	3.20	3.80	3.40	55.00
0	2	2	3.20	4.40	3.00	4.00	3.65	59.00
0	4	2	3.40	3.80	2.80	3.80	3.45	58.00
0	1	2	3.20	3.80	3.20	3.80	3.50	54.00
0	3	2	3.80	3.20	3.20	3.80	3.50	55.00
0	4	2	3.60	4.00	3.60	4.00	3.80	64.00
0	2	2	3.20	4.00	3.20	4.60	3.75	60.00
0	2	2	4.40	4.20	3.20	4.00	3.95	58.00
0	1	2	4.00	4.00	2.40	4.40	3.70	52.00
0	3	2	3.60	4.20	3.00	3.80	3.65	58.00
0	4	2	4.00	4.40	4.00	3.80	3.95	68.00
0	2	1	4.00	4.20	3.00	4.20	3.85	51.00
0	1	2	3.80	3.80	4.40	3.40	3.85	59.00
0	2	2	3.60	4.80	3.40	3.80	3.90	63.00
1	2	2	3.80	3.80	2.60	3.60	3.45	51.00
1	3	2	3.60	3.20	2.40	3.60	3.20	55.00
1	2	1	3.40	2.80	2.40	3.20	2.95	48.00
1	3	2	3.20	2.80	2.60	3.00	2.90	55.00
0	3	2	3.80	4.00	2.80	3.80	3.60	56.00
0	2	2	3.80	4.00	2.60	4.00	3.70	57.00
0	3	2	4.00	4.00	3.00	3.40	3.60	59.00
1	3	2	2.80	3.20	2.80	3.40	3.05	53.00
1	3	2	3.00	3.80	3.80	3.80	3.60	62.00
0	4	2	3.60	4.00	2.60	4.00	3.55	59.00
1	3	2	4.00	2.80	3.00	3.80	3.40	51.00
0	3	2	3.80	4.20	2.60	3.40	3.50	52.00

0	2	1	3.40	2.80	2.60	3.20	3.00	50.00
1	3	2	3.60	2.80	2.60	3.60	3.15	56.00
1	3	2	3.20	2.80	3.00	3.60	3.15	58.00
0	2	2	3.00	3.40	3.00	3.80	3.35	55.00
1	2	2	3.80	4.00	3.40	3.00	3.55	60.00
0	4	2	4.40	3.80	3.20	3.40	3.70	60.00
0	3	1	4.40	4.40	3.20	3.80	3.95	56.00
0	3	2	3.80	4.40	3.00	4.00	3.80	67.00
1	2	2	4.40	3.80	2.80	4.20	3.80	52.00
0	2	2	4.40	4.40	3.00	3.60	3.85	57.00
1	3	2	4.00	3.00	3.20	3.80	3.50	61.00
0	1	2	4.00	4.00	3.00	3.40	3.60	59.00
0	2	2	3.80	4.00	2.80	3.60	3.55	54.00
0	3	2	3.80	4.00	2.80	3.60	3.55	64.00
0	2	2	4.00	3.80	3.00	4.40	3.80	61.00
0	4	2	3.80	3.20	3.60	4.00	3.65	61.00
0	4	2	3.80	3.80	2.80	3.80	3.55	55.00
0	3	2	3.60	4.40	3.00	3.60	3.65	54.00
1	3	1	4.00	2.80	3.20	3.80	3.45	53.00
0	3	2	3.80	4.20	2.60	3.40	3.90	53.00
1	4	3	3.40	4.20	3.80	3.80	3.80	67.00
0	4	3	2.60	3.40	4.40	2.40	3.20	75.00

KEY: Teachers' Background

Gender:

Male - 0
Female - 1

Experience:

0 and below 3 years - 1
3-5 years - 2
6 -10 years - 3
Over 10 years - 4

Qualification:

Diploma - 1
B.ED/PGDE - 2
Masters in Mathematics Education-3

Appendix IX: Teachers' Responses on Qualitative Data

Teacher Number: Statements on Attitude

Tr.3: Trainers need to improve their skills to motivate teachers and change their negative attitude.

Tr. 4: Trainers lack skills to change teachers' negative attitude.

Tr. 8: It will not allow syllabus coverage due to the many activities.

Tr.9: Quality of facilitation is wanting.

Tr. 11: The INSET is mostly relevant to schools in developed countries.

Tr.12: Unprepared INSET trainers may be seen as a waste of time during training.

Tr.14: INSET training is time consuming.

Tr.13: Training span is usually short. Should be in cooperated in training curriculum at diploma and University.

Tr. 15: The INSET is costly and does not contribute to improved performance by learners,

Tr. 21: Time allocated is too short (5) days not enough

Tr. 25: INSET is not consistent, attendance is pegged on experience.

Tr. 35: ASEI/PDSI is more time consuming and may not allow syllabus completion

2. Teachers Number: Statements on Pedagogy.

Tr. 11: The method is relevant to schools in developed countries.

Tr.34: It brings about slow coverage of syllabus.

Tr.50: ASEI/PDSI involves too many activities which cannot be achieved within a lesson.

Tr. 53, 54, 58: ASEI/PDSI is time consuming hence completing the syllabus may be a problem.

3. Teacher Number: Statements on implementation.

Tr.6: It requires many resource materials.

Tr. 7, 14, 20, 22, 23, 30, 55, 56, 66, and 67: some activities are not applicable due to time factor.

Tr. 10: Resources to be availed and school principals to be sensitized on importance of using the materials,

Tr. 24, 67: Implementation requires a lot of time when team teaching is applied.

Tr. 30: ASI/PDSI is not applicable in a lesson of forty minutes.

Tr. 41, 42, 44, 46, 47, 48, 50, 53, and 61: The program lacks follow up to ensure implementation of ASEI is done.

Tr. 66: ASEI/PDSI activities are too involving hence they take a lot time.

Tr. 68: Lack of resources prevent implementation of ASEI/PDSI

Tr. 70: Resources to be provided to sub-county schools for implementation to be effective.

v. Teacher Number: Statements on Evaluation

Tr. 26: Some improvement should be done in improving project based assessment.

Tr. 32: Some assessment methods under SMASSE are difficult to apply.

Tr. 56: Most of the assessment methods are not easy to be applied in classroom situation with a lesson.

Appendix X: INSET Trainers responses on quality of teaching mathematics.

IT No.1: Yes, It has brought a lot of collaboration among teachers through lesson study.
IT No. 2: No, teaching methods taught at SMASSE may be difficult to apply in schools with large number of students.
IT No. 3: Yes, it has improved psychomotor skills but cognitive skills for exams still not effective.
IT. No. 6: Yes, it has brought better approaches to teaching and learning.
IT. No. 16: Yes, quality teaching is not only seen in results but alsoon how learners are motivated.

INSET Trainers responses of in-service program on ASEI/PDSI

IT. No. 1: Most teachers conduct lessons without lesson plans.

IT No. 2: ASEI/PDSI has been implemented to some extent though not so much.

IT. No: 3, 16: Many teachers still do not understand the ASEI/PDSI approach due to Cycles being widely spread.

IT.No. 4, 19: Some of the teachers have challenges.

IT. No.5: The approach is partially used depending on the circumstances due to time constrain.

IT.No. 6: Teachers practice ASEI/PDSI without knowing.

IT. No.7, 20: It helps the learners to participate since it is learner centred.

IT.No. 8: Teachers are not using team teaching approach which is part of ASE/PDSI.

IT.Nos: 9, 10, 14, 17: ASEI/PDSI approach is used to some extent since it require a lot of time.

IT.No. 11, 21: Team teaching approach is used in some classes in handling difficult topics.

IT. No.12: Some teachers are trying to approach learning by using learner centred method.

IT. No.13: To use the approach, it will depend on the availability of materials to be used in handling a particular topic.

IT. No.15, 22. There are some challenges with implementation of ASEI/PDSI and therefore teachers are not keen on it.

IT.No. 18: Teachers at times use ASEI/PDSI by involving learners.

Appendix XI: SQASO Response on whether teacher qualification contributes to quality of teaching mathematics

SQ. 1: Yes, it is grounded on the level of education especially when genuine character is expressed and applied.
SQ. 3: Yes, it depends on the teacher imparting information in an organized way to the learners.
SQ. 4: Yes, if only the teacher is willing to accept change.
SQ. 6: Yes, understanding of concepts depend on academic level.

SQASO Response on use of ASEI/PDSI approach by teachers.

SQ. 1: *No, they are not using the approach due to lack of materials and interest to make the resources; completion of syllabus while ASEI/PDSI requires a lot of work.*

SQ. 2: *They rarely use the approach.*

SQ. 3, 4, 5, 6: *No, teachers do not use because it requires many activities which cannot be accomplished within forty minutes.*

SQASO response on whether gender determines quality of teaching mathematics

SQ. 1 No, it depends on the teachers approach of teaching.

SQ. 2.It depends on the teachers attitude towards the subject.

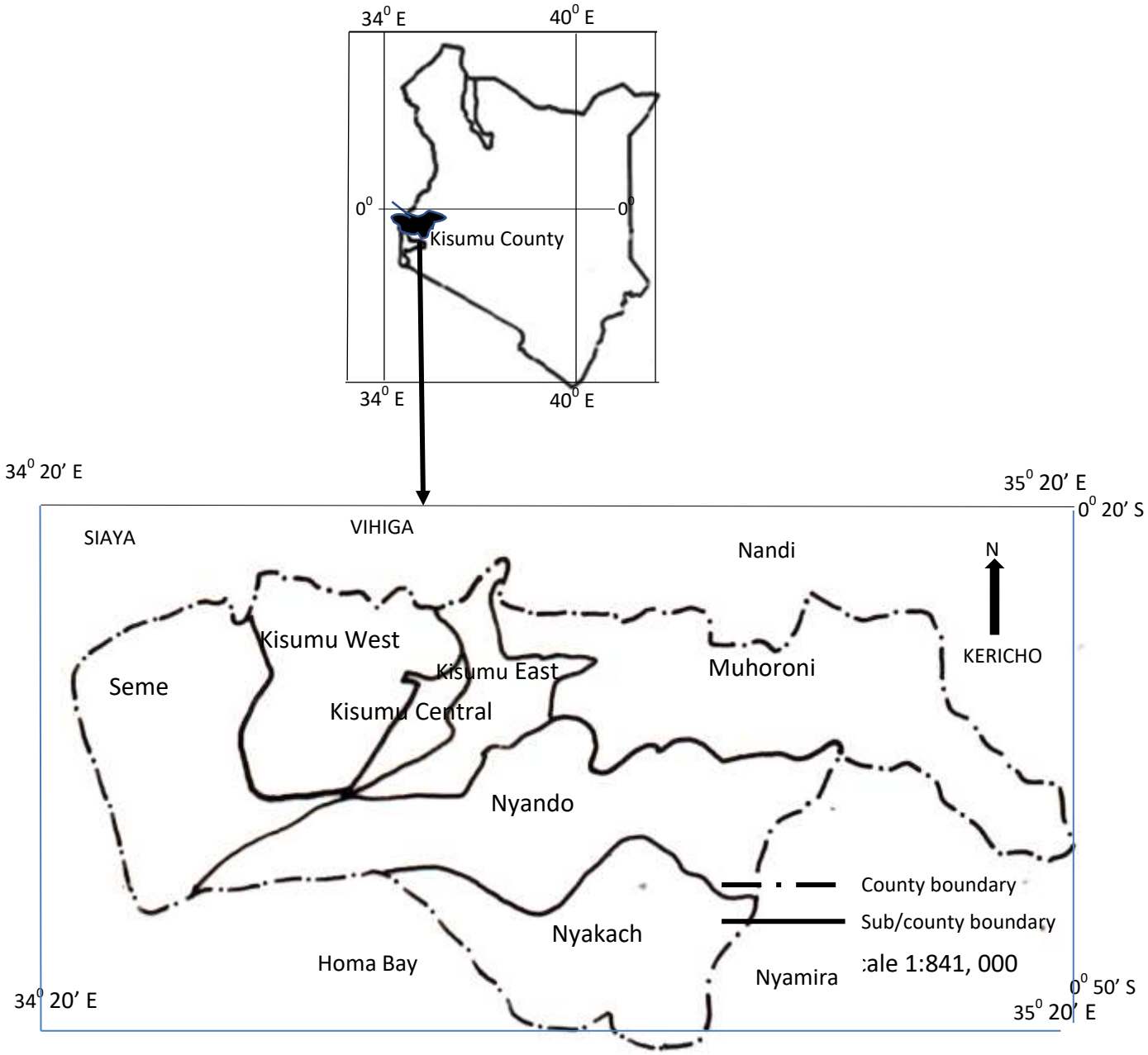
SQ. 3.No, it depends on the teachers content knowledge and experience in the subject.

SQ. 4. No, it depends on the teachers background of mathematics and attitude towards the learners.

SQ. 5. No, all teachers are capable of teaching mathematics so long as they have the interest and knowledge.

SQ. 6. No, regardless of gender it is individuals decision to make learners perform.

Appendix XII: Map of Kisumu County



Appendix XIII: SGS Approval Letter

MASENO UNIVERSITY
SCHOOL OF GRADUATE STUDIES
Office of the Dean

Our Ref: PG/PHD/0133/2012

Private Bag, MASENO, KENYA
Tel:(057)351 22/351008/351011
FAX: 254-057-351153/351221
Email: sgs@maseno.ac.ke

Date: 7th June, 2019

TO WHOM IT MAY CONCERN

RE: PROPOSAL APPROVAL FOR MANOAH SYLVIA AWUOR — PG/PHD/00133 /2012

The above named is registered in the Doctor of Philosophy Programme in the School of Education, Maseno University. This is to confirm that her research proposal titled "Influence of Teachers' Background and Perception of In-service Program on Quality of Teaching Mathematics in Public Secondary Schools in Kisumu County, Kenya." has been approved for conduct of research subject to obtaining all other permissions/clearances that may be required beforehand.

Prof. J.O. Agure
DEAN, SCHOOL OF GRADUATE STUDIES

MASENO UNIVERSITY
11 JUN 2019

Appendix XIV: MUERC Approval Letter

MASENO UNIVERSITY ETHICS REVIEW COMMITTEE

Tel: +254 057 351 622 Ext: 3050
Fax: +254 057 351 221

Private Bag – 40105, Maseno, Kenya
Email: muerc-secretariate@maseno.ac.ke

FROM: Secretary - MUERC

DATE: 21st August, 2019

TO: Sylvia Awuor Manoah
PG/PHD/00133/2012
Department of Educational Communication,
Technology and Curriculum Studies
School of Education, Maseno University
P. O. Box, Private Bag, Maseno, Kenya

REF: MSU/DRPI/MUERC/00741/19

RE: Influence of Teachers Background and Perception of In-Service Program in Quality Teaching of Mathematics in Public Secondary Schools. Proposal Reference Number MSU/DRPI/MUERC/00741/19

This is to inform you that the Maseno University Ethics Review Committee (MUERC) determined that the ethics issues were adequately addressed in the initial proposal. Consequently, the study is granted approval for implementation effective this 21st day of August, 2019 for a period of one (1) year. This is subject to getting approvals from NACOSTI and other relevant authorities.

Please note that authorization to conduct this study will automatically expire on 20th August, 2020. If you plan to continue with the study beyond this date, please submit an application for continuation approval to the MUERC Secretariat by 15th July, 2020.

Approval for continuation of the study will be subject to successful submission of an annual progress report that is to reach the MUERC Secretariat by 15th July, 2020.

Please note that any unanticipated problems resulting from the conduct of this study must be reported to MUERC. You are required to submit any proposed changes to this study to MUERC for review and approval prior to initiation. Please advice MUERC when the study is completed or discontinued.

Thank you.

MASENO UNIVERSITY SECRETARY 21 AUG 2019 ETHICS REVIEW COMMITTEE

Dr. Bernard Guyah
Ag. Secretary,
Maseno University Ethics Review Committee.

Cc: Chairman,
Maseno University Ethics Review Committee.

Appendix XV: NACOSTI Research Licence

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **867771**

Date of Issue: **22/November/2019**

RESEARCH LICENSE

This is to Certify that Ms.. sylvia manoah of Maseno University, has been licensed to conduct research in Kisumu on the topic: Influence of Teachers Background and perception of In-Service Program on Quality of Teaching Mathematics in Public Secondary Schools in Kisumu County,Kenya for the period ending : 22/November/2020.

License No: **NACOSTI/P/19/1286**

867771

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix XVI: County Director of Education Approval Letter

REPUBLIC OF KENYA

MINISTRY OF EDUCATION
State Department of Early Learning & Basic Education

Telegrams:"schooling",Kisumu
Telephone: Kisumu 057 - 2024599
Email: countyeducation.kisumu@gmail.com

When replying please quote

COUNTY DIRECTOR OF EDUCATION
KISUMU COUNTY
PROVINCIAL HEADQUARTERS NYANZA
3RD FLOOR
P.O. BOX 575 – 40100
KISUMU

REF: CDE/KSM/GA/3/24 IV/75

19th December, 2019

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION
MS. SYLVIA MANOAH– NACOSTI/P/19/1286

The above named is from Maseno University.

This is to certify that she has been granted authority to carry out research on ***"Influence of teachers background and perception of In-service Program on Quality of Teaching Mathematics in Public Secondary Schools in Kisumu County, Kenya "*** for the period ending **22nd November, 2020.**

Any assistance accorded to her to accomplish the assignment will be highly appreciated.

ORINA NYANKIRA
For: COUNTY DIRECTOR OF EDUCATION
KISUMU COUNTY

Appendix XVII: Sample Filled Lesson Observation Guide

TR 70

75%

Appendix III: Lesson Observation Guide (LOG)

Section I: General information

Sub-County: KSH WEST ..... Form III ..... Time: 8:40 - 9:20 AM

Topic: COMPOUND PROPORTION & RATES OF WORK. Sub-Topic .....

Date 24-10-2019 ..... Teachers' Background: a). Gender MALE .....

b). Qualification... M/ED .....c). Teaching experience.....9 YRS .....

d). No. of students.... 52 .....

Section 2: Rating of teachers' quality of teaching mathematics.

CRITERION OF ASSESSMENT	PERFORMANCE	
	MARKS DISTRIBUTION	
	Mark range	Score
1.PREPARATION (T/Marks 12)		
a) Scheme of work: Availability of scheme of work & relevance from current syllabus	0-2	2
b) ASEI-Lesson Plan Format(T/ Marks 10)		
i) Rationale for the lesson: needs of subject area, student, society	0 -3	2
ii) Objectives (SMART): any three features of lesson objectives	0- 3	2
iii) Prerequisite Knowledge/ skills: at least two skills	0-2	2
iv) References: use of at least two different textbooks	0-2	2
2.PRESENTATION (T/Marks 80)		
a) Introduction: Use of at least 5 learners' experiences and link with current lesson.	1-5	4
b) Lesson development		
i).Logical presentation of content: depends on flow of information	1-5	4
ii).Relevance of content to class level: Use of varied recommended text books.	1-5	3
iii) Adequacy of content to lesson time: use of time appropriately	1-5	5
iv)Strategies and methods appropriate to content(at most 5	1-5	3
v)Use of teaching skills: motivation, reinforcement, questioning, stimulus variation, verbal exposition	1-5	3
vi)Mastery of content	1-5	5
c) Communication (T/Marks 6)		
i)Verbal communication: fluency, audibility and use of	1-3	3

TR-70

appropriate language.		
ii) Nonverbal communication: appropriate use of gestures, eye contact and body movement	1-3	2
d)Use of ASEI-PDSI Approach (T/Marks 6)		
i)Use of activities: manipulative, intellectual, discussions	0 -3	3
ii)Learning is student-centered: learners, not involved, partly involved, fully involved	0 -3	2
e) **Use of resource materials (T/Marks 15)**		
i) Attractiveness of resource materials: not attractive, attractive, very attractive	1-3	2
ii) Originality and creativity of resource materials: improvised, modified, new use	1-6	3
iii) Appropriateness of resource material: moderately suitable, suitable, very suitable	1-3	2
iv)Innovativeness of resource material: not original, partly original, original,	1-3	2
f) Classroom organization & Management (T/Marks 20)		
i) Control of learners in class: not noisy, no rudeness, no disobedience	1-3	3
ii) Knowledge of learners by names	1-2	2
iii) Learner participation: individual, group, whole class	1-5	2
iv)Use of groups in doing work (same ability, mixed ability, social grouping, age grouping, sex grouping)	0 -5	2
v) Provision for individual differences (physically, temperamentally, intellectually)	0 -3	2
vi) Teacher / Learner rapport(friendly, not friendly)	0 -2	2
g) Conclusion (T/Marks 6)		
i) Closure skills: review, questions	0 -2	2
ii) Concluding activities, evaluation	0 -2	2
iii). Assignment: relevant and adequate	0 -2	2
Total Marks: 100%		75

TR 39

Appendix III: Lesson Observation Guide (LOG)

Section I: General information

Sub-County: MUHORONI ....Form ....III.....Time: 10:00 - 10:40 AM

Topic: SEQUENCES & SERIES ....Sub-Topic ....Sequences.....

Date ....08/11/2019..... Teachers' Background: a).Gender....FEMALE....

b). Qualification....DIPLOMA.....c).Teaching experience.....5 YRS.....

d). No. of students.....52.....

Section 2: Rating of teachers' quality of teaching mathematics.

CRITERION OF ASSESSMENT	PERFORMANCE	
	MARKS DISTRIBUTION	
	Mark range	Score
1.**PREPARATION (T/Marks 12)**		
a) Scheme of work: Availability of scheme of work & relevance from current syllabus	0-2	2
b) ASEI-Lesson Plan Format(T/ Marks 10)		
i) Rationale for the lesson: needs of subject area, student, society	0 -3	2
ii) Objectives (SMART): any three features of lesson objectives	0- 3	2
iii) Prerequisite Knowledge/ skills: at least two skills	0-2	1
iv) References: use of at least two different textbooks	0-2	1
2.**PRESENTATION (T/Marks 80)**		
a) Introduction: Use of at least 5 learners' experiences and link with current lesson.	1-5	3
b) Lesson development		
i).Logical presentation of content: depends on flow of information	1-5	3
ii).Relevance of content to class level: Use of varied recommended text books.	1-5	2
iii) Adequacy of content to lesson time: use of time appropriately	1-5	4
iv)Strategies and methods appropriate to content(at most 5	1-5	3
v)Use of teaching skills: motivation, reinforcement, questioning, stimulus variation, verbal exposition	1-5	2
vi)Mastery of content	1-5	4
c) Communication (T/Marks 6)		
i)Verbal communication: fluency, audibility and use of	1-3	1

TR 39

appropriate language.		
ii) Nonverbal communication: appropriate use of gestures, eye contact and body movement	1-3	1
d)Use of ASEI-PDSI Approach (T/Marks 6)		
i)Use of activities: manipulative, intellectual, discussions	0 -3	0
ii)Learning is student-centered: learners, not involved, partly involved, fully involved	0 -3	0
e) Use of resource materials (T/Marks 15)		
i) Attractiveness of resource materials: not attractive, attractive, very attractive	1-3	1
ii) Originality and creativity of resource materials: improvised, modified, new use	1-6	1
iii) Appropriateness of resource material: moderately suitable, suitable, very suitable	1-3	1
iv)Innovativeness of resource material: not original, partly original, original,	1-3	1
f) Classroom organization & Management (T/Marks 20)		
i) Control of learners in class: not noisy, no rudeness, no disobedience	1-3	2
ii) Knowledge of learners by names	1-2	2
iii) Learner participation: individual, group, whole class	1-5	3
iv)Use of groups in doing work (same ability, mixed ability, social grouping, age grouping, sex grouping)	0 -5	0
v) Provision for individual differences (physically, temperamentally, intellectually)	0 -3	0
vi) Teacher / Learner rapport(friendly, not friendly)	0 -2	2
g) Conclusion (T/Marks 6)		
i) Closure skills: review, questions	0 -2	1
ii) Concluding activities, evaluation	0 -2	1
iii). Assignment: relevant and adequate	0 -2	1
Total Marks: 100%		48