

EVALUATION OF CAPACITY DEVELOPMENT PROGRAMS IN KENYA: A CASE OF SMASSE INSET FOR SCIENCE TEACHERS

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ABSTRACT

The purpose of this article was to evaluate the impact of SMASSE Program on students' attitude and academic performance in secondary schools in Kenya. The government of Kenya and Japan jointly initiated SMASSE INSET program since 2004 with the aim of changing teachers' attitude and teaching approaches of science and mathematics which was expected to translate into changing students' attitude hence improving their academic achievements. Teachers were expected to apply the new skill 'ASEI-PDSI' in the curriculum implementation at school level, while the QASO and head teachers were expected to supervise its implementation. The objective of the study was to evaluate the extent to which the training has changed the teachers' teaching approaches and students' attitude towards the teaching of biology in secondary schools. The study was conducted in Bomet district in Kenya. A sample of 360 from three students, 24 science HODs, 24 Biology SMASSE teachers and 24 public secondary schools were selected using stratified, purposive and simple random sampling. The study adopted mixed method design and pragmatic philosophical paradigm. Data were collected using questionnaires and analyzed using both descriptive and inferential statistics. The result shows that there is positive attitude of students towards the teaching of biology in secondary schools. The research further reveals that teachers partially apply ASE-PDSI skills because of little supervision of the SMASSE Program implementation. The study recommended further training and collaboration of both head teachers and Quality Assurance Officers.

Keywords: Capacity building, ASEI-PDSI, SMASSE Program, Attitude and Academic Performance

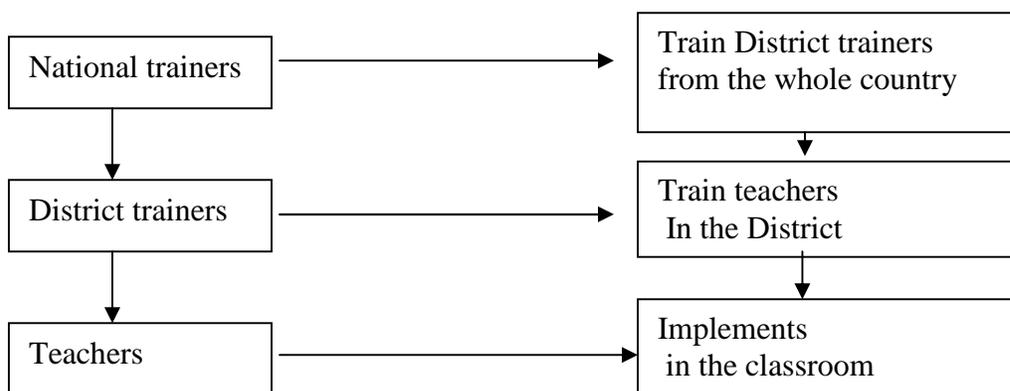
Introduction

The government of Kenya with the assistance from the government of Japan began the program of strengthening the teaching and learning of Mathematics and Science education in Public Secondary schools in Kenya through a project known as “Strengthening Mathematics and Science in Secondary Education (SMASSE)” . The persistent state of low academic performance in National Examination in Science and Mathematics has been a major concern to all stakeholders in Kenya.

A baseline survey was carried out in Kenya in 1998 and identifies the root causes of the low achievement as: Poor attitude of the learners, inappropriate teaching approaches, and poor content mastery by the teachers, poor utilization and mobilization of teaching and learning resources. SMASSE Project was introduced a planned change called ASEI movement and PDSI approach to change the attitude and approaches of teaching and learning of students towards science.

Upon the end of SMASSE phase 1 (pilot) in June 2003, phase II was launched in 2004 to cover the whole country. The SMASSE INSET was organized into four cycles of ten days each with the following objectives: Cycle 1 targeted attitude change of teachers; Cycle 2: Hands- on activities with emphasis on Practical activities; Cycle 3: Actualization and practice in the classroom; Cycle 4: Students growth and impact it transfers. The project operated through cascade system as illustrated below.

Cascade system of training



The ASEI is concerned with the shift from chalk and talk to students’ activity oriented learning with the focus on meaningful activities. The PDSI approach targets the teachers and emphasis on

early preparation of the lesson, ensuring that the lesson is conducted effectively and making the necessary improvement during or after the lesson.

The SMASSE INSET activities intended to achieve the institutionalization of In-Service Training (INSET) for capacity building of changing the teachers' attitude and teaching approaches along with the prudent use of school resources and improvisation. This was the key to unlocking the full potential of the learner as it lies in the expertise teacher (Ndirangu, 2004).

Problem Statement

The academic performance in Science Subjects and Mathematics in national examinations has been below average (50%) for many years in Kenya. For instance, in 2007 and 2008 biology mean percentages were 41.95 and 30.32, Chemistry: 25.38 and 22.74 and Physics: 41.32 and 36.71 while Mathematics was 15.74 and 21.30 respectively.

SMASSE Project (1998) found the main root cause of poor performance as negative attitude towards the learning of Science and Mathematics by students. The SMASSE INSET was introduced in 2004 country to change the teachers' attitude and teaching approaches along with the prudent use of available resources. Development of science is through engagement in science activities that lead to curiosity to discover new knowledge (Njuguna, 2009 and Fraser-Abder, 2002).

Koontz (2010) recognizes re-training as the most desirable way to improve the teachers. Di Martino (2003) and Cross (1999) note that attitude determine what students learn and their willingness to learn effectively. Fullan and Miles (1992) demonstrate that challenges facing educational innovations emanate from lack of effective planning and implementation.

Thus there is need to check the views of students regarding the aspects of the SMASSE Program (ASEI-PDSI), its implementation and impact it has transferred to their attitude and academic achievements.

Research objectives

The article intends to assess if teachers adopted and sustained SMASSE Program innovation of teaching approaches and its impact on students' attitude and academic achievement in biology in secondary schools.

Research Focus

Wabwile (2007) affirms that it is a significant effort to make teacher education programme scientific, effective and meaningful. Kafu (1996) notes that teacher education curriculum has remained narrow and rigid in nature and scope. It emphasizes the training rather than preparation of teachers. There has been no attempt to make it responsive to the emerging trends in the society in general and education in particular (Karugu, 2007). Consequently, it has continued to produce traditional school teachers who are conservative and resistant to change.

Cross (1999) notes that attitudes determine what students learn and their willingness to learn. Negative attitude can powerfully inhibit intellect and curiosity and keep us from learning what is well within our power to understand. Attitude is a general feeling of favor or otherwise towards some stimulus (Di Martino, 2003). One of the factors that affect the output when carrying out a task is the attitude towards that task or towards the people with who carry out the task. A positive disposition will enable one to push on with the task despite advance situations. SMASSE Project (1998) show that there was a general feeling among some teachers, students and key stakeholders that Science is difficult subjects.

According to Bishop (1986) there is a dilemma inherent in an attempt to increase teacher effectiveness because of reluctance to change and lack of opportunities to learn from others. Koontz (2010) states that training on job must be based on the needs analysis derived from a comparison of actual performance and behavior with required performance and behavior. Koontz recognizes retraining as the most desirable way to improve the teacher effectiveness.

In the ASEI lessons, a bridge is created to enable learners to relate and integrate practical activities with theoretical knowledge. The movement advocates a shift from teacher's centered approaches to student's centered approaches. The ASEI movement emphasizes teaching the student and not the subject (Stigler, 1999). The SMASSE project demonstrates that challenges facing educational innovations emanate from lack of effective planning and implementation (Fullan and Miles, 1992). There is a need for schools to pay attention to motivating students to participate in the learning process and develop their abilities.

Research Methodology

The study adopted a mixed method design which involves a process of collecting data in order to test hypothesis or to answer questions concerning the current status of the subject in the study.

Orodho(2012) states that descriptive survey approach are used in preliminary and exploratory studies to allow researchers to gather information, summarize, present and interpret for the purpose of clarification. The survey research is useful because of the economy of taking a sample of the population to generalize results for the whole population. Descriptive survey is a method of collecting information by interviewing or administering a questionnaire to a sample of individuals. It is used when collecting information about peoples' attitudes, opinions (Kombo and Tromp, 2001).

Sample and Sampling Procedures

Bomet district has 72 public secondary schools with form three students' population of 4500, 48 Biology SMASSE trained teachers and 72 HOD sciences in the district. There are 6 boys, 6 girls and 60 mixed secondary schools in Bomet district. Orodho define sampling as a procedure for obtaining a sample which researcher uses to gather people, places or things to study.

The subjects of the study were drawn from form 3 students and their response to items in the questionnaire was used in finding out students' attitudes towards the learning and teaching approaches in biology. The choice of the form 3 students was based on the assumption that they have a longer experience in learning biology after introduction of SMASSE INSET. The form 4 students were exempted because they were preparing for the KCSE Examinations. The Biology KCSE performance was gauged using KCSE performance before SMASSE (2002-2004) and after introduction of SMASSE INSET (2005-2007).The KCSE performance normally follows a similar trend every year.

A sample of 360 students was selected from Boys' schools (BS), Girls' schools (GS) and Mixed schools (MS). The sample size was arrived at by using a generalized scientific guideline for sample size decision by Krejcie and Morgan (1970). Out of 360 questionnaires, 16 students did not fill the entire questionnaire and their questionnaires were ignored.

Therefore 344 respondents were finally used in the analysis and interpretation of data. Stratified sampling procedure was used to categorize schools into BB; GB & MS while random sampling was used to select 2 BS, 2 GS and 20 MS Schools from the strata. An average of 9 students per stream was randomly selected from the sample schools. From Sample schools there were 12- single, 8- double and 4- triple- stream schools giving a total of 40 streams. A sample of 24 public secondary schools, 24 heads of science department and 24 biology SMASSE teachers were

selected to participate in the study. A biology SMASSE teacher in every sampled school was selected using simple random sampling technique.

Random sampling technique was used because it ensures that all the components of a population have equal probability of being included (Kothari, 2008). The independent variable in this study was SMASSE INSET while the dependent variables were teaching students' attitudes. Variables are attributes or qualities of the cases that are measurable and vary in their scores. Kothari define independent variables as the cause or predictor while dependent variable as the outcome or effect.

Research Instruments and Procedures

According to Creswell (2011) research instruments are the means by which primary data are collected. Tuchman 1978) defines a questionnaire as ways of getting data about persons by asking them rather watch their behaviour. The study in particular used questionnaires and Document analysis schedules to complement and enhance the truthfulness of questionnaires. Closed- ended questions which are accompanied by a list of all possible alternatives from which the respondents select the answer that best describes their situation were used. The questionnaire sought to obtain data on student's attitudes towards learning, teaching approaches and performance in biology using five- likert scales.

The reliability coefficients (r) were determined during pilot phase where three schools from each stratum of the secondary schools that did not take part in the main study were selected and research carried out. This pre-testing of the research instruments on a small sample of respondents was a preparatory exercise to find out if there was any weakness so that it could be corrected before the main research was carried out (Cresswel, 2011). The half- split reliability coefficient (r) for students' questionnaire was 0.77 while for the teachers' was 0.82. A positive coefficient, $r > 0.5$ is strong and the research instruments are deemed reliable. The advantage of half- split technique is that it eliminates chance error resulting from differing test conditions as in the case of test- retest technique (Orodho, 2000).

Data Analysis

Kombo and Tromp (2006) define data collection as gathering of specific information to prove or refute some facts. The data collected were analyzed using both descriptive and inferential

statistical techniques. Frequencies, percentages and means of the respondents were employed for the descriptive statistics. The chi-square was used to analyze relationship of SMASSE INSET and school categories while one way analysis of variance (ANOVA) were employed for inferential statistics to test the hypotheses. The Significance was tested by computing F ratio at a significance or alpha level of 0.05.

Research findings

The students' attitude towards the teaching and learning of biology before the introduction of SMASSE INSET was negative. This was attributed to the poor teaching approaches of the teachers. The introduction of new teaching approach called ASEI- PDSI was meant to change students' attitude from negative to positive (SMASSE project baseline survey, 1998).

There were 8 items that the study used to determine the attitude with likert rating scale. The results were recorded in table 1.

Table 1: Student's overall analysis of attitude towards the learning of Biology

Item	Statement	N	Sum	Mean \bar{X}
3	Biology is very interesting to me	344	1596.00	4.6395
4	I have not got chance to do practical in Biology	344	859.00	2.4971
5	Biology questions are challenging and difficult	344	988.00	2.8721
6	I don't have adequate knowledge of biology to enable me pass the exams	344	725.00	2.1076
7	Biology lessons have helped me to learn values that are useful in life	344	1619.00	4.7064
8	Students who study biology get good grades	344	1447.00	4.2064
	Total	344	7,234	$\bar{X}=3.8381$

There were 8 items that were testing students' attitude towards the learning of biology. The grand mean of all the items is 3.8381. The results reveals high mean for the following items; Biology is very interesting to students(4.6395), biology lessons have helped students to learn values of life(4.7064) and students who study biology get good grades(4.7064). However, other items such as biology questions are challenging and difficult (2.8721) and students have adequate knowledge of biology to pass national examinations (2.1076).

The researcher collected data in Boys schools, girls' schools and mixed schools to find out if there is a change of students' attitude towards the teaching and learning of biology after the introduction of SMASSE INSET in 2004. The researcher used 8 items in the study and the findings were made in the three categories of schools.

Table 2: Analysis of students' attitude towards the learning of biology by School category

Item	Statement	Means of boys school (\bar{X}_1)	Means of girls school (\bar{X}_2)	Means of mixed school (\bar{X}_3)
3	Biology is very interesting	4.4727	4.8868	4.6229
4	I have not got chance to do practicals in biology	2.1818	1.6038	2.7712
5	Biology questions are challenging and difficult	2.8727	2.6226	2.9280
6	I don't have adequate knowledge to pass biology exams	2.1091	1.7170	2.1949
7	Biology lessons have helped me to learn values of life	4.7636	4.6604	4.7034
8	Students who study biology get good grades	4.1455	4.2455	4.2119
		$\bar{X}_1=3.2970$	$\bar{X}_2= 3.2894$	$\bar{X}_3= 3.5721$

There is a high mean in the attitude of students in the three categories of schools; Boys (3.2970), Girls (3.2894) and Mixed schools (3.5721). However, students in girls' schools are not given more chance like other students in boys and mixed schools. Biology questions are challenging and difficult among the students in the three categories of schools. The students don't have adequate knowledge to pass biology examinations in all the school categories as revealed by low mean in their attitude. The results show that there is more attention given to students in mixed schools than both boys' and girls' schools. The grand mean of student's attitude for mixed schools is the highest (3.5721) with the girls' schools grand mean being the least (3.2894).

Table 3: Analysis of variance (ANOVA) of students' attitude towards the learning of Biology

	Sum of squares	df	Mean squares	F	Sig.
Between groups	0.295	2	0.147	0.506	0.365
Within groups	7.025	341	0.572		
Total	7.678	343			

When the differences in means of students' attitude in the three categories of schools were subjected to ANOVA, a P- value of 0.365 was obtained. Since the calculated ANOVA, P- value of 0.365 is greater than 0.05, the null hypothesis was therefore rejected.

The means of school categories were subjected to one- way analysis of variance (ANOVA) to establish whether there is statistical difference in the means among the three categories of schools. The research hypothesis revealed that students' attitude is positive towards the learning of biology in all the schools.

SMASSE project (1998) initiated a new teaching approach called ASEI-PDSI where teachers were expected to adopt and implement it in 2004 country wide. The students were used in the study to assess teachers' teaching approaches that constitute the ASEI-PDSI during biology lesson. The students were given questionnaires to obtain information on whether the teachers have implemented the new teaching approaches in the classroom.

The results of the students' responses were analyzed using SPSS and the results are as shown in the table.

Table 4: Students overall analysis of responses to teachers teaching approaches in biology

Item	Statement	N	Sum	Mean (\bar{X})
9	Our biology teacher starts a lesson by reviewing the previous lesson	344	1368.00	3.9767
10	Our biology teacher gives us practical/ activities to do	344	1314.00	3.8198
11	Our biology teachers use locally available materials to teach us biology	344	1425.00	4.1424
12	Our biology teacher uses prepared notes to teach us	344	1367.00	3.9738
13	Our biology teacher guides us during practical lessons	344	1394.00	4.0523
14	Our biology teacher allow us to present activities in class	344	1294.00	3.7616
15	Our biology teacher summarizes what she or he has taught at the end of the lesson	344	1389.00	4.0378
16	Our biology teacher marks our assignments	344	1238.00	3.5988
17	Our biology teacher does not give us chance to ask questions	344	650.00	1.8895
18	Our biology teacher give us assignments	344	1509.00	4.3866
19	Our biology teacher like and enjoy teaching the subject	344	1498.00	4.3547
20	Our biology teacher takes us for a field study	344	1240.00	3.6047
				$\bar{X} =$ 3.7495

Key \bar{X} = grand mean (mean of means)

The student's responses in the majority of the items indicated high mean of 3.7495. The results shows that teachers give students practical activities (3.8195), review the previous lesson(3.9767) and majority use prepared notes to teach student(3.9738). The students reveal that majority of the teachers review previous lessons, improvise, design activities prepare for the lesson, guides students and allow them to present the practical activities in class. This implies that teachers have moved from teacher- centeredness to student-centeredness which is the characteristic of ASEI-PDSI approach. When students are allowed to present in class their findings, they get opportunity to share their experiences and correct misconceptions that exist in subject. The review of the previous lesson was meant to create interest among learners and link the current lesson topic to the past knowledge. This is an indication that teachers have implemented ASEI- PDSI approach to teaching in biology.

Analysis of students responses to teaching approaches in biology by school category

This analysis was done to find out whether the implementation of SMASSE project of ASEI-PDSI approach to teaching was done uniformly in all the three categories of schools. The data were subjected to analysis and the results were as shown in the table 3.

Table 5: Analysis teachers' teaching approaches and school category

Item	Statement	Means of Boys schools (X ₁)	Means of Girls schools (X ₂)	Means of mixed schools (X ₃)
9	Our biology teacher starts a lesson by reviewing the previous lesson	3.8182	4.0000	4.0085
10	Our biology teacher gives us practical/ activities to do	4.2909	4.1321	3.6398
11	Our biology teachers uses locally available materials to teach us biology	4.0000	4.3019	4.1398
12	Our biology teacher uses prepared notes to teach us instead of textbook alone	3.6909	4.4151	3.9407
13	Our biology teacher guides us during practical lessons	4.1818	4.4717	3.9280
14	Our biology teacher summarizes what she or he has taught at the end of the lesson	3.6364	4.1887	3.6949
15	Our biology allow us to present in class activities.	3.9091	3.8491	4.1102
16	Our biology teacher marks our assignments	3.8727	3.8113	3.4873
17	Our biology teacher does not give us chance to ask questions	2.0727	1.8113	1.8644
18	Our biology teacher give us assignments	4.2545	4.6415	4.3602
19	Our biology teacher like and enjoy teaching the subject	4.4727	4.6038	4.2712
20	Our biology teacher takes us for a field study	3.8364	4.3585	3.3812
		$\overline{\overline{X_1}}$ 3.8364	$\overline{\overline{X_2}}$ 4.0189	$\overline{\overline{X_3}}$ 3.4788

Key: grand mean (mean of means)

$$\overline{\overline{X_1}}, \quad \overline{\overline{X_2}}, \quad \overline{\overline{X_3}}$$

The overall rating of the use of the new teaching approaches of teachers is high (3.5) (70%). The items on teaching approaches were rated high in the three categories of schools i.e. boys (3.8364) Girls (4.0189) and mixed schools (3.4788). Students in mixed schools rated their teachers the lowest in most of the items (items 10, 13, 16, 19, 20); the students in the three categories of schools agreed that most teachers mark assignments, summarize the lesson, use prepared notes,

and improvise teaching learning materials. However, the rating of the implementation of the new teaching approach ASEI- PDSI was the highest in Girls Schools while that of mixed schools was the lowest. This could be due to inadequate teaching and learning resources in mixed schools.

The research reveals that some teachers don't mark students' assignments whereas assignments form the basis of feedback and doing remedial work for slow learners. The ASEI- PDSI advocates that each lesson should have an assignment. Most teachers review the previous lesson so as to create interest among the learners and linked the past knowledge to the current lesson topic. Students in mixed schools rated their teachers lowest because of inadequate practical activities they are being given. The high students rating of their teachers imply that teachers are practicing ASEI approach in teaching students biology.

Hypothesis testing of teachers' teaching approaches by school category

The research hypothesis to be tested was H_{01} ; there is no significant difference between ASEI-PDSI approach and implementation in the teaching of biology in three school categories. The one way analysis of variance (ANOVA) was used to establish whether the differences in means for the three categories of schools were statistically significant. The results are presented in table.

Table 6: Analysis of variance (ANOVA) of teachers' teaching approaches in the classroom in the three schools Category

	Sum of squares	Df	Mean square	F	Sig.
Between groups	1.649	42	0.825	0.441	0.644
Within groups	638.165	341	1.871		
Total	639.814	343			

The results gave p- value (0.644) which is greater than the critical 0.05 i.e. $P > 0.05$.

Since the P- value is > 0.05 the differences in the means of the responses on the teaching approaches in the three categories of schools are not statistically significant. The null hypothesis was therefore not accepted. It implies that there is difference between SMASSE INSET and

teachers teaching approaches in biology in the three categories of schools. This suggests that SMASSE INSET has improved the teachers teaching approaches in all the three categories of schools.

Discussion

The study reveals that majority of the students have positive perception of the teaching and learning of biology. They now believe that if they study biology they can get good grades and acquire values that are useful in life. The students have improved their attitude towards the learning of biology. The students currently find biology enjoyable and interesting. The teachers must have translated hands-on activities they were exposed to in the SMASSE INSET to students.

Lehiste(2012) said that learners are interested in the learning process if they are actively involved. Allan(2002) define attitude as willing to accept verified facts thus science is based on attitude. Njuguna (2009) also asserts that children are natural investigators and they love to touch and feel things. Children find themselves observing, questioning, hypothesizing, predicting, interpreting and communicating. SMASSE innovation to change teachers' attitude through unfreezing of old methods of teaching students to new approach of ASEI-PDSI was laudable development in science in its small way as it has given children opportunities to explore and satisfy their curiosity.

Conclusions

The effects of SMASSE INSET on the attitude of students in biology were analyzed in this chapter. The findings showed that SMASSE INSET has improved the student's attitude towards the learning of biology. This implies that teachers' unfreeze the old ways and moved to new way of handling students during the teaching of science.

The study revealed that there is statistic significant relationship between the training of science teachers through SMASSE program and students' attitude towards the teaching of science in secondary schools. The innovations introduced to teachers greatly changed their attitudes and translated to students.

The training of teachers under SMASSE INSET provided skills and knowledge to teachers for improving their teaching approaches in science

The interview with the head teachers revealed that SMASSE Program is not being supervised. The teachers implement what they were taught during the INSET without monitoring. The trainers and Quality Assurance Officers are not facilitated to monitor the implementation making it less effective.

Recommendations

The study suggests the need for collaboration between the head teachers and QASO in strengthening the supervision of SMASSE program.

There is a need for re-training of head teachers on effective management of teacher professional development

The SMASSE Program should go beyond improvisation and train teachers on how to integrate information communication technology (ICT) in the classroom instruction so as to enhance greater attitude among the students towards science.

References

- Allan, P.O.W, Sally, W. & Paul, D. (2002). *Managing change successfully: using Theory and experience to implement change*. Great Britain: TJ International.
- Bell, B. & Gilbert, J. (2004). *Teacher development: A model from science education*: London: Routledge Falmer.
- Bishop, G. (1986). *Curriculum development: A text book for students*. Hong Kong : Macmillan Publisher.
- Bogonko, J. N. (1992). *Reflecting on education in East Africa*. Nairobi: Oxford University.
- Creswel, W.J. (2011). *Research design; qualitative, quantitative and mixed methods approaches* (3rd ed.). California: Sage Publication.
- Cross, G. (1999). *A vision for science education: Responding to the work of Peter Fensaham*. New York: Routledge Falma
- Di Martino, P. & Zam, R. (2003). "What does positive attitude really means?" In pateman N. Doherty B. and Zilliox, J. (eds) *proceedings of the 2003 joint meeting of PME and PMENA*, 4, 451-458.

- Digolo, O. O. (2006). *The Challenges of Education in Kenya in the 21st Century*. A journal of the school of Education, Moi University: 1, 1-226.
- Fullan, M. G. & Miles, M.B. (1992). Getting the reform right: "What works and what doesn't". *Phi Delta Kappan* , 73 ,10, 745-752.
- Fraser-Abder, P. (2002): *Professional Development of Science, Teachers: local insights with lessons for the Global community*, London: Routledge Falmer.
- Kafu, P. A (2001). Future development in education technology. Eldoret: Moi University.
- Karugu, A. M. (2007). Challenges of graduate teacher education in Kenya in the 21st Century. Eldoret: Moi University.
- Kenya National Examinations Council (2008).The KCSE Examination Candidate's Performance Report. Nairobi: Government printers.
- Koech Report (2000).Totally integrated quality education and training. Nairobi: Government printers.
- Kombo, D. K. & Tromp D. L. A. (2006). *Proposal and Thesis Writing: An Introduction*. Nairobi. Pauline's publication Africa.
- Kothari, C. R. (2008). *Research methodology: methods and techniques*. New Delhi: new Age International (P) .
- Krejciec, R. & Morgan, D. (1970). Determining sample size for research activities, education and psychological measurement.
- Piht, S., Lehist, P., Raus, R. & Lazarev, M. (2012).The relevance of evocation and reflection cards in the learning process. *Problems of education in the 21st century*, 41, 61-74.
- Ndirangu, M. (2004). An analysis of factors hindering the achievement of curriculum goals in Kenyan schools. *Journal of education and human resource* , 13, 2.
- Njuguna, N.J. (2009).*Science Activities*. Nairobi: Loghorn.
- Orodho, A. J. (2002). Essential of educational and social sciences research methods. Nairobi: Malosa Publishers.
- SMASSE project (1998). Strengthening mathematics and science in Secondary Education, Science and technology, Republic of Kenya. Retrieved on 9th march 2008 from <http://www.Smasse.org>.
- Stigler, J. W. & Hiebert, J. (1999). *The teaching Gap: Best ideas from the worlds' teachers for improving education in the classroom*. New York: Free press.

UNESCO (2000). Education for All 2000 Assessment. Dakar: UNESCO.

Wabwile, J. (2007). Mathematics and Science teachers' perception and expectations of SMASSE In-service Training. A case study of Trans-Nzoia District. Unpublished M. phil thesis. Nairobi: Moi University