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Effects of Smasse Programme in Service Education and Training on the Teaching of Mathematics and Science in Secondary Schools in Koibatek District, Kenya

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Abstract
Strengthening of Mathematics and Science in Secondary Education (SMASSE) In – Service Education and Training (INSET) programme is one of the strategies that the Ministry of Education put in place to strengthen the teaching and learning of Mathematics and Science in secondary schools in Kenya. This study sought to establish the extent to which teachers were practicing the principles, skills and knowledge they learnt in the SMASSE INSET training programme in the course of their teaching and whether there is any relationship between teacher characteristics and the level of adoption of principles, skills and knowledge learnt in the SMASSE INSET programme in secondary schools in Koibatek District, Kenya. The study adopted an *ex post facto* research design. The targeted population included 150 Mathematics and Science teachers from 23 secondary schools. A sample of 22 Principals and 110 teachers was drawn from 22 schools. Data were collected using two sets of structured questionnaires (teachers and principals). Reliability was tested using Cronbach coefficient alpha to determine the internal consistency of the questionnaire items; A Cronbach's Coefficient Alpha of 0.8139 was obtained. The collected data were processed and analyzed using descriptive and inferential statistics. The descriptive statistics included frequencies, percentages and means. Inferential statistics using chi-square and Spearman Rank correlation coefficient were used and tested at $\propto = 0.05$ significance level. Analysis was done using Statistical Package for Social Sciences (SPSS). The study found that teachers implemented the principles, skills and knowledge they learnt in the course of their teaching and that individual teachers' characteristics do not influence the adoption of SMASSE INSET. The study recommends that Headteachers should put in place mechanisms in their schools to ensure that teachers implement all the principles, skills and knowledge learnt from SMASSE INSET. There is also need for schools to take advantage of the high level of adoption of the SMASSE INSET to encourage more students to enroll and improve their academic performance in these subjects.

Background Information

Teachers are probably the most important human resource a country has. This is because all efficient human capital development depends partly on the quality and effectiveness of teachers (Okumbe, 1999). This quality and effectiveness of teachers would be a function of their personal talents and training. According to Moraga (1983), teacher training is one of the most important aspects about curriculum development and implementation in any education system. Ideally, the training of teachers should have two phases: pre-service training followed by in-service training.

Assistance for Development of Education in Africa (ADEA) states in one of its 2005 newsletter that adequate pre-service teacher training notwithstanding, the emerging consensus is that the pre-service teacher training is just sufficient for an orientation of the teacher into the profession; the real teacher is gradually formed in the classroom (ADEA, 2005). Pre-service teacher education is aimed at introducing prospective teachers to the fundamental knowledge of teaching; development of good attitudes towards the teaching profession; introduction of the prevailing program and some basic theories of teaching skills before assuming the position. However, pre-service teacher training is not considered to be adequate enough for a trainee to carry out the duties of the teaching profession for long (ADEA, 2005; Moraga, 1983).

ADEA (2005) asserts that Mathematics and Science education, especially at the secondary level, is a prerequisite for industrial and technological advancement. In the past, great effort has gone into ensuring that adequate qualified teachers and sufficient equipment and material are provided to schools, but in most cases, they remain inadequate in most African Countries (ADEA, 2005). Even where they are adequate, the quality of student

achievement in Mathematics and Science education is not always high. Attention is thus drawn to what classroom practices, utilisation of available equipment and materials and approaches and methodologies that are employed in content delivery. Providing opportunities for teachers to share experiences and to mentor each other, to update their skills and interact with innovative approaches and practices that create interest and inspire confidence in learners is a critical component of the answer to Mathematics and Science education problem. This is the basis for existence of In-service Education and Training (INSET) for Mathematics and Science teachers (ADEA, 2005; Moraga, 1983).

INSET can be organized for a variety of reasons such as certification of untrained teachers, introduction of new curriculum or teaching methodology, upgrading the content, introducing a new supervisory system amongst other reasons (Thuku, 2003). Donoughue *et. al* (1981) states that an INSET has an important part to play in educational innovation. They argue that INSET is one of the means by which schools can be innovative. Ray Bolan states that INSET has received attention for three reasons. One reason is its potential for stimulating professional development; the second one is that INSET can improve School practice, and the third reason is that INSET may be a viable strategy for implementing social policy (Hopkins, 1986).

According to Strengthening of Mathematics and Science in Secondary Education (SMASSE, 2003), the objectives of Mathematics and Science teaching in Kenya have largely not been achieved as indicated by the poor performance of the students in national examinations.

As an intervening measure to this poor performance, the strengthening of Mathematics and Science in Secondary Education (SMASSE) project was started as a joint venture between the government of Kenya through the Ministry of Education Science and Technology (MOEST) and the government of Japan through Japan International Cooperation Agency (JICA). At its inception, SMASSE targeted continuing education for teachers of Mathematics and Science, but has since expanded to include In-service Education and Training of Secondary School Headteachers, Inspectors of Schools, District Education Officers, tutors of Mathematics and Science in Secondary School Teacher Training Colleges and tutors at Technical and Vocational Institutions (ADEA, 2004).

Statement of the Problem

SMASSE INSET programme is one of the strategies that the Ministry of Education put in place to strengthen the teaching and learning of Mathematics and Science in secondary schools in Kenya. However, the effects of this strategy had not been documented despite the high premium that has been placed on it as evidenced by the amount of time as well as human and capital resources invested in it. The question that arose is whether the SMASSE INSET programme has had any effect on the teaching and learning of Mathematics and Science in the secondary schools whose teachers had gone through the programme. This study therefore sought to establish the level of adoption of the principles, skills and knowledge learnt by the teachers during the SMASSE INSET in secondary schools in Koibatek district, Kenya.

Objectives of the Study

The study was guided by the following objectives:

(i) Find out the extent to which teachers are practicing the principles, skills and knowledge they learnt in the SMASSE INSET training programme in the course of their teaching.

(ii) Determine whether there is any relationship between teacher characteristics and the level of adoption of principles, skills and knowledge learnt in the SMASSE INSET programme.

Scope of the Study

The study was carried out in secondary schools in Koibatek district in Baringo county. Koibatek district is one of the pilot districts where the four phases of SMASSE INSET programme had already taken place. The study targeted Mathematics and Science teachers to establish the extent to which the programme had influenced their change of attitude and the extent to which they implement what they learn during the SMASSE INSET programme. The study established the effects of new skills, knowledge and attitudes gained on the enrolment and performance of the students in Mathematics and Science subjects. The enrolment and performance of the students was used as indicators of attitude change and effective learning amongst them. For purpose of triangulation, information was also sought from the secondary school Principals.

The study sought to establish the extent to which the Mathematics and Science teachers were applying in their teaching the principles, skills and knowledge learnt in the SMASSE INSET programme. The study also sought to establish whether there is a significant relationship between teacher characteristics and their level of adoption of the principles, skills, and knowledge learnt in the SMASSE INSET programme.

Keywords: In this section, operational definitions are presented as used within the context of this study.

ASEI/PDSI movement: An acronym for Activities, Students, Experiments and Improvisation/Plan, Do, See and Improve; is the makes up the main content of the training of the

training offered by SMASSE

Classroom practices: All the activities that the teachers and students undertake in the course of a given lesson for purposes of teaching and learning respectively

District Planning Committee: This is the group of education officers and educators who are responsible for organizing the in-service programme on behalf of the ministry of education and SMASSE at the district level.

District trainer: A teacher who has been trained by the SMASSE national staff and then participates in training of other teachers during the SMASSE INSET at district level.

Graduates: The trainees who have gone through all the four cycles of SMASSE INSET as participants.

INSET: In–Service Education and training comprises of all the activities undertaken by teachers or professional educationists while still working in a job, in order to improve their professional competence, skills and abilities.

Non – pilot district: Any one of the districts in Kenya where the SMASSE INSET programme was not conducted during the pilot phase of the project

Pilot district: One of the fifteen districts in Kenya where the SMASSE project was carried out during the pilot phase of the SMASSE INSET programme.

Principles, skills and Knowledge learnt in INSET curriculum: The ASEI/PDSI movement concept which comprises the training curriculum content

Science Subjects: Physics, Biology and Chemistry are regarded as the Science subjects in this study.

SMASSE INSET cycle: This refers to training carried out by SMASSE within a period of ten days during one of the school holidays in the course of one year.

SMASSE: Strengthening of Mathematics and Science in Secondary Education is the organisation entrusted with the responsibility of in-servicing Mathematics and Science teachers in secondary schools in Kenya

Teacher characteristics: This is the typical qualities that different teachers may have such as age, professional qualification, teaching experience, teaching subjects and role played in the SMASSE INSET.

Trainees: Serving Teachers of Mathematics and Science who attend SMASSE INSET.

Research Design

This study used co-relational study design, which is one kind of the *ex post facto* research design. Kothari (2004) describe an *ex post facto* as a research where the researcher has no control over the variables and can only report what has already happened or observe what is happening. Cohen, Manion and Morrison (1987) state that *ex post facto* design is used to investigate the possible cause-and-effects relationship by observing an existing condition or state of affairs and searching back in time for plausible causal factors. According to Kerlinger (2000), an *ex post facto* design is a systematic empirical inquiry in which the researcher has no ability to control the independent variables because their manifestations have already occurred or they cannot be manipulated. The independent variable, which is the SMASSE INSET programme, had already taken place in the Koibatek district. The researcher attempted to find out the effects of the independent variable on the teaching and learning as manifested by the attitudes of teachers and students on the Mathematics and Science subjects, classroom practices of the teachers and the students' academic achievements without any manipulation of the independent variable.

Location of the Study

The study was conducted in secondary schools in Koibatek District in Baringo county in Rift Valley province. Koibatek District is was selected since it is one of the districts in which the four cycles of the pilot phase of the SMASSE INSET programme had already been carried out.

Population of the Study

According to the Koibatek District Education Office, as at September 2005, Koibatek District had 23 secondary schools of different types as indicated in Table 1 below. The schools had a total of 150 mathematic and Science teachers, all of whom were attending SMASSE INSET. The Mathematics and Science teachers comprise the graduates of the SMASSE INSET programme. The schools were used as the study units.

Table 1

Distribution of Schools by Category and Type in Koibatek District

Type of school	*Number of schools*
Boys only	5
Girls only	8
mixed	13
Total	23

Source: Koibatek District Education Office, September 2005

The population from which the sample was drawn therefore consisted of all the 150 Mathematics and Science

teachers, as well as the 23 secondary school Principals in the district. The schools Principals were included in the study for the purpose of triangulation. Any changes in the practice of the teachers, the use of facilities, the attitude of students in these subjects and progress in student performance must be noticeable by the principal as the supervisor of academic programmes in the school.

Sample and Sampling Procedure

The school sample comprised of 22 secondary schools out of the 23 in the district whose teachers underwent the SMASSE training. One mixed school was left out due to its inaccessibility and the fact that it had no unique characteristics that may have affected the results of the study. The number of Mathematics and Science teachers in secondary schools in Koibatek district who underwent SMASSE training and their distribution based on the subjects for which they were trained as at September 2005 is as shown in Table 2.

Table 2

Distribution of Teachers by Subject

Subject	*Number of Teachers*
Mathematics	45
Physics	40
Chemistry	33
Biology	32
Total	150

Source: Koibatek District Education Office, September 2005

All the 22 Principals were drawn from the selected school sample. A sample of 112 out of 150 Mathematics and Science teachers constituted the teachers' sample. According to Kathuri and Pals' table for determining sample size of a given finite population, the needed sample out of a population of 150 should be 108 (Kathuri & Pals, 1993:55). The teachers were stratified into four categories in accordance to the subjects for which they attended the SMASSE INSET, namely Mathematics, Physics, Biology and Chemistry. The sample was drawn in such a way that it was proportionately representing the number of teachers from each respective subject. The formula to be used is

$$n = \frac{108}{150} \times \frac{c}{22} \times T$$

Where;

n is the needed sample from a given subject in the category of school,
C is the number of schools in a given category and
T is the number of teachers who teach the subject and attended SMASSE INSETS for the said subject.

Based on this formula, the distribution of the teacher sample targeted was as in Table 3.

Table 3

Distribution of Teacher Sample per Subject

Type of School	No. of school in category	Teacher sample in the subject				*Total*
		Mathematics	Physics	Chemistry	Biology	
Boys only	5	7	7	5	5	24
Girls only	8	12	10	9	8	39
Mixed	10	15	13	11	10	49
Total		34	30	25	23	112

From the above sampling procedures, 112 Mathematics and Science teachers and 22 Principals formed the sample size for this study. However, only 108 teachers and 17 Principals managed to respond and correctly complete the questionnaires. The remaining 4 teachers and 5 Headteachers were unwilling to respond and correctly complete the questionnaires.

Instrumentation

The research instruments consisted of two questionnaires, with both open and closed questions. The first questionnaire was administered to the teachers and the second questionnaire was administered to the Headteachers. The teachers' questionnaire solicited information on the respondents' bio data, their classroom practices, level of confidence in teaching, and the level of application of teaching methods learnt during the SMASSE INSET programme. The Headteachers' questionnaire solicited information on the respondents' bio data, and their

Validity
The researcher carefully scrutinized the questionnaire items to find out whether they adequately addressed the objectives of the study in order to establish the validity of the instruments. Additionally, the researcher sought expert opinion concerning the research instruments from the supervisors and senior lecturers in the Department of Curriculum, Instruction and Educational Management.

Reliability
A pilot study was conducted in two schools in Baringo district before the actual data collection. Baringo district was one of the pilot districts where the four cycles of the programme had been fully carried out. Piloting was done so as to establish their reliability and make the necessary adjustments on the instruments. Reliability was tested using Cronbach coefficient alpha to determine the internal consistency of the questionnaire items. According to Mugenda and Mugenda (1999), this is a method of testing reliability of test scores by the use of a single administration of a test (Nachimias & Nachimias, 1996). A Cronbach's Coefficient Alpha of 0.81 was obtained and considered to be sufficient enough to confirm and reflect the internal consistency of the instruments (Koul, 1984).

Data Collection Procedures
The researcher first sought a permit to conduct the study from the Ministry of Education and permission from the Provincial Education Officer – Rift Valley, Koibatek District Education officer and the Principals of respective schools. The researcher traveled to the individual schools and administered the questionnaires to the selected respondents. The researcher clarified any issue concerning the questionnaire in order to uphold objectivity. The respondents were given time to respond to the questionnaires after which the researcher revisited the schools to collect the filled questionnaires. The response rate was 96.4%

Data Analysis
Data collected were processed, coded and analyzed to facilitate answering the research questions and addressing the objectives. This was done using both descriptive and inferential statistics. Descriptive statistics in form of percentages, frequencies, and means presented in tables, charts and cross-tabulations were used to summarize and organize data and to describe the characteristics of the sample population. Inferential statistics (chi-square and Spearman's Rank Correlation Coefficient) were used in making deductions and generalizations about the whole population. The inferential statistics were tested at $\propto = 0.05$ significance level. This was done with the aid of a computer programme - Statistical Package for Social Sciences (SPSS)

Demographic Characteristics of the Respondents
The demographic characteristics included school type and category, age, gender, professional qualification as a teacher, teaching experience, teaching subject, SMASSSE subject, and status in attending SMASSE INSET.
The study was conducted in twenty two secondary schools in Koibatek District. The twenty two schools were divided into categories and types. The school categories include: provincial and district schools. Table 4 illustrates the distribution of the sampled teachers in the seventeen schools by their category.

Table 4
Distribution of the Teachers by Their School Categories

School category	Frequency	Percent
Provincial	80	73.9
District	28	26.1
Total	108	100.0

The distribution of the sample in the two categories was based on the number of teachers in the district who had attended SMASSE INSET programme. Majority of them came from provincial schools compared to district schools. Also the district had more of provincial than district schools. The seventeen schools were further divided into three types based on the gender of their students including co-educational (mixed), boys' only and girls' only schools.
The variation in the sample distribution was based on the number of teachers who had attended the SMASSE INSET programme.
When the sampled teachers were asked about their gender, 75 (69.3%) responded that they were males while 33 (30.7%) were females. The gender disparities depict the overall imbalance between male and female teachers in terms on teaching and learning Mathematics and Science subjects. Majority of female students do not prefer Science subjects and therefore there are fewer females than males who pursue it at higher levels of education to be employed as teachers in secondary schools. It also depicts the general low levels of employment of females compared to males in professional jobs like teaching. The respondents also varied in their ages as depicted in

Table 5.

Table 5

Age Category of the Sampled Teachers

Age category	*Frequency*	*Percent*
20-29	23	21.3
30-39	54	66.3
40-49	16	14.8
Above 50	3	2.8
Total	108	100.0

Table 5 indicates that 87.6 percent of the sampled teachers were below the age of 40. This suggests that majority of the teachers who attended SMASSE programme were relatively young and in their early career years. Such teachers were still very eager to develop and improve their careers by adopting measures that boost the teaching and learning environment such as SMASSE INSET programme. The study also established that the teachers varied in their highest level of professional teaching qualifications as illustrated in Figure 3.

In terms of education and training, 54 (50.0%) of the teachers had a Bachelors degree in education. The remaining 32 (29.6%), 16 (14.8%) and 6 (5.7%) had a diploma in education, PGDE and Masters Degree, respectively. This suggests that the sampled teachers had sufficient professional qualifications to undertake their teaching responsibilities and meet the educational needs of students at secondary school level. Efficiency in teaching and handling of students academic needs would also depend on the experience of the teachers concerned. Table 6 depicts the number of years that the teachers had been in teaching profession.

Table 6

Number of Years in Teaching Profession

Number of years	*Frequency*	*Percent*
1-5	33	30.6
6-10	34	31.5
11-20	36	33.3
above 20	5	4.6
Total	108	100.0

Table 6 indicates that 92.7 percent of the teachers had taught for at most 20 years. Out of this, 30.6 percent had taught for 1-5 years, 31.5 percent had taught for 6-10 years while and 33.3 percent had done so for 11-20 years. The remaining 4.6 percent had taught for more than 20 years. This suggests a wide range of teaching experience in schools, mixing new and old teachers. Such a wide ranging teaching experience was critical for better teaching and learning environment. The new teachers are still fresh from college and thus could be very receptive to new ideas, while the older teachers had the necessary hands-on experience to understand the dynamics involved in teaching and learning Mathematics and Sciences.

Majority (34 each) of the sampled teachers taught Mathematics and Biology, while the remaining 26 and 14 taught Physics and Chemistry, respectively. The study also established that the teachers attended SMASSE INSET for different subjects as illustrated in Table 7.

Table 7

Subject for Which the Teachers Attended SMASSE INSET

Subject	*Frequency*	*Percent*
Mathematics	33	30.6
Biology	32	29.6
Physics	22	20.4
Chemistry	21	19.4
Total	108	100.0

Table 7 indicates that majority of the teachers also went for Mathematics and Biology during the SMASSE INSET programme. The remaining 22 and 21 went for Physics and Chemistry respectively during the programme, respectively. The variations in the subjects that teachers went for SMASSE INSET programme was attributed to the application, but also availability of Mathematics and Science teachers in a school. The study also established that teachers attended the SMASSE INSET programme in various capacities including district trainers and trainees. 94 (87.0%) of the teachers attended the SMASSE INSET programme as trainees, while 14

(13%) were district trainers. This suggests that majority of the teachers attended the programme to be trained.

Extent of Practising Principles, Skills and Knowledge of SMASSE INSET

The first objective sought to find out the extent to which teachers were practicing the principles, skills and knowledge they learnt in the SMASSE INSET training programme in the course of their teaching. The objective was based on the fact that after going through the SMASSE INSET programme, they were expected to implement and put into practice the principles, skills and knowledge they learnt. All this was aimed at improving their efficiency in teaching and academic performance of the students. The study assessed this from a series of 13 statements seeking respondent's rating of the extent to which the teachers were practising the tenets of SMASSE INSET programme. Responses to these statements were measured on a five-point likert scale ranging from 1 to 5 (where 1 = never - N, 2 = rarely - R, 3 = some lessons - SL, 4 = most lessons - ML, and 5 = every lesson - EL). The higher the score, the higher was the extent to which the teachers practiced the principles, skills and knowledge they learnt in the SMASSE INSET programme, and vice versa. Table 8 highlights the distribution of their responses on the statements.

Table 8

Practising the Principles, Skills and Knowledge of SMASSE INSET

Statement	*Response (%)*					*Mean*
	N	R	SL	ML	EL	
Invite questions from students during or after the lesson	0.0	0.0	3.4	19.3	77.3	4.74
Evaluate students' understanding of the concepts	1.1	1.1	10.2	48.9	38.6	4.23
Use lesson notes instead of lesson plan	3.4	4.5	12.5	33.0	46.6	4.15
Allow students to report the results of practical work during the lesson	2.3	9.1	48.9	35.2	4.5	3.31
Engage students in group work	0.0	5.7	60.2	33.0	1.1	3.30
Assign students practical work during the lesson	3.4	11.4	46.6	34.1	4.5	3.25
Use charts and other visual aids in class	1.1	14.8	47.7	33.0	3.4	3.22
Assign students discussion questions during the lesson	2.3	8.0	64.8	18.2	6.8	3.19
Consult other teachers about the lesson before or after teaching	2.3	13.6	52.3	29.5	2.3	3.16
Use both lesson plan and lesson notes during lessons	22.7	29.5	26.1	13.6	8.0	2.55
Engage students in project work	8.0	60.2	30.7	1.1	0.0	2.25
Make lesson plans	36.4	33.0	13.6	4.5	12.5	2.24
Invite other teachers to observe your lesson as you teach	55.7	38.6	5.7	0.0	0.0	1.50

N = 108

Results in Table 8 indicate that the teachers rated their practising of majority of the tenets of SMASSE INSET programme as frequent. Out of the 13 statements, 9 were rated above average (3.00) indicating frequent practice with mean scores of between M = 3.16 and M = 4.74. The respondents reported that they: invited questions from students during or after the lesson, evaluated students' understanding of the concepts, used lesson notes instead of lesson plans, allowed students to report the results of practical work during the lesson, engaged students in group work, assigned students practical work and discussion questions during the lesson, used charts and other visual aids in class, and consulted other teachers about the lesson before or after teaching. However, the respondents rated the last four statements below the average score with M = 1.50 and M = 2.55. They indicated that on average, they rarely used both lesson plan and lesson notes during lessons, rarely engaged students in project work, rarely made lesson plans, and never invited other teachers to observe their lessons as they teach.

The findings suggest that while the teachers seemed to have adopted a paradigm shift in their teaching from teacher centered approaches to student centered approaches, there were still some of the approaches that SMASSE INSET programme advocated that they had not adopted. Such include the making of lesson plans, inviting other teachers to observe their lessons as they taught and involving students in project work. To assist the teachers in their planning, SMASSE advocates for what is referred to as an ASEI lesson plan where the lesson notes are merged with the plan of activities. This is emphasized during the training where it is said that effective practice of ASEI, calls for proper **P**lanning, **D**oing (Carrying out the planned activity), **S**eeing (evaluating the outcome of the activity), followed by **I**mprovement; hence the acronym PDSI (SMASSE, 2005). This then indicates some weakness in the application of PDSI principle in the classroom situation. The reasons for this weakness in the application of PDSI principle may be linked to what the teachers cited as the hindrances to application of what they learnt in SMASSE INSET programme. The main hindrances cited were high workload and class sizes (20.3%), lack of resources for improvisation (34.4%) and lack of adequate time for

improvisation (35.9%). Teachers not applying what they learnt in the INSET programme is therefore not necessarily an indication of their disagreement with the INSET course content but what they said were hindrances to the implementation.

The effectiveness of the SMASSE INSET programme will depend on the extent to which all the 13 aspects of principles, skills and knowledge are applied. Therefore, responses to each of the 13 constituent statements were scored on a scale of 1, indicating least extent of practising, to 5, indicating highest extent of practising principles, skills and knowledge learnt through SMASSE INSET programme. The individual statement scores were added up to form an extent of practice index score for each respondent. The index score varied between 13, indicating the least extent of practice, and 65, indicating the highest extent of practice. The higher the score, the higher was the extent to which the teachers practiced the principles, skills and knowledge learnt through SMASSE INSET programme, and vice versa. The total score was later coded into three ordinal categories in order to differentiate the extent of practising the principles, skills and knowledge learnt among the respondents. This included a score of 13 to 30 (rarely), a score of 31 to 47 (often) and a score of 48 to 65 (always). Table 9 presents the extent of practising the principles, skills and knowledge learnt through SMASSE INSET programme.

Table 9
Extent of Practising Tenets of SMASSE INSET Programme

Extent of practising	*Frequency*	*Percent*
Rarely	2	1.9
Often	96	88.8
Always	10	9.3
Total	108	100.0

Table 9 indicates that overall, 88.8 percent of the sampled teachers often practiced the principles, skills and knowledge learnt in the SMASSE INSET training programme in the course of their teaching. This suggests a high level of implementation of most of what the teachers learnt in the SMASSE INSET programme; with only a few aspects not being applied in the teaching and learning of Science subjects and Mathematics. It also suggests a great deal of relevance of the SMASSE INSET programme course and the needs of the teachers; and a strong effect on the teachers' attitudes and beliefs. This is in line with previous studies by Somers and Sikorova (2002); Mohanty (2002); Harris, Busher and Wise (2001); Johnson, Kahle and Fargo. (2000); Flecknoe (2000) which indicated that effective planning and teaching of an INSET course necessitate change of practice by the teachers. Hopkins (1986) observed that there is evidence that INSET is directly linked to improved teaching and learning.

According to Harris, Busher and Wise (2001), changes in behaviour and practices are not achievable in isolation. Such developments need to be facilitated and nurtured by an external agency. They argue that it is difficult to transfer teaching or management skills from INSET sessions to classroom settings without adequate support of colleagues and school managers. The results of the study therefore imply there was good support from the colleague teachers and school principals in implementation of what they had learned in the INSET programme. Hopkins (1986) observed that after the INSET, there are also possibilities of adequate support from the school management, especially the school principals. Donoughe et al, (1981) summed up that the effectiveness or otherwise of much of the INSET programme, judged in terms of whether it leads to changes in practices, depends upon whether it produces greater or lesser security, greater or lesser enjoyment, greater or lesser job satisfaction, for the teachers involved in it. From the findings, after the SMASSE INSET programme, there is greater enjoyment of the lessons by both the teachers and the learners, leading to greater satisfaction with their work.

Teacher Characteristics and Adoption of SMASSE INSET Knowledge

The second objective sought to determine whether there was any relationship between teacher characteristics and the level of adoption of principles, skills and knowledge learnt in the SMASSE INSET programme. The demographic and professional characteristics considered included age, teaching subjects, status in attendance of SMASSE INSET, and teaching experience. Each of them was evaluated in terms of how it influenced adoption. The four characteristics were assessed on different measurement scales with age, teaching experience and status in attendance of SMASSE INSET measured as ordinal variables, while teaching subjects were nominal variables. Therefore, different statistics were used to establish their relationships with the adoption of principles, skills and knowledge learnt in the SMASSE INSET programme. For the ordinal variables, their relationships with adoption were determined using Spearman's Rank correlation (rho). Spearman's Rank correlation (rho) is used when determining the relationship between an interval/ratio variable and ordinal variable. Age was categorized as 20-29years, 30 –39years, 40-49 years and above 50years; teaching experience as 1 – 5 years, 6 – 10 years, 11 – 20 years and above 20years; while status in attendance of SMASSE INSET had district trainer and trainee. For

Spearman's Rank correlation (rho) to be used, the interval variable (extent of practice index score) was also collapsed into ordinal categories (rarely, often and always). Table 12 shows a Spearman's rho correlation coefficient matrix between adoption of principles, skills and knowledge learnt in SMASSE INSET and age, teaching experience and status in attendance of SMASSE INSET.

Table 8

Spearman's rho Correlates of Adoption of SMASSE INSET

Variable		Level of extent of practice of principles, skills and knowledge
Age category	Correlation Coefficient	-0.031
	Sig. (2-tailed)	0.775
	N	108
Number of years in teaching profession	Correlation Coefficient	-0.040
	Sig. (2-tailed)	0.710
	N	108
Status in attending SMASSE INSET	Correlation Coefficient	0.195
	Sig. (2-tailed)	0.068
	N	108

From Table 12, it is observed that adoption of principles, skills and knowledge learnt in the SMASSE INSET programme had weak negative and non-significant correlations with the age of the respondents (rho = -0.031) and number of years in teaching profession (rho = -0.040) and status of attending SMASSE INSET (rho = 0.195). This suggests that the higher the age and teaching experience of the teacher, the lower the level of extent of adoption of the principles, skills and knowledge learnt in the SMASSE INSET programme. However, the higher the status of attending SMASSE INSET programme, the higher the level of extent of adoption of the principles, skills and knowledge learnt. This suggest that older teachers who had been teaching in schools for a longer period of time were more likely to be reluctant in embracing new methods of teaching Mathematics and Science subjects compared to their younger counterparts. This may be attributed to the level of receptiveness of new ideas and better way of service delivery. However, the status of the teachers attending the training influence their level of adoption with district trainers being more likely to adopt the practice, skills and knowledge in comparison to trainees. This may be attributed to their level of knowledge and understanding of the importance of the SMASSE INSET programme. These findings contradict a study of experienced and beginning teachers by Luft & Roehrig (2007) which found out that beginning teachers were less likely to change their practices, while experienced teachers were more likely to change their practices after a professional development programme. He explained that the experienced teachers had beliefs about teaching that were established and consistent with the goals of the professional development program, which in turn influenced their decision to even participate in the program and therefore change their classroom practices. The contradiction in the findings may be attributed to general apprehension on the part of the older teachers on the effect of SMASSE INSET on the performance of their students. The findings suggest that teachers should be taken through the SMASSE INSET programme early in their career since there is a higher likelihood of adoption of its principles, skills and knowledge.

For the training subject, its relationships with adoption of principles, skills and knowledge learnt in the SMASSE INSET programme was determined using chi square test. Chi square statistical test using cross tabulations was used to establish the difference in the level of adoption by the teaching subject and whether it was significant or not. In this case, Chi-square was used to compare the frequency of cases found in one variable (teaching subjects) in two or more unrelated samples or categories of another variable (level of adoption of principles, skills and knowledge learnt in the SMASSE INSET. It is preferred when dealing with variables that had been categorized, training subjects (Mathematics, biology, physics and chemistry); and level of adoption was categorized in terms of the extent of principles, skills and knowledge learnt in the SMASSE INSET (rarely, often and always). However, χ^2 only indicates the significance of a relationship between two variables, but does not provide an estimate of the magnitude of association (strength and direction) between two attributes. Therefore, in order to estimate the magnitude of association between two attributes, the χ^2 value was converted into contingency coefficient. Contingency coefficient is calculated by obtaining the square root of the product of χ^2 value divided by the sample size. The values varies between 0 and +1, and the closer it is to +1, the stronger the relationship, while the closer it is to 0 (zero), the weaker the relationship (Bryman & Cramer, 2001). The χ^2 and Contingency coefficient were tested at $\propto = 0.05$ significance level. In order to calculate the Chi- square statistic, the level of adoption of SMASSE INSET was cross tabulated by teaching subjects. Table 13 shows a cross tabulation of the level of adoption of SMASSE INSET by training subjects.

Table 9
Training Subject by Level of Adoption of SMASSE INSET

			Training subjects				*Total*
			Mathematics	Biology	Physics	Chemistry	
Level of adoption	Rarely	Count	2	0	0	0	2
		%	6.1%	0.0%	0.0%	0.0%	1.9%
	Often	Count	29	30	20	17	96
		%	87.8 %	93.8 %	90.9%	81.0%	88.9%
	Always	Count	2	2	2	4	10
		%	6.1 %	6.2 %	9.1 %	19.0 %	9.2%
Total		Count	33	32	22	21	108

$\chi^2 = 7.117$ df = 6 $p = 0.310$ Contingency coefficient = 0.274

Study results in Table 13 indicates that there was no significant difference in the adoption of principles, skills and knowledge learnt in the SMASSE INSET programme due to the training subjects. It was observed that in all the categories of teachers by their training subject, majority of them fell in the often level of adoption category. This suggests that the level of adoption of the skills, principles and knowledge learnt in SMASSE INSET programme is not dependent on the subject trained in. Adoption depends on skills and knowledge gained and not the subject trained in. Since most teachers teach more than one subject, there is an implication that they applied what they learnt in the INSET programme regardless of the subject one trained in. This was further supported by the chi-square value ($\chi^2 = 7.117$), whereby p (0.310) > 0.05 significance level. This means that there was no significant difference in the adoption of principles, skills and knowledge learnt in the SMASSE INSET programme according to the training subjects of the teachers. Contingency coefficient value (0.274) indicates a weak relationship between adoption of SMASSE INSET and the training subjects. This could be attributed to the fact that the teachers go through very similar programmes. The main focus of SMASSE INSET programme is the ASEI/PDSI principle which is emphasized across the subjects including in the aspects that are subject specific. The training programme is also undertaken at the same time and many topics are handled by trainers from across the subjects.

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