An Assessment of the Influence of SMASSE Project Activities on Learning of Chemistry in Bomet District Secondary Schools, Kenya

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Abstract

The study was used to investigate the perceptions of the influence of SMASSE project activities on learning of Chemistry. The study was carried out in Bomet district in Rift Valley Province of Kenya. A descriptive survey design was used in which data was collected using questionnaire materials given to the sampled respondents in the district. A sample size of fifty respondents out of one hundred and twenty one was randomly selected from principals and Chemistry teachers of public secondary schools in the district. The schools were stratified into boys', girls' and mixed secondary schools then taking a purposive random sampling in each subgroup. Data collected was both quantitative and qualitative. Analysis was done using Pearson Product Moment coefficient of Correlation, r. The results from the findings showed that there was no significant relationship between the performance during and after SMASSE training. Furthermore, there was a positive significant relationship between impact of SMASSE training on the teacher and the impact on students at 5% level of significance. The SMASSE training has impacted on the teacher through training and the student through improved classroom activities but the impact on the students through improving their performance was not significant during the study. The government through the ministry of education should continue carrying out SMASSE INSET to improve the teachers' instructional skills and capacity development.

Key Words: SMASSE, Performance, Chemistry

INTRODUCTION

Background of the Study

Poor performance in science subjects in secondary schools have been of a serious concern to all stakeholders in education worldwide. In Kenya, poor performance in sciences has been a common occurrence in secondary schools since the inset of KCSE. Examination results in mathematics and sciences have been poor in many secondary schools despite efforts to ensure that qualified teachers are employed; teachers' remuneration and terms of service are improved; science equipment are provided and even laboratories constructed. In response to this, the government through Ministry of Education (MOE) made an attempt to improve this deteriorating performance by initiating the SMASSE (Strengthening of Mathematics And Sciences in Secondary Education) program in conjunction with JAICA from the government of Japan from a pilot phase (1998-2003) to national phase (2003-2008). The main goal of the SMASSE program is to upgrade the capability of young Kenyans in mathematics and sciences (Biology, Chemistry and Physics) through INSET (In-Service Education and Training).

The SMASSE initiative is based on a need for effective classroom practices, existing policy indications and demands by critical stakeholders in education.

At the beginning of the project, ministry of education and Teachers Service Commission recruited national trainers on merit, two each from mathematics, physics, chemistry and biology departments who were trained in Japan and subsequently deployed as full time staff in the project. Their main duty was to work together with Japanese personnel to develop materials, management procedures and activities for the INSET. The technical co-operation for capacity development for SMASSE has been effected through long-term training, short-term exchange visits, study tours, seminars, workshops, and mentoring by short-term and long-term Japanese experts. SMASSE has been acknowledged as an appropriate and suitable example of technical cooperation in capacity development for developing countries.

The System of operation is through the Cascade System as shown in figure 1. SMASSE INSET is delivered through a two- tier cascade system in which training is conducted at national and district levels. At national level, the trainers facilitate INSET for district trainers who in turn train all other mathematics and science teachers in their respective districts throughout the country. The curriculum for the INSET is based on; General topical issues in secondary school mathematics and science education and topic areas that are of concern to both teachers and students in the four subjects: Biology, Chemistry, Physics and Mathematics. The curriculum is designed and divided into four cycles of 10 days each per year. This is to allow trainers and teachers to be free for two (2) weeks during the school holidays and to ensure that lessons learnt are applied as soon as possible to benefit the learners. Each of the four cycles has specific emphasis but covers a wide range of relevant aspects in teaching and learning of mathematics and sciences in the classroom.

Cycle 1 of SMASSE INSET: emphasizes on positive attitude change towards mathematics and science education among the teachers. Positive attitude is seen as a pre-requisite for teachers to embrace the ideals of SMASSE INSET.

Cycle 2 of SMASSE INSET: emphasis is made on hands-on/practical activities in which the participants are provided with the opportunity to experience an assorted hands-on activities / practical work in order to enhance their skills in designing relevant teaching and learning activities that promote student interest and understanding.

Cycle 3 of SMASSE INSET: Focuses on actual classroom implementation of the principles of ASEI/ PDSI that is, actualization of the ASEI/ PDSI teaching and learning approaches. INSET participants plan for, implement and discuss ASEI lessons during peer-teaching sessions then proceed to schools for actual classroom implementation. It also includes sessions on monitoring and evaluation with bias towards classroom observation.

Cycle 4 SMASSE INSET: The main objective is to consolidate, enhance, sustain and implement the SMASSE instructions on their own in the classroom (Republic of Kenya, 1988). The first cycle of the SMASSE Project INSET was therefore started in Bomet district in August 2004 and the fourth cycle came to completion four years later, that is,

in August, 2007. The SMASSE initiative whose focus is to assist teachers to reflect on their teaching strategies and acquire skills for effective teaching and efficient learning is driven by the ASEI movement (World Bank, 2004).

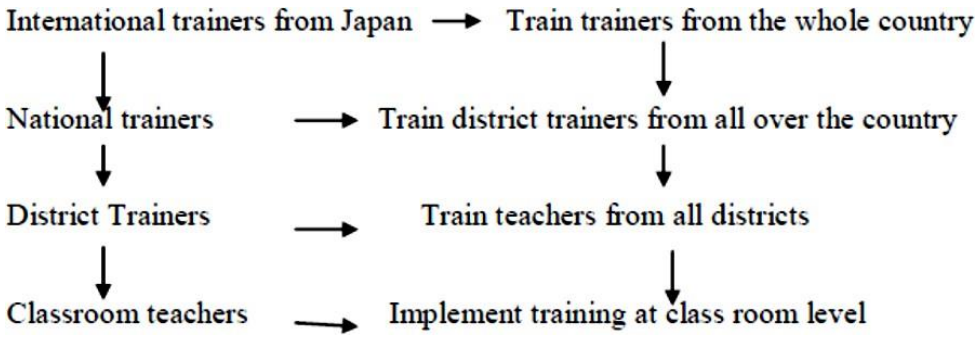

Figure 1. A cascade system of training

Impact of SMASSE - INSET

The government of Kenya realizes the important role of science and mathematics in national development and this has been reflected in the amount of resources both human and financial channeled to science education programmes in secondary schools. The government deploys qualified teachers, provides science equipment and has introduced in-service education and training programme (INSET) for serving teachers (Waititu and Orando, 2009). It was reported that the application of ASEI/PDSI in the teaching practices has made science and mathematics relevant, interesting and accessible in terms of classroom activities (ibid). SMASSE-INSET addresses teachers' attitude, pedagogy, content mastery and teaching/learning materials. Learner–centred approaches through the Activity–Student–Experiment–Improvisation (ASEI) pedagogic paradigm and the Plan-Do-See-Improve (PDSI) approach are the focus of SMASSE INSET. Teachers design and use locally available resources and students' real life situations to improvise teaching /learning materials that enhance learner participation and scientific skills. They improve their skills in work planning, monitoring learning achievement, self-evaluation and utilization of feedback to improve subsequent lessons (internet).

SMASSE has had a positive impact as evidenced in lesson participation and increased enrolment in science subjects, especially Physics which is an elective subject. This has been particularly observed in the case of girls. Lesson observation carried out from time to time show changes from teacher-centred towards learner-centred methods. In particular, students' activities and participation were more frequent as a result of the INSET (JICA, 2006).

Since 2004, SMASSE monitoring and evaluation task force has been conducting achievement test known as SMASSE Project Impact Assessment Survey (SPIAS) to find out the impact of INSET on learning achievement. Every year about 6,000 students from 150 schools in 10 districts have been sampled and given a multiple choice type test based

on Bloom‘s taxonomy. Although improvements in KCSE examination grades have been observed, analysis of SPIAS data towards establishing the impact of learning attainments found the INSET promising to be effective on teaching/learning quality as long as INSET will be continuously offered to teachers (SMASSE, 2004). From their findings student attitude towards science and mathematics have improved and that the quality of INSET has impacted the learning activities in the classroom. This study sought to investigate into the perceptions of the impact of SMASSE on the performance of Chemistry in secondary schools in Bomet district.

World Bank, (2004) reports that Quality of education negatively affects enrolment, participation, completion rate and quality of graduates from the education system, and subsequently, the country‗s development. According to Heneveld and Craig (1996), low grades in mathematics and sciences are interpreted to mean that the students have not learnt well or the subjects are either difficult to teach or learn, regardless of other factors affecting their teaching and learning including school and home environment. Other factors that affect performance include: shortage of teachers, inadequate and poor facilities; shortage of instructional materials and low teachers' morale due to low remuneration and poor terms of service. Studies on how to improve the quality of education indicate that this can be done through improvement of the quality of teachers. That is, equipping them with relevant competencies (World Bank, 2004).

INSET trained teachers uses the ASEI/PDSI lesson plans to guide classroom activities and teachers who have completed INSET cycles provides a lot of activities in the classroom to encourage active participation of learners‘ as they relate science to real life situation (Waititu and Orando, 2009). Most of the teachers use participatory teaching methods of SMASSE and therefore the project has impacted on the teachers and the students (ibid). According to Waititu and Orando (2009), the quality of teaching and learning has not been attained as revealed by results of the performance in KCSE. These findings are similar to those obtained from the study in Bomet district secondary schools. According to a survey (Kibe *et al.*, 2008), it was found that the quality of teaching in the classroom becomes better after the teachers completes the INSET cycles. Because of application of SMASSE approaches the extent of student participation was improved and hence better mastery of concepts was achieved.

The SMASSE project Impact Assessment Survey (SPIAS) carried out a nationwide survey to investigate the impact of training on the teachers and the students and came up with the following findings. It was reported that teachers were able to plan for instructions more consistently and attend students‘ needs confidently after the INSET. They also carried out teaching as a team, try new methods and face challenges of lack of resources through improvisation. As a result of the INSET, SPIAS reported that learners‘ became actively involved in classroom activities with great interest and responsiveness which was evident by positive response to do assignments and carry out group discussions. They were punctual and regular as they attend the lessons.

Challenges in Implementing SMASSE –INSET Activities

According to the survey Waititu and Orando (2009), the challenges in the implementation process were categorized as: those affecting teachers, those affecting

students and those relating to the school. (i) The challenges affecting teachers included: poor working conditions that made teachers feel low esteem, overloaded syllabi, teachers‘ attitude towards teaching profession, the subject and students, use of inappropriate teaching approaches and methods, inadequate mastery of content, inadequate use of assessments and inadequate quality assurance mechanisms. (ii) The challenges affecting students were mostly related to inadequate learning time in school occasioned by absence due to fees, for those who were day scholars, they found themselves with other home chores that were competing for the time that otherwise could be used for learning. (iii) School based challenges affecting quality of education included: inadequate facilities; inadequate teaching and learning materials; inadequate staffing; negative attitude towards school by the society and poor/weak management (Waititu and Orando, 2009).

Kibe *et al.* (2008) reported various challenges that were identified to hinder successful achievements in the implementation of SMASSE. The regularization of INSET has not been supported wholly by some educationist in the sector. The implementation process was found to be challenged by conflict of interest that arises from the science and the art-based teachers. During the training session in the holidays, fellow art-based teachers are free in their own activities. With the current competitive trends in education most teachers would want to pursue post graduate programmes through in-service for financial and promotional gains. This prevented some teachers from attending the INSET.

Poverty level has made the education institutions unable to remit SMASSE funds to District Planning Committee (DPC) hence their work is inconvenienced. Staff turnover and transfers of trainers together with QASO and SMASSE monitoring and evaluation activities which have not been harmonized challenges the implementation of SMASSE.

MATERIALS AND METHODS

Study Area

The research was carried out in Bomet district of Rift Valley province in Kenya. The district lies between latitudes 0º 39‘ and 1º 02‘ South of the Equator and between longitudes 35º 00‘ and 35º 32‘east of the Prime Meridian. It is bordered by four districts, namely, Bureti to the North East, Chebalungu to the South West, Molo to the East and Narok South to the South. The district was picked because no studies have been carried out on the perceptions of the impact of SMASSE project on KCSE performance in chemistry in secondary schools since its implementation in 2003 as a government policy in education.

Research Design

The research adopted a descriptive survey design in which a sample group was used to provide information relating to the problem of study.

Target Population and Sample Size

The target population of the study comprised of all the 53 head teachers and 68 chemistry teachers in Bomet district secondary schools. Out of these, a sample of 20 head teachers and 30 Chemistry teachers was chosen for the study. A probability sampling and purposive sampling were used together to obtain the secondary schools to be used in the study. In order to control the effects of the extraneous variables, the sample was obtained from trained Chemistry teachers who had undergone SMASSE INSET but for the head teachers, some were art-based but were involved in secondary school management of teaching and learning.

Data Collection Instrument

A structured questionnaire was used as the main data collection instrument during research. Reliability of the research instrument was determined by using test- retest method.

Data Collection Procedure

The questionnaires were administered to the selected respondents. They were granted sufficient time to effectively fill in the required information after which the researcher collected the filled questionnaires and extracted the data into Ms-Excel spreadsheets.

Data Analysis

Analysis was done using Statistical Package of Social Scientist, (SPSS). Pearson Product Moment Coefficient of Correlation, *r* was used compute a relationship between two variables during the study. The results were also presented in form of tables, bar graphs and pie charts.

RESULTS AND DISCUSSIONS

Gender of the Respondents

Majority 12 (60%) head teachers and 24 (85.7%) of the teachers were male, while their female counterparts comprised of 8 (40%) head teachers and 4 (14.3%) teachers. The findings show that there was sex disparity in the distribution of head teachers and chemistry teachers in the district.

School Population

The school population of the selected head teachers was ascertained. The results are tabulated below.

Table 1. School population

School enrolment	Head teachers		Teachers	
	Frequency	%	Frequency	%
1-100 students	1	5.0	3	10.7
101-200 students	9	45.0	4	14.3
201-300 students	2	10.0	6	21.4
301-400 students	3	15.0	6	21.4
401-500 students	2	10.0	2	7.1
>501 students	3	15.0	7	25.0
Total	20	100.0	28	100.0

From the results, most of the principals in the study area head schools with a student population between 101 – 200 while most of the teachers are in schools with a student population of above 500 students. This means that for these schools, the teacher : student ratio is 1: 71 which is far much higher than the recommended ratio.

Size of Chemistry Classes

The size of chemistry classes varied during the study and is summarized in table 2.

Table 2. Chemistry class size

Chemistry class size	Head teachers		Teachers	
	Freq	%	Freq	%
0-50 students	10	50.0	20	71.4
51-100 students	8	40.0	8	28.6
101-150 students	2	10.0	-	-
Total	20	100.0	28	100.0

From the above findings, the greater the number of students, the fewer the opportunities for participation and the greater the amount of time devoted to classroom management rather than for instruction. From the study, majority of schools have class size of less than 50 which increases learner participation.

Type of School

The data on the type of school where the respondent works was ascertained and the results are summarized in table 3.

Table 3. Type of school

Type of school	Head teachers		Teachers	
	Freq	%	Freq	%
Boys	4	20.0	5	17.9
Girls	5	25.0	8	28.6
Mixed schools	11	55.0	15	53.6
Total	20	100.0	28	100.0

From the findings it shows that the highest proportion of respondents was from mixed schools as compared to boys and girls schools. This means that most of the teachers in the district teach in mixed secondary schools which also form a higher number in the district.

Education Level of Respondents

The data on the highest level of education of the respondents was obtained and summarized in table 4 below.

Table 4. Education level of respondents

Education level of Respondents	Head teachers		Teachers	
	Freq	%	Freq	%
Diploma	2	10.0	5	17.9
Bachelor‘s degree	17	85.0	23	82.1
Masters	1	5.0		
Total	20	100.0	28	100.0

The findings show that majority of the head teachers had taught over 10 years while chemistry teachers had an experience of 5 to 10 years. This means that teachers in the field were experienced and therefore were capable of carrying out instructional activities as outlined in the curriculum.

Chemistry Lessons Taught per Week

The data on the number of lessons taught by chemistry teachers per week in the study area was elucidated and summarized in Figure 2 below.

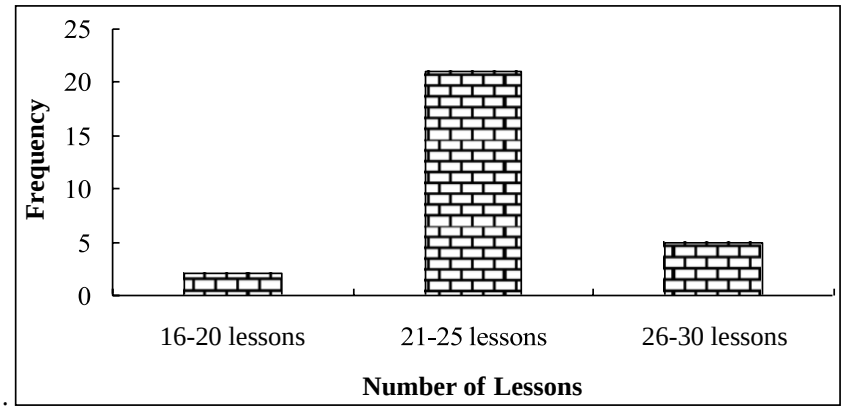

Figure 2. Number of Chemistry lessons taught per week

The findings show that majority of the teachers had a teaching load of between 21 and 25 lessons per week. According to the government policy in education each teacher is supposed to teach twenty seven lessons per week. It is also worth noting that apart from instructional activities, teachers are assigned other duties and responsibilities for example, guidance and counseling, head of department, director in charge of examination and co-curricular activities. This increases the teacher‘s work load and time for lesson preparation in line with SMASSE approach is limited. SMASSE project approach involves planning of instructions before class presentation.

SMASSE INSET Cycles

The chemistry teachers identified the various SMASSE- INSET cycles they had undergone as summarized in the figure 3.

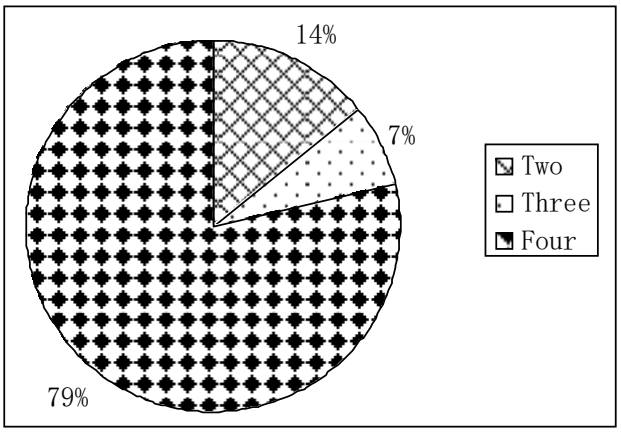

Figure 3. SMASSE INSET cycles undergone

From the findings, majority of the teachers had undergone four SMASSE- INSET cycles, thus enabling them be acquainted with relevant skills and techniques to handle and teach chemistry. Since a good number of teachers have completed the INSET cycles there could be a change in terms of classroom activities and the extent of student participation. This is also in accordance with the findings of (Kibe *et al*, 2008).

Preparation and Use ASEI/PDSI Lesson Plan

The teacher's views on how often they prepared and used ASEI/PDSI lesson plan was varied as summarized in figure 4.

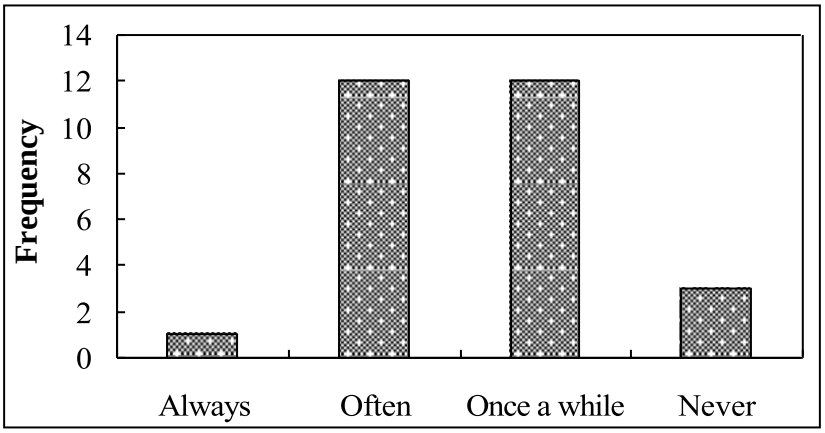

Figure 4. Preparation of ASEI/PDSI lesson plans

Majority (42.9%) of teachers often prepared and used the lesson plan. A similar percentage of teachers prepared and used it once in a while. However, 3 (10.7%) had never prepared ASEI/PDSI lesson plans and the least 1 (3.6%) always prepared ASEI/PDSI lesson plans. This indicates that the preparation and use of ASEI/PDSI lesson plan, was done by some teachers while others have never prepared them to guide their classroom activities. From these findings most teachers plan for instructions for effective lesson delivery.

Perceptions of the Impact of SMASSE

The perceptions of the influence of SMASSE project activities on learning chemistry. The teachers were asked to give their views on the much they agreed or disagreed with the influences of SMASSE activities on learning chemistry. Majority 26 (92.9%) of teachers agreed that learners attitude towards chemistry and content mastery had greatly improved since the SMASSE training while a small percentage 2 (7.1%) disagreed. Most of the teachers 22 (78.5%) agreed that learners took the assignments more positively, with 2 (7.1%) disagreeing and 4 (14.3%) undecided. Ten of the teachers (35.7%) agreed that learners did the assignments more promptly, with 9 (32.1%) disagreeing and same percentage undecided. Higher percentage of the teachers 16 (57.1%) agreed that the missing link between primary and secondary school science had been addressed, with 6

(21.4%) disagreeing and 6 (21.4%) undecided. Three quarters of the teachers 21 (75%) agreed that learners show great interest and responsiveness in the lessons, with 3 (10.7%) disagreeing and 4 (14.3%) undecided. Most of the teachers 17 (60.7%) agreed that learners carry out discussions beyond the class time, with 10 (35.7%) disagreeing and 3 (10.7%) undecided. Eleven of the teachers 11 (39.2%) agreed that learners asked questions in and out of class since the SMASSE training, with 9 (32.1%) disagreeing and 8 (28.6%) undecided. Three quarters of the teachers 22 (78.6%) agreed that leaner‘s participate more actively in group work since the SMASSE training, with 3 (10.7%) disagreeing and similar percentage remained undecided. SMASSE Project activities have influenced learning of chemistry. Attitude towards the subject has greatly improved and this was evident where students took assignments more positively and do them. There was also increased student participation through group discussions. These are similar findings on SMASSE achievements (JICA, 2006).

Perceptions of the impact of SMASSE project on Chemistry teachers. The head teachers were requested to rate impact of SMASSE project on Chemistry teachers. Majority of head teachers 14 (70%) agreed that teachers plan better and more consistently for lessons, with 4 (20%) disagreeing and 2 (10%) undecided. Higher percentage of head teachers 17 (85%) agreed that teachers attend learners needs more effectively and face the challenges of large classes better, with 2 (10%) disagreeing and 1 (5.0%) undecided. With respect to team work, eighteen 18 (90%) of head teachers agreed that teachers were more open to team work than before, with 1 (5.0%) disagreeing and same percentage undecided. All the head teachers were in agreement that teachers were more confident to carry out practical activities and experiments previously thought to be difficult or dangerous.

Majority 18 (90%) of head teachers agreed that teachers tried out new methods of teaching while 2 (10%) disagreed. Most head teachers 18 (90%) agreed that teachers faced the challenges arising from lack of resources better while 2 (10%) were undecided. The findings above show that SMASSE-INSET has improved the teacher‘s performance in the classroom through planning for instructions. Through sharing experiences, teachers developed confidence in carrying out class experiments and attempting new methods of teaching to enhance learning. They also improvised apparatus and simple chemicals to solve problems arising from lack of resources. All these are similar to the achievements of SMASSE Project in teacher capacity development (Kibe *et al.*, 2008).

Perceptions of the impact of SMASSE on Chemistry students. The head teachers were requested to rate the impact of SMASSE project on Chemistry. Most of the head teachers 18 (90%) agreed that learners were actively involved in the lessons through participation as a result of SMASSE activities, with 1 (5%) disagreeing and the same percentage undecided. Seventeen head teachers 17 (95%) agreed that learners showed great interest and responsiveness and that their interest and curiosity was aroused and sustained as they relate chemistry to their real life experiences, with 2 (10%) disagreeing and 1 (5%) undecided. A large number of head teachers 16 (80%) agreed that learners attended lessons more punctually and consistently while 2 (10%) disagreed and 2 (10%) remained undecided.

Half the number of head teachers 10 (50%) were undecided on whether learners did their assignments more neatly and promptly as a result of INSET while 7 (35%) agreed and 3 (15%) disagreed. The head teachers equally rated the learners' carrying out group discussions beyond class time. Most head teachers 10 (50%) agreed that learners asked questions in and out of class, while 8 (40%) disagreed and 2 (10%) were undecided. Majority 18 (90%) of head teachers agreed that SMASSE had impacted on the learners by providing them with opportunities to develop key competencies such as problem solving, analysis, synthesis and application of relevant information in the subject whereas 2 (10%) disagreed with the statement. Most of head teachers 17 (85%) agreed that through SMASSE approach of teaching, chemistry is demystified as the learners relates the subject content to real life experiences and hence their attitude gradually becomes positive. Three of the head teachers 3 (15%) disagreed with the statement.

The findings show that after the SMASSE –INSET, classroom activities have greatly improved. There has been a change in learners' attitude towards the subject and has been revealed by participation, punctuality and consistency in the classroom. Learners' also have adopted the SMASSE Project learning approaches which include; use of group discussion and real life experiences to enhance learning. These observations are known to the head teacher during evaluation of the lesson. All these findings show that learner-centered methods of teaching takes place in the classroom and are similar to those obtained from research (JICA, 2006) and (Kibe *et al.*, 2008).

CONCLUSIONS AND RECOMMENDATIONS

Majority of teachers agreed that learners' positive attitude towards the subject has been observed. This was evident where students took assignments more positively and do them. Three quarters of teachers agreed that great interest and responsiveness have been observed in the classroom after the implementation of SMASSE-INSET. It has been observed that there was increased student participation through group discussions. These were similar to the findings on SMASSE achievements (JICA, 2006).

From the study it was concluded that learners' positive attitude towards the subject has been observed; learners' did assignments more positively. They show great interest and responsiveness and have adopted the use of group discussion method for learning. There was increased student participation where learners' were actively involved in classroom activities. Generally, leaner-centered methods of learning took place in the classroom.

From the conclusion it was recommended that the government through the ministry of education should introduce motivational strategies to performing students in the district level in science especially chemistry in national examinations. For example, scholarship award for high education and training.

From the study the following recommendations were drawn;

- ✓ The government through the ministry of education should strengthen and support the SMASSE-INSET activities for continuous teacher development.
- ✓ The government through the ministry of education should deploy more chemistry teachers to reduce teacher-student ratio and teacher workload in

secondary schools.

- ✓ The pedagogical approaches ASEI/PDSI should be introduced in teacher training institutions to enable the teachers to fully appreciate the method of teaching for effective lesson delivery.
- ✓ The government through the ministry of education should introduce motivational strategies for the best performing teachers in national examinations. For example, promotions, monitory gifts and certificate awards.
- ✓ The ministry of education through QASO with the support of head teachers should ensure that teachers plan their work consistently using SMASSE approaches of ASEI/PDSI for better performance.

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