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Influence of Teacher's Perception of in-Service Program on Quality of Teaching Mathematics

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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 Education and Training (INSET). Teachers of Mathematics in Kenya have attended in-service program called Strengthening of Mathematics and Science in Secondary Education (SMASSE) INSET for the purpose of enhancing their skills and improving quality of teaching. However, this has not been translated into improved performance as expected. However there has been persistent poor performance in Mathematics in secondary schools in Kisumu County as revealed by the Kenya Certificate of secondary Examination results for the period 2012-2019 during which the mean score dropped from 34.00 to 20.45. This may deny students admission to scientific and technological professions at university due to low performance in the subject. The purpose of this study was to establish influence of teachers' perception of in-service program on quality of teaching mathematics. The study was conducted in public secondary schools in Kisumu County and employed descriptive and correlational designs in which the dependent variable was quality of teaching mathematics and independent variable was teachers' perception of in-service program. The study sample was 70 teachers representing 30% of the population of teachers found in the category of sub-county schools. Data collection instruments were Mathematics Teachers Questionnaire (MTQ) and Lesson Observation Guide (LOG). Quantitative data was analyzed using descriptive and inferential statistics. Pearson Product Moment Correlation Coefficient was used to determine the strength and direction of the relationship after which regression analysis was run to show the influence of teacher's perception on quality teaching. The findings established that implementation of Activity, Students, Experiment, Improvisation /Plan, Do, See, improve (ASEI/PDSI), approach was the most significant variable among the four variables of in-service program. Based on the results, teachers to be in-serviced regularly, INSET Trainers to improve on their facilitation, school principals to support teachers to enable them embrace and implement ASEI/PDSI.

Keywords: Teachers' perception, quality of teaching mathematics

1. Introduction

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 forAll (EFA), adopted in Jomtien, 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 al.* (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.

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 program 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 complained like lack of regular follow up activities to

support the workshop and difficulties they encountered in implementation due to lack of time (Ramatlapan, 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 opinions of teachers on INSET 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 learner's 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 opinions 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 (Sadiaga *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 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. He further says 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 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:

- To determine the causes of acquired attitude and its effect on the teaching and learning of mathematics and science.
- Share experiences for the purpose of developing a common understanding on the management of attitude for effective teaching and learning of mathematics and science.
- 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:

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

- Explain the fundamentals of work planning.
- Prepare different work planning tools.
- Appreciate importance of work planning for effective teaching and learning.
- Identify resources for effective teaching and learning.
- Identify criteria for selection of teaching learning resources.
- 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 learner's work in classroom. The objectives were:

- Distinguish between assessment and evaluation.
- Identify and explain common methods of assessment used in Kenya.
- Describe the modern trends of assessment.
- Explain purpose of assessment.
- Distinguish between Reliability and Validity in assessment
- Apply Bloom's taxonomy in the development of assessment tools.
- 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). Mathematics is one of the core subjects in secondary school curriculum in Kenya. 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 Kisumu County as provided in Table1.

Year	Kisumu
2012	34.00
2013	29.42
2014	27.33
2015	25.50
2016	23.75
2017	24.33
2018	20.68
2019	20.45
Average	25.68

Table 1: KCSE Analyzed Results in Mathematics for Kisumu county for the Years 2012-2019
Source: County Director of Education – Kisumu

Performance of Mathematics in Kisumu County shows that it is below average as compared with an average mean of 50 percent. At the same time the performance shows a negative deviation. These results are indication that INSET attended has not been matched with improved academic performance of students. This could also reveal teacher's 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). 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 teachers' perception of in-service program on quality of teaching mathematics and find out the most significant construct of perception; attitudinal change, pedagogy (ASEI/PDSI), implementation of ASEI/PDSI and assessment & evaluation of learner's 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.

2. Literature Review

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. 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 concern 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 former study looked at the general provision of the INSET whereas the current study was to establish influence of teachers' perception of INSET Program on quality of teaching mathematics.

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 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 and both qualitative and quantitative methods were used to provide information on influence of their perceptions of INSET program on quality of teaching mathematics.

An investigation of Kindergarten teachers' perceptions on 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.

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 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 Project, the current study looked at teachers' perception of INSET in relation to objectives of the four cycles. The researcher did this to establish influence of teachers' perception of INSET program on quality of teaching mathematics in secondary schools.

Therefore, the specific objectives of the study were:

Establish teachers' quality of teaching mathematics.

Establish teachers' perception of in-service program with reference to:

- Attitudinal change
- Pedagogy (ASEI/PDSI)
- Implementation of ASEI/PDSI
- Assessment and evaluation of learner's work.

Determine influence of teachers' perception of in-service program on quality of teaching mathematics.

3. Research Methodology

3.1. Venue and Sample

The study was carried out in Kisumu County, Kenya. The study population comprised of 234 mathematics teachers who have attended SMASSE in-service program. Out of the population 70 (30%) teachers were selected by proportionate simple random sampling technique which was used to select teachers from sub-county schools located within the 7 sub-counties of Kisumu County.

3.2. Data Collection Instruments

Two tools were used. These were Mathematics Teachers Questionnaire (MTQ) and Lesson observation Guide (LOG). The MTQ was divided into three sections. Section 1 was to give background information about teachers. Section 2 was to give information on teacher's perception of in-service program which used a five-point Likert scale developed by the researcher and section 3 had open ended questions. The MTQ is attached as Appendix A. Teachers were expected to indicate their level of agreement with various statements which were constructed based on the objectives of the four cycles of SMASSE INSET program namely attitudinal change, Pedagogy (ASEI/PDSI), Implementation of ASEI/PDSI and assessment and evaluation of learner's work. Teachers level of agreement ranged from Strongly Agree (SA), Agree(A), Undecided(U), Disagree(D) and Strongly Disagree (SD). The LOG was used to measure quality of teaching mathematics in secondary schools as teachers were handling various topics in mathematics indifferent forms (classes). The LOG is attached as Appendix B.

3.3. Validity and Reliability of the Instruments

The face and content validity of MTQ and LOG was established after experts in the field of study in Maseno University evaluated the relevance of each item in relation to objectives. Mulusa (1990) notes that validity is the extent to which a measuring instrument measures what it is supposed to measure and reliability is when the instrument measures what it is supposed to measure consistently. The suggestions made by the experts were used to revise the instruments before collecting data. The results for MTQ and LOG were established through test retest and application of Pearson Product Moment Correlation Coefficient reliability at 0.72 and 0.78 respectively. Kathuri and Pals, (1993) recommend for a 0.7 and above threshold. The pilot study involved 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.

3.4. Data Collection Procedure

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) in Nairobi before embarking on data collection process as dictated by ethics. In order to observe teachers in class and administer the questionnaire effectively, a personal visit to all the sampled schools was done by the researcher who explained the purpose of the research to the school principals and mathematics teachers and agreed on schedule of time. The 70 teachers were observed in classroom using the students' they teach regularly and were given the MTQ to fill immediately after observation in class.

3.5. Data Analysis Procedure

The data from MTQ and LOG provided information which was first serialized, coded then keyed in Statistical Package for Social Sciences (SPSS) version 16, computer programme to provide analyzed results. Data on quality of teaching mathematics was worked out as percentage score for individual teacher depending on the scores assigned for each construct to be measured from the LOG. The mean for teacher's 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%).

Analysis of data concerning teachers' perception of in-service program was done by calculating mean scores on the Likert scale. To achieve this, numerical scores were assigned to five response options given to each item on the perception scale. For positively stated items the score value were assigned as follows: Strongly Agree (SA)-5; Agree (A)-4; Undecided (U)-3; Disagree (D)- 2; and Strongly Disagree(SD)-1. However for negatively stated items, the scoring was 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. The data was keyed into SPSS data editor for analyses. Arithmetic mean and percentages were done for every element on the Likert scale, thereafter; an average of the arithmetic means of the elements on the Likert scale was done. In interpretation of the scores, a value of between 3.50 and 5.00 meant a positive perception; on the other hand, a value between 2.50 and 3.49 meant undecided, while a value between 1.00 to 2.49 meant a

negative perception. Therefore, data on perception was analyzed by using frequencies, means and percentages. Qualitative data was analyzed using responses to the open-ended items in the questionnaires which was transcribed and organized in categories and reported as verbatim excerpts. The data was presented in terms of tables.

4. Results and Discussion

4.1. Quality of Teaching Mathematics by Teachers

The result of quality teaching of mathematics by teachers 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. This is shown in Table 2.

Score	Frequency	Rating Scale
70 and above	4	Very high quality
60 – 69	21	High quality
50 -59	44	Average quality
40 -49	1	Low quality
0 -39	0	Very low quality

Table 2: Quality of Teaching Mathematics

Teachers who scored between 70% and above were 4. Those who scored between 60% -69% were 21. While teachers who scored between 50%-59% were 44 teachers. And finally, teachers who scored between 40% -49% was only one teacher. None of the teachers scored between 0 -39%. 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 59.03 and a standard deviation of 5.843 as shown in Table 3.

M in	Max	Mean	SD
48	75	59.03	5.843

Table 3: Results of Quality of Teaching Mathematics as Provided by Descriptive Statistics N =70

Using the rating scale, the mean of 59.03 was rated as average. This result mean that teachers in Kisumu county can improve their quality of teaching if they can embrace the pedagogy of the in-service program and implement it in classroom situation.

4.2. Teachers’ Perception of SMASSE In-Service Program

Teachers’ perception towards in-service program was done with specific reference to the four objectives of in-service cycle which included attitudinal change, pedagogy (ASEI/PDSI), implementation of ASEI/PDSI, and assessment and evaluation of learner’s work. On attitudinal change, teachers had a mean of 2.99 displaying that they were undecided. On pedagogy (ASEI/PDSI), teachers had a mean of 3.47 displaying undecided perception. On implementation of ASEI/PDSI, mean was 3.11 still displaying undecided perception. Finally, on assessment and evaluation of learner’s work, the mean was 3.43 displaying again undecided perception. Overall, teachers are undecided about the in-service program. This finding shows that teachers’ perception towards the four elements of the in-service program could have affected the quality of teaching mathematics. The analysis is given in Table 4.

Elements	Mean	Teachers’ Perception
Attitudinal change	2.99	undecided
Pedagogy (ASEI-PDSI)	3.47	undecided
Implementation (ASEI-PDSI)	3.11	undecided
Assessment &Evaluation of learners	3.43	undecided
Overall	3.25	Undecided

Table 4: Teachers’ Overall Perception towards the Elements of In-Service Program

Findings on qualitative data from teachers was collected when they were asked to write the weakness of the in-service program they attended in mathematics. The following verbatim remarks on existing gaps on in-service program were noted:

‘Trainers need to improve on their skills to motivate teachers hence enable them change students negative attitude towards the subject’. (Teachers’3,4,22).

‘Quality of facilitation by the trainers is wanting therefore it cannot change teachers’ attitude towards mathematics’. (Teacher 9)

‘Unprepared INSET trainers are seen as discouraging hence teachers develop negative attitude towards the in-service program’. (Teacher 12, 14)

4.3. Influence of Teacher’s Perception of In-Service Program on Quality of Teaching Mathematics

The objective of this study was to determine the influence of teachers’ perception of in-service program on quality of teaching mathematics. To achieve this, first the researcher correlated two variables namely teacher’s perception of in-

service program using the four elements from the objectives of the four cycles of in-service program namely: attitudinal change, pedagogy (ASEI/PDSI), implementation of ASEI/PDSI, and assessment and evaluation of learners work with results from quality of teaching mathematics. Pearson Product Moment Correlation was used to determine the strength and direction of the relationship that existed between the two variables. It produced the following correlation matrix as shown in Table 5

		Y ₂	X ₄	X ₅	X ₆	X ₇
Y ₂	Pearson Correlation	1.000				
X ₄	Pearson Correlation	-.110	1.000			
X ₅	Pearson Correlation	.447**	.225	1.000		
X ₆	Pearson Correlation	.747**	-.292*	.135	1.000	
X ₇	Pearson Correlation	-.096	-.243*	-.038	-.058	1.000

Table 5: Correlation Coefficients between Quality of Teaching Mathematics and Teachers Perception Of in-Service Program N =70

** Correlation Is Significant at the 0.01 Level (2-Tailed)

*Correlation Is Significant at the 0.05 Level (2 Tailed)

Key

- Y₂ = Quality of Teaching Mathematics (QTM)
 X₄ = Attitudinal change
 X₅ = Pedagogy (ASEI/PDSI)
 X₆ = Implementation of ASEI/PDSI
 X₇ = Assessment and Evaluation of Learners work

From the correlation matrix, variable X₆ had the highest correlation coefficient of 0.747 with quality of teaching mathematics. The variable that had the second highest association with QTM was variable X₅ with a correlation coefficient of 0.447. Variable X₄ had a correlation coefficient of -0.110 and variable X₇ had a correlation coefficient of -0.096 which had the least association with QTM. Variables X₆ and X₅ were significantly associated with the dependent variable which is QTM at .01 level (2-tailed) except for variable X₄ and X₇ which were insignificant. The finding is in line with Ramatlapana (2009) who reported that teachers were not able to implement what they learnt during INSET provision due to lack of support from school administrators hence a challenge. This explains how important implementation of the program is.

The study was to determine the influence of teacher's perception of in-service program on quality of teaching mathematics using regression analysis. The coefficient of multiple determination is presented in Table 6.

R	R Square	Adjusted R Square	Std Error of the Estimate
.825	.680	.670	3.354

Table 6: The Coefficient of Multiple Determination

5. Conclusion

A sample of 70 teachers were observed in classrooms as they were teaching mathematics in secondary schools in Kisumu County. The study established the overall quality of teaching mathematics had a mean of 59.03 which was rated as average. Perception of teachers towards in-service program was analyzed using the four elements from objectives of the four cycles of SMASSE in-service program namely attitudinal change; Pedagogy (ASEI/PDSI), Implementation of ASEI/PDSI and assessment and evaluation of learner's work. On all the four elements, teachers displayed that they were undecided with the INSET program. On influence of teachers perception of in-service program on quality of teaching mathematics, implementation of ASEI/PDSI had the highest correlation coefficient of .747 significant at the 0.01 level (2-tailed). When regression analysis was run to determine the relationship between teachers perception using the four constructs of in-service program and quality of teaching mathematics, the coefficient of multiple determination produced a value of R as .825 while R Square was .680. Multiple R is a correlation between dependent and independent variable while R Square is an indicator of how well the model fits the data.

6. Implication

Quality teaching of mathematics in Kisumu County at a mean percentage of 59.03 was rated as average. This implies that teachers stand a chance of improving performance of students in mathematics in secondary schools. Teachers' perception of SMASSE INSET Program was established to be on the fence meaning they were undecided about the INSET Program. If teachers could embrace the INSET pedagogy and implement the ASEI/PDSI approach, performance of students in mathematics could improve.

7. Recommendations

Based on the conclusions, the study recommends that:

- Teachers to be in-serviced regularly to acquire skills which will help improve performance in mathematics in secondary schools.
- INSET Trainers to improve on their facilitation to enable teachers have a positive perception towards the INSET Program.
- School principals to support teachers to enable them embrace and implement ASEI /PDSI.

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Appendix

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 I 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.					

Table 7

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

Lesson Observation Guide (LOG)

Section I: General information

Sub-County: ... FormTime:.....

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 different strategies	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 appropriate language.	1-3	
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	0 -2	
Total Marks: 100%			

Table 8