



ISSN 2278 – 0211 (Online)

Perceptions to Techniques of Improving Mathematics and Science: Case of SMASSE Project on Teaching and Learning of Chemistry in Bomet District Secondary Schools, Kenya

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Abstract:

Strengthening of Mathematics and Sciences in Secondary Education (SMASSE) is a government intervention on capacity development in Kenya. It was launched in 1998 as a pilot project and expanded to cover all the districts in Kenya in 2003. The paper was used to investigate the perceptions of the impact of SMASSE project on KCSE performance in Chemistry in secondary schools. A descriptive survey design was used. Where a sample of 50 respondent were given questionnaires. Simple random sampling technique was used to select respondents from head teachers and Chemistry teachers of public secondary schools in Bomet district, Kenya. The schools were stratified into boys', girls' and mixed secondary schools then taking a purposive random sampling in each subgroup. The findings noted positive attitude towards chemistry subject and recommended that government should motivate performing students. SMASSE has assisted teacher development though setback from lack of resources. Learners have positively improved in punctuality and consistency, though there was no significant output in KCSE as at now. The laboratory should then be improved and the government should continue with the SMASSE-INSET project and programme to achieve the long-lasting solution to poor performance.

Keywords: SMASSE, Chemistry Particles, Education Science, Bomet, Kenya.

1. Introduction

Education performance and standards in the parts of Kenya are in deplorable state and deteriorating in an alarming rate. It is acknowledged that majority percentage of the children out of school and illiterate adults are in sub-Saharan Africa. There are disadvantaged groups in terms of access, retention and performance in education. Numerous studies have illustrated this situation to the point that education policy makers have been forced to accept that there are serious disparities that call for urgent action in performance if Africa is to achieve the millennium development goals by 2015 (Mghanga, 2010). The African continent is facing enormous challenges due to poverty, bad governance, social, economic and political conflicts and the HIV/AIDS pandemic. These make the tasks of raising development levels difficult to accomplish. Fortunately, education provides the skills and competencies that will allow individuals to perform productive roles in society and nation building.

The challenges in the education system today are the faulty methods used by teachers of science and mathematics especially Chemistry in instructional presentations. They have concentrated on teacher- centered methods of teaching to accomplish their classroom activities. Therefore, there is need to monitor the performance at every stage to ensure consistent acquisition of both skills and knowledge as teachers prepare the learners for a competitive world of science and technology (Majali, 2010).

SMASSE Project provides competencies in mathematics and sciences. This body of knowledge is important for innovations particularly in this era of information, communication and technology (Maganga,2006). These subjects particularly Chemistry are used as a basis for the entrance to many careers for example, medicine, pharmacy, nursing and engineering in middle level and higher institutions of learning. The instructional approaches for better understanding of Chemistry is a practical oriented curriculum in which theoretical work is related to real life situations for effective learning. This is the essence of SMASSE through the ASEI/ PDSI teaching approaches.

In Bomet district, KCSE performance in Chemistry has been very poor too as shown by the low mean grades over the years. The mean grades have been: 3.75 in 2007, 3.63 in 2008, 3.68 in 2009 and 3.95 in 2010. From the mean grades, it can be concluded that SMASSE has had little impact despite the fact that teachers attend the INSET. This study sought to find out the

perceptions of the impact of SMASSE Project on Chemistry performance, its influences on teaching and learning and finally determine the challenges facing teachers in their effort to implement SMASSE methods in their respective schools.

2. Literature Review

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 Orlando, 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-centered towards learner-centered 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, 2006). 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, (1988) 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; 2006).

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 Orlando, 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 Orlando (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.

SMASSE targeted teachers for they are responsible for planning and guidance of instructions in the classroom. Amidst this responsibility, teacher's attitude impact negatively on students. Negative attitude among students is manifested in frequent absenteeism, lack of attention in class, failure to do assignments and poor performance. There is need to improve on teachers' attitude to be able to present the work systematically and effectively. In this therefore, they should provide meaningful learning activities as the students become active in the learning process. Research conducted in some districts reveals the achievements of SMASSE-INSET in capacity development and effective classroom delivery.

3. Objective

The paper investigates the perceptions of the impact of SMASSE Project on KCSE chemistry performance in Bomet district.

4. Methodology

Descriptive survey design was appropriate where a target population of 121 comprised of the head teachers and chemistry teachers in Bomet district secondary schools. The head teachers were fifty-three from the 53 secondary schools in Bomet district and sixty-eight Chemistry teachers already deployed by the government in the district. Head teachers: 30% of 53 is equivalent to 15 head teachers. Chemistry teachers: 30% of 68 is equivalent to 20 teachers according to Kombo and Tromp (2006). Using purposive sampling technique to obtain the schools, the head teacher of the school qualified to be used as a respondent. Chemistry teachers from the selected secondary schools were obtained by simple random technique. Questionnaire were given to the respondent and later analyzed with help of Statistical Package of Social Scientist, (SPSS).

5. Results and Discussion

The results obtained on perception of SMASSE were grouped onto SMASSE project activities perception on learning chemistry, on teachers of chemistry and on chemistry students. The relevant data from the analysis were then presented as below;

5.1. The Perceptions 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. Their views were varied as summarized in table 1 below.

Influence of SMASSE on Learning Chemistry	SA		A		U		D		SD	
	F	%	F	%	F	%	F	%	F	%
Learners attitude towards chemistry has greatly improved	8	28.6	18	64.3	0	0.0	2	7.1	0	0.0
Learners content mastery has greatly improved	11	39.3	15	53.6	0	0.0	2	7.1	0	0.0
Learners take assignments more positively	2	7.1	20	71.4	4	14.3	2	7.1	0	0.0
Learners do assignments more promptly	0	0.0	10	35.7	9	32.1	9	32.1	0	0.0
The missing link between primary and secondary school science have been addressed	10	35.7	6	21.4	6	21.4	6	21.4	0	0.0
Learners show great interest and responsiveness in the lessons	9	32.1	12	42.9	4	14.3	2	7.1	1	3.6
Learners carry out discussions beyond the class time	4	14.3	13	46.4	3	10.7	7	25.0	1	3.6
Learners ask questions in and out of class	2	7.1	9	32.1	8	28.6	9	32.1	0	0.0
Learners participate more actively in group work or discussions.	14	50.0	8	28.6	3	10.7	3	10.7	0	0.0

Table 1: The Perceptions of SMASSE Project Activities on Learning Chemistry
Source: Research Data (2012)

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 learner'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).

5.2. Perceptions of the Impact of SMASSE

Perception of impact of SMASSE was determined on the chemistry teacher and student level.

5.2.1. Perceptions of the Impact of SMASSE Project on Chemistry Teachers

The head teachers were requested to rate impact of SMASSE project on Chemistry teachers and their views varied as summarized in table 2 below.

Impact of SMASSE on Chemistry teachers	SA		A		U		D	
	F	%	F	%	F	%	F	%
Teachers plan better and more consistently for lessons	1	5.0	13	65.0	2	10.0	4	20.0
Teachers attend learners needs more effectively	1	5.0	16	80.0	1	5.0	2	10.0
Teachers are more open to team work than before	8	40.0	10	50.0	1	5.0	1	5.0
Teachers are more confident to carry out practical activities and experiments previously thought to be difficult or dangerous	11	55.0	9	45.0	0	0.0	0	0.0
Teachers try out new methods of teaching	8	40.0	10	50.0	0	0.0	2	10.0
Teachers face the challenges arising from lack of resources better	7	35.0	11	55.0	2	10.0	0	0.0
Teachers face the challenges of large class better	4	20.0	13	65.0	1	5.0	2	10.0

Table 2: Perceptions of the Impact of SMASSE on Chemistry Teachers

Source: Research Data (2012)

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).

5.2.2. Perceptions of the Impact of SMASSE on Chemistry Students

The head teachers were requested to rate the impact of SMASSE project on Chemistry students and their views varied as summarized in table 3.

Impact of SMASSE on chemistry students	SA		A		U		D		SD	
	F	%	F	%	F	%	F	%	F	%
Learners actively involved in the lessons through participation	7	35.0	1 1	55.0	1	5.0	1	5.0	0	0.0
Learners show great interest and responsiveness	1 1	55.0	6	30.0	1	5.0	2	10.0	0	0.0

Impact of SMASSE on chemistry students	SA		A		U		D		SD	
Learners attend lessons more punctually and consistently	1	5.0	15	75.0	2	10.0	2	10.0	0	0.0
Learners do their assignments more neatly and promptly	2	10.0	5	25.0	10	50.0	2	10.0	1	5.0
Learners carry out group discussions beyond class time	5	25.0	5	25.0	5	25.0	5	25.0	0	0.0
Learners ask questions in and out of class	3	15.0	7	35.0	2	10.0	8	40.0	0	0.0
Learners interest and curiosity is aroused and sustained as they relate chemistry to their real-life experience	7	35.0	10	50.0	1	5.0	2	10.0	0	0.0
Provide learners with opportunities to develop key competencies e.g. problem solving, analysis, synthesis and application of relevant information in the subject	7	35.0	11	55.0	0	0.0	1	5.0	1	5.0
Demystify chemistry because by relating it to learner's real life experiences their attitude gradually becomes positive	8	40.0	9	45.0	0	0.0	1	5.0	2	10.0

Table 3: Perceptions of the Impact of SMASSE on Chemistry Students

Source: Research Data (2012)

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 take place in the classroom and are similar to those obtained from research (JICA, 2006) and (Kibe et al., 2008).

6. Conclusions and Recommendations

The conclusion and recommendation were dealt on the grounds of perception of SMASSE project activities on learning of chemistry as well as perception of impact of SMASSE project on both chemistry teacher and students.

6.1. Perceptions of SMASSE Project Activities on Learning of Chemistry

The influence of SMASSE project on learning chemistry was obtained from the views of the teachers. Majority of teachers agreed that learners' 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, learner-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.

6.2. Perceptions of the Impact of SMASSE on Chemistry Teachers

From the findings, most of the teachers had undergone four SMASSE- INSET cycles and they prepared and use ASEI/PDSI lesson plan to guide classroom activities. Secondary schools in the district had science laboratories put in place for practical activities.

Group discussion method of teaching was always used by chemistry teachers in teaching. However, the class experiments and teacher demonstrations were often used to enhance student participation. Lecture method of teaching was also used to introduce the topic, review, and obtain feedback from the learners. Majority of head teachers agreed that teachers plan better and more consistently for the lessons and were confident to perform practical activities previously thought to be difficult. Through sharing experiences, teachers developed confidence in carrying out class experiments and attempted new methods of teaching to enhance learning. Majority of head teachers agreed that teachers faced challenges that arose from lack of resources through improvisation. Most of the head teachers agreed that teachers were more open to team work and were able to attend learners' needs. All these findings were similar to the achievements of SMASSE Project in teacher capacity development (Kibe et al., 2008).

6.3. Perceptions of the Impact of SMASSE on Chemistry Student

A higher proportion of head teachers agreed that there has been a change in attitude of the learners' in the classroom towards the subject. This was observed from learners' punctuality and consistency in lesson attendance. They promptly did class assignments. Half of the head teachers agreed that learners' have adopted the use of group discussion method of learning and the use of real life experiences to study chemistry. All these findings show that learner-centered methods of teaching took place in the classroom. These findings were similar to those obtained through research (JICA, 2006) and (Kibe et al., 2008).

From the study it was concluded that most of the teachers had undergone four SMASSE- INSET cycles and they prepared and use ASEI/PDSI lesson plan to guide classroom activities. Secondary schools in the district had science laboratories put in place for practical activities and missing apparatus were therefore improvised according to SMASSE approach. Chemistry teachers have embraced SMASSE- INSET activities through the use of real objects in the classroom to enhance learners' skills and promote student interest and understanding. Group discussion method of teaching was always used. However, class experiments and teacher demonstrations were often used to enhance student participation. Lecture method of teaching was also used to introduce the topic, review, and obtain feedback from the learners. Chemistry teachers planned better and more consistently for the lessons and were confident to perform practical activities previously thought to be difficult. They faced challenges arising from lack of resources through improvisation and they carried out their duties as a team.

Learners' attitude towards Chemistry was positive and was evident from their punctuality and consistency in lesson attendance. They also did their assignments promptly. Learners' carried out group discussion and used real life experiences to understand concepts in chemistry. There was no significant relationship between the performance in chemistry KCSE examination during and after SMASSE training.

From the conclusion, the following recommendations were drawn:

- The government through the ministry of education should continue carrying out SMASSE- INSET to improve the teachers' instructional skills and capacity development so that the teachers could master the subject content in the classroom.
- Most of the schools do not have well equipped science laboratories; this could be a contributing factor to poor performance in examinations despite the INSET. Therefore, the government should support the infrastructural development in secondary schools for instance equipping of science laboratories.

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