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INFLUENCE OF SMASSE INSET ON BIOLOGY TEACHERS' CLASSROOM PRACTICES, ATTITUDES AND STUDENTS' ACHIEVEMENT IN NYANDARUA COUNTY SECONDARY SCHOOLS, KENYA

BY

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A Thesis Submitted to the Graduate School in Partial Fulfillment of the Requirements for the Award of the Degree of Master of Education in Curriculum and Instruction of Egerton University

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DECLARATION AND APPROVAL

DECLARATION

I declare that this thesis is my original work and has not been previously presented for the conferment of a degree in this or any other University.

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DEDICATION

To my family members and the Almighty God for their love, care and understanding during the entire study period.

ACKNOWLEDGEMENT

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ABSTRACT

Teaching approaches are a crucial factor that affects students' achievement in Biology. Teachers have been more commonly using teacher-centred approaches to teach science in secondary schools. This has contributed to continued under achievement. The introduction of Strengthening Mathematics and Science in Secondary Education (SMASSE) In-service Education and Training (INSET) was intended to enhance teachers' classroom practices, attitudes and students' achievement in science and mathematics. The focus of this study, therefore, was to establish whether this has been achieved. The study sought to evaluate the influence of SMASSE on Biology teachers' classroom practice, attitudes towards biology teaching and students' achievement in the subject within Nyandarua County Secondary Schools, Kenya. The study adopted cross-sectional survey research design. The target population included 160 Biology teachers who had participated in the SMASSE INSET in 110 secondary schools. A sample of 89 Biology teachers in 30 secondary schools purposively selected formed the study sample. Three instruments, a structured questionnaire, an observation schedule and performance table were used. These were piloted and validated by five experts in curriculum and instruction. The two instruments had reliability coefficients of 0.70 and 0.82 respectively. The collected data was processed and analyzed using both descriptive and inferential statistics with the aid of Statistical Package for Social Sciences (SPSS) version 17.0 for windows. Hypothesis was tested using t-test and results accepted at the 0.05 level of significance. The study findings indicate that SMASSE INSET has had a positive influence on the attitude of teachers towards not only their teaching of Biology, but also the SMASSE INSET. The findings indicate that teachers are using student-centered teaching approaches and effective classroom management that they learnt in the SMASSE INSET in the course of their teaching. SMASSE INSET has had a marked and positive influence on the performance of students in Biology in secondary schools. It is recommended that the teachers be encouraged to continue attending the SMASSE INSET so as to change their attitudes towards the teaching and student learning of Biology. There is a need to put mechanisms in place in all the schools to ensure that teachers use ASEI/PDSI approach to enhance good classroom practices and improve the learners' academic performance in Biology. Teacher educators and SMASSE INSETs organizers should make ASEI/PDSI approach part of teacher education curriculum. They should evaluate their courses and identify other innovative and effective teaching methodologies in teaching and learning of biology.

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LIST OF ABBREVIATIONS AND ACRONYMS

ASEI	Activity focused teaching/learning, Student- centred learning, Experiments and Improvisation.
BLOS	Biology Lesson Observation Schedule
BTQ	Biology Teachers' Questionnaire.
CEMASTEA	Centre for Mathematics, Science and Technology Education in Africa
INSET	In-Service Education and Training
JICA	Japan International Cooperation Agency
KCSE	Kenya Certificate of Secondary Education.
MoE	Ministry of Education
NGO	Non Governmental Organization.
PDSI	Plan activities according to the principle of ASEI, Do the planned activities, See how effectively the activity was done (evaluate), Improve on the whole process based on the evaluation.
PRE-SET	Pre-service Training
PTA	Parent Teachers Association
SMASSE	Strengthening Mathematics and Sciences in Secondary Education
SMASSE-WECSA	Strengthening of Mathematics and Science in Secondary Education in Western, Central and Southern Africa
TIQET	Totally Integrated Quality Education and Training.

CHAPTER ONE

INTRODUCTION

1.1 Background Information

It has become widely accepted among stakeholders in education that pre-service training (PRE-SET) is only an induction into the teaching profession. The quality of teachers is dependent on top quality candidates for teaching, their pre–service education and continuous professional development (Ndirangu, 2004). On starting to teach, a teacher puts into practice theories, teaching methods and student management styles as learnt at pre-service training. However, these have to be continually revised in the light of prevailing conditions or circumstances and of emerging discoveries. Ouko (2004) noted that the training of teachers is premised on the realization that the quality of classroom activities is critical for effective teaching and learning. In-service Education and Training (INSET) of teachers is thus important for continuous professional development. It allows teachers to share experiences and continually expose them to new ideas to keep a breast with new developments in the teaching profession. Attitudes, pedagogy, content mastery, resource mobilization and utilization, administrative and policy issues are some of the concerns that can be handled in interactive fora that INSETs provide. The INSETs are meant to improve classroom practice and stimulate professional development (Hopkins, 1986).

Strengthening Mathematics and Sciences in Secondary Education (SMASSE) INSET is principally meant to improve the performance in core subjects, that is, mathematics and sciences, since it has been poor over the years. Results of the formal examinations and observations by the stakeholders constantly indicate a decline in academic achievement. The issues related to teachers are important in explaining the poor performance of their learners (GOK, 2005). Thus greater attention should be paid to improving classroom aspects of teacher quality. Teachers who make use of practical activities to illustrate concepts in science and mathematics help their students to perform better in those subjects (Ndirangu, 2004). As such, the Ministry of Education in collaboration with the government of Japan through Japan International Co-operation Agency (JICA) started an intervention measure in the form of SMASSE project for teachers of Mathematics and sciences.

A baseline study conducted by SMASSE in the year 1998 identified many factors that contributed to low performance in mathematics and sciences. The project isolated the teachers' factors which it had the capacity to address. The issues related to teachers were: - attitude change and motivation towards mathematics and sciences in secondary schools, pedagogy, content mastery which was inadequate, poor mobilization and utilization of resources (SMASSE, 1999). Ouko (2004) notes that teachers had negative attitudes towards teaching mathematics and sciences and thus put little or no effort in preparing lessons in these subjects. Creativity and improvisation were hardly visible in these lessons and learning facilities were hard to come by. The same attitude was observed among students. During class observations it was noted that teaching of sciences was teacher -centered. Most lessons were conducted through lecture method with very little active participation by students. Students were only actively involved in note taking, doing assignments, calculation on chalkboard and answering questions (SMASSE, 2004*b*). Teachers also displayed a general incompetence in practical skills. There was too much reliance on laboratory assistants. There was low frequency of experiments which teachers attributed to lack of resources and facilities. There was lack of active participation by students during experiments. When experiments were done in groups, some students were not willing to participate. Students lacked confidence due to long intervals between experiments. The prevailing challenges and contributing factors to poor performance were therefore isolated by SMASSE project after the baseline study conducted by the project in 1998 (SMASSE, 2004*b*).

The overall goal of SMASSE project is to enhance the capability of young Kenyans in Mathematics and Science. The main activity has been the provision of In-service Education and Training (INSET) for serving teachers of mathematics and science subjects in the country. The main objective was to enhance the participants' capabilities as effective classroom teachers who can adapt and use innovative approaches and practices to make the teaching and learning of mathematics and science real and interesting to learners (SMASSE, 2004*a*). The SMASSE INSET was aimed at strengthening teachers' competencies by addressing the areas of concern. It therefore introduced Activity, Student-centred, Experiments and Improvisation (ASEI) movement through, Plan, Do, See and Improve (PDSI) approach as a paradigm shift towards student centered learning (JICA, 2005).

SMASSE focuses on the African region through SMASSE- Western, Eastern, Central and Southern Africa (WECSA). It adapted SMASSE's approaches as a way of improving classroom practice. The impact of these approaches in the classroom in Malawi, Zambia, Rwanda and Zimbabwe was positive (Wambui, 2005). According to Ouko (2004), the SMASSE – WECSA association exists for the sole purpose of strengthening the four subjects at secondary level, through INSET, pre- service education and training (PRE-SET), research and exchange of information, seminars, joint workshops and participation in conferences.

The KCSE examination results in Nyandarua county show that most students were performing poorly when SMASSE INSET was being introduced. The results of the year 2002 show that 3616 candidates scored a mean of 3.6483. In the year 2003, 3929 candidates scored a mean of 3.7902 (DEO, 2004). The general performance has been poor as depicted by the mean scores. Although there was a slight rise of 0.1419 between the two years, it was still below average. This study therefore evaluated the influence of the SMASSE on Biology teacher's professional development and improvement of classroom practice. It also investigated their attitudes towards Biology teaching and students' achievement in biology in KCSE.

1.2 Statement of the Problem

Teaching and learning of mathematics and science has been a subject of debate for a long time. Teachers have been using teacher-centered methods, that is, talk and chalk pedagogical approach to teach the subjects in secondary schools. The Ministry of Education together with J.I.C.A have exposed the serving teachers to In-service Education and Training –Strengthening Mathematics and Sciences in Secondary Education (SMASSE) in order to improve teaching and learning and change the traditional instructional practices and the attitudes of teachers and learners. The project isolated issues related to teachers which it had the capacity to address. However, there is no documentation on the evaluation of the INSET and the contributions it has made in improving classroom practice and learners' achievement in Biology. Little is also known about the influence the INSET has had on the teachers' attitudes towards Biology teaching and the approaches learnt in the INSET. This study, therefore, aimed at evaluating the influence of

SMASSE on teachers' classroom practice, their attitudes and students' achievement in biology in KCSE.

1.3 Purpose of the Study

The purpose of this study was to investigate whether the SMASSE in-service education and training of Biology teachers has improved their classroom practice. It also aimed at investigating whether the SMASSE INSET had an influence on the Biology teachers' attitudes towards Biology teaching and the approaches learnt in the INSET. The study further investigated whether the in-service education and training of Biology teachers has had any impact on students' K.C.S.E Biology performance.

1.4 Objectives of the Study

The following objectives guided this study:

i) To determine the attitudes of Biology teachers towards the Biology teaching and the SMASSE INSET.

ii) To evaluate the influence of SMASSE INSET on Biology teachers' classroom practices.

iii) To assess whether the SMASSE INSET has had any impact on students' achievement in Biology in KCSE.

1.5 Hypothesis of the Study

This study tested the following hypothesis at 0.05 level of significance.

Ho: There is no statistically significant difference in students' achievement in biology in K.C.S.E between the period before and after the SMASSE INSET.

1.6 Significance of the Study

The SMASSE INSET has been running for the last twelve years. Its contribution towards Biology teachers' classroom practice and students' achievement in biology in KCSE had not been evaluated. The findings of this study provided empirical evidence that SMASSE INSET has had a positive influence on Biology teachers' classroom practice, their attitudes towards Biology teaching and the INSET and also students K.C.S.E performance. These findings are useful to the Ministry of Education in assessing the effectiveness of the teaching methods used in teaching Biology in secondary schools on students' achievement at KCSE examination. This highlights the need for future organizations of such INSETs. The findings would also inform curriculum developers to design appropriate instructional strategies that involve active learning that would

enhance learning of Biology. The findings of this study would further inform school managers and principals on the need to support teachers to enhance active learning. Finally teacher education institutions may use the findings of this study to design teacher education programmes capable of producing effective biology teachers who can actively engage learners in meaningful learning.

1.7 Scope of the Study

This study was conducted in Nyandarua North and Nyandarua South districts in Central province of Kenya. The study aimed at determining the Biology teachers' attitudes towards biology teaching and the SMASSE INSET. It was also finding out whether the Biology teachers in secondary schools were practicing the ASEI-PDSI approaches of teaching as learnt during the in-service training. The study targeted Biology teachers and KCSE biology performance in public secondary schools within the two districts in Nyandarua County.

1.8 Limitation of the Study

This study had the following limitation: Due to poor record keeping, some science head of departments didn't have all the KCSE biology records. The information in such instances was sourced from specific heads of subjects and subject teachers.

1.9 Assumptions of the Study

The following assumptions were made in this study:

(i) The respondents were honest and therefore provided responses to the best of their knowledge.

(ii) The Biology teachers did not change their behaviour in the class due to presence of the researcher.

1.10 Definition of Terms

Attitudes: A relatively stable organization of beliefs, feelings and behavior tendencies towards something. In this study, this is shown by teachers' change of feelings towards Biology and SMASSE INSET. These are also shown by teachers' opinions, feelings, and certain inclinations towards Biology measured by a five point Likert scale on degree of agreement.

Continuing education: This is the In-service Education and Training for teachers which should be life long, recurrent, whose aim is for individual career and professional development. In this study this is the SMASSE INSET that took four cycles.

Influence: An action or process of producing effects on the actions, behavior, opinions etc of others. In this study, influence is on biology teachers' attitudes and classroom practices.

INSET: This is the In-service Education and Training of teachers which is meant to extend their personal education and develop professional competence. In this study, this is the SMASSE In-service education of Biology teachers.

Performance: An action or achievement considered in relation to how successful it is. This is the efficiency and effectiveness in improving classroom practice and reflected in the learners Biology KCSE scores and grades in this study.

Professional development: This is used to refer to the individualistic and personal process of Continuing Professional Education. In this study professional development is the ability of teachers to apply ASEI-PDSI approach to teaching as learnt in the INSET, change attitudes and improve classroom practices.

Staff development: This is the activity of staff training to improve their capability. In this study, staff development is used to mean the development of an individual teacher as a member of staff of a particular school.

Students' achievement: Students success in learning which is portrayed by good performance. In this study, it is shown by the students' Biology K.C.S.E scores and grades.

Teachers' classroom practice: These are the practices that promote the teaching and learning of Biology in the classroom. They include the teaching procedure, methodology and classroom management. In this study, these are measured by three points and five points Likert scales.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature on variables relevant to this study. The review falls under five subheadings which include: pedagogical approaches in science education, teachers' attitudes and teachers' professional development. The importance of the INSET is reviewed and finally the SMASSE INSET in some parts of Africa and Kenya.

2.2 Pedagogical approaches in science education

Good teaching is both an art and science. A good teacher should be able to match learning activities to learners' cognitive abilities. Most students in high school reason at the concrete and formal levels, therefore, it is important for science teachers to recognize the role of concrete and formal processes in understanding science (Black & Nordland, 1978; Hastenes, 1979).

Weil (1980) noted that knowledge of how teaching methods affect students learning may help educators to select methods that enhance meaningful and effective learning. For science education to achieve its goals, the teaching processes are important. Learners should be taught skills and processes used in the scientific enterprise (Okere, 1996; Keraro, 2002). The particular teaching method that a teacher uses is determined by a number of factors. These include; the content to be taught, the objectives the teacher plans to achieve, availability of teaching and learning resources and willingness of a teacher to improvise if conventional teaching aids are not available, evaluation and follow-up activities and individual learners (SMASSE, 2004*b*) .

There are many teaching methods that are used in teaching science and mathematics. The use of a variety of instructional methods influence students differently (Githua & Mbugua, 2004; SMASSE, 2004*b*). The science teaching methods are techniques that are used to impart scientific knowledge to learners which include lecture (talk and chalk) method, teacher demonstrations, practical work (students experiment), project work, field work (excursion) and discussion (SMASSE, 2004*b*; Okere, 1996). Byrne and Johnstone (1988) postulate that scientific activities should not only be confined to laboratories. Other than learners' practical work, interactive

modern methods like simulations, puzzles and games, case studies, role play (skit), debates and group discussions can stimulate thoughts and interest and develop a greater commitment on the part of a student. Teachers need to de-emphasize expository approaches in favour of more interactive methods (Ndirangu, 2004). Above all, a science teacher needs to be proactive in seeking solutions to problems that stand in the way of effective teaching and learning of science.

In the world over, there has been debate on the relevance of education to the science and technology in the communities. The development and application of science requires a variety of problem- solving techniques (Black & Nordland, 1978; SMASSE, 2004*b*). This has resulted into frequent changes in the curricula and changes in methodology and approaches in teaching. The science curriculum is designed to include teaching strategies as well as the selection and organization of subject matter. It is concerned with details of students' and teachers' activities. From the foregoing, it is clear that science teachers have been unable to prepare learners for higher level cognitive skills such as application, synthesis and evaluation. This is a disadvantage to the students who do not adopt an inquisitive and practical approach towards biology because many examination questions demand knowledge and understanding of practical situations (KNEC, 2000). This situation could be corrected by use of student-centered activities and involving a lot of improvisations in the experiments (SMASSE, 2004*b*). The pedagogical strategies used in teaching science in schools, include didactic approach, discovery learning, cooperative learning, concept mapping, constructivist approach and most currently the ASEI/PDSI Approach (SMASSE, 2004*b;* Ouko, 2004).

2.2.1 Didactic approach of teaching science

This is a teaching strategy in which a teacher presents information to inactive learners. According to Hergenhan (1997) the didactic approach involves giving learners rigidly formulated statements which they memorize and regurgitate when required to do so by a teacher. Little or no emphasis is placed on understanding. Didactic teaching involves spoken instruction and is often used to convey a substantial volume of information to a large audience at a time. Teachers are central to this method of teaching because they control the content and layout of the entire session. Learning is generally passive, by watching and listening during the lecture, but learners also have the opportunity to make notes for use in future learning. Okere (1996) notes

that this strategy restricts learners to passive listeners unless they are asked questions during the lessons. A teacher is likely to deliver the content at a faster rate than learners can comprehend and they are likely to be inattentive since they are not actively involved.

Didactic teaching can be complemented by the use of teaching aids, for example, handouts, worksheets, or audiovisual material. Gray and Stark (2007) assert that if done well, didactic teaching can allow a teacher to communicate a large amount of information in a clear, concise, and systematic manner. But because an audience's attention is difficult to hold for more than 20 minutes at a time without a change in activity, didactic teaching is best used to introduce a topic that will be explored further using other methods or self directed study. It is therefore imperative that in order to enhance teaching and learning, a teacher should make use of other effective teaching strategies which is investigated in this study.

2.2.2 Discovery approach of teaching science.

The discovery method is a teaching technique that encourages students to take a more active role in their learning process by answering a series of questions or solving problems designed to introduce a general concept (Mayer, 2003). This approach is characterized by students' involvement in learning activities with a teacher taking the role of a facilitator in the learning process. The approach enables students to develop scientific skills such as observation, classification, making conclusions, analysis, data collection and presentation, and manipulation (Okere, 1996; Simiyu, 2001; Maundu et al, 1998). Discovery teaching approach is common especially in mathematics and science. The students learn from nature, facts and things which alone are incorruptible (Driver, 1993).

The three main principles that guide the development of this approach are; consideration should be given to experiences and contexts that motivate the student's interests, there should be a spiral organization of the material forcing students to build upon previously acquired information, and the instruction should facilitate extrapolation (Mayer, 2003). In this teaching approach, the instructor guides student's thought process by posing a series of questions whose responses would lead to the understanding of a concept before it is explicitly stated. Students act as detectives as they solve concept-attainment activities in stimulating learning environments. In doing so, they place a newly introduced object in a category that they have previously discovered

or identified. This teaching method is believed to increase retention of material because the student organizes the new information and integrates it with information that has already been stored. According to Okere (1996) students make conclusions and hypotheses based on data they obtain during class experiments or during class demonstrations. In this study, the learners are expected to be involved in learning activities, answer questions and solve problems. The teachers ask students questions and guide them in course of the lessons as learnt in the SMASSE INSET.

2.2.3 Cooperative learning approach

Cooperative learning is based on a small group approach to teaching in which each student is accountable for both individual and group achievement. Slavins (1990) and Duke (1990) postulate that cooperative learning is a comprehensive approach to teaching that derives from a theory of education with key assumptions about what students should learn and how they learn. Wachanga and Mwangi (2004) assert that use of cooperative class experiment facilitates students' achievement as compared to use of regular teaching methods. In cooperative learning, learners interact in groups, acquire greater mastery of materials and may result to better self images for slow learners.

Cooperative learning is more effective in increasing performance when coordination of efforts is vital for effective functioning. Interaction among children while performing appropriate tasks facilitates learning of critical concepts. Collaborative activity among children promotes growth because children of similar ages model collaborating group behaviours more advanced than those they could perform as individuals (Rachael, Lazarowitz & Norman, 1995). Slavings (2003) evaluated many studies and concluded that the overall effects stand as strong evidence for the superiority of cooperation in promoting achievement and productivity. Therefore, increase in use of cooperative learning procedures promotes higher student achievement.

The opportunity for students to discuss, argue, and present their own and hear one another's viewpoints is the critical element of cooperative learning with respect to students achievement. Through mutual feedback and debate, peers motivate one another to abandon misconceptions and search for better solutions. The experience of peer communication can help a child master social processes such as participation and argumentation, and cognitive processes, such as verification and criticism. Peer interaction can also introduce learners to the process of

generating ideas. Finally, corroboration between peers can provide a forum for discovery learning and can encourage creative thinking (Rachael et al, 1995). In this study, the influence of the SMASSE INSET on classroom practices was determined. Cooperative learning is one of the good classroom practices that promote biology learning.

2.2.4 Concept mapping

Concept mapping is an active, creative, visual and spatial learning activity used by constructivist in which concepts are organized according to their hierarchical relationships (Kinchin, 2000). Linking words are used to describe relationships among concepts. Concept maps help to explain the meaning of concepts in terms of their relationships (Pinto & Zeits, 1997; Novak, 1983). To construct a concept map, a learner has to understand the information that appears in the map. Students must also relate and integrate the concepts that will be recorded in the map (Smith & Dwyer, 1995). Concept maps help to translate subject-matter into a form that makes it more compatible with the hierarchical organization in minds. They also provide a concise representation for the knowledge to be learnt and concepts to be assimilated into what we already know. While investigating the use of concept mapping in the learning of Biology, Kinchin (2000) found that concept mapping is a highly flexible tool that can be adapted for use by almost any group of learners. It was concluded that concept mapping reduces strain on the working memory of the participants (Saito & Kim, 1998).

Concept mapping is a type of structured graphic display of an individual's conceptual scheme within a well-circumscribed domain (White, 2002). There are numerous permutations of operationally defined steps that can be used to construct a map (Tanner, Allan, 2003; Ruiz-Primo, et al, 2001). The common steps are: Step 1. *Brainstorming stage*- Select an important concept within the map domain to serve as a stimulus or starting point. Identify all other words (nouns) that represent key concepts related to the map domain; Step 2. *Organizing stage*- Establish a hierarchical ordering of the words (from most to least general or important); Step 3. *Layout stage*- Begin to sketch out the map. The concepts (nodes) can be drawn within boxes or circles. The hierarchical ordering in Step 2 can then take shape as an arrangement of the nodes in a conventional top-to-bottom configuration or any other configuration in which the ordering can be readily perceived. Cluster closely related concepts near one another and finally; Step 4. *Linkage stage*- Establish propositional linkages between concepts. Propositional linkages are

lines and words drawn between concepts that the map maker thinks are connected in some important way. Write the word or phrase (usually an adverb or verb) above each line that describes the essential connection between the concepts. For complex maps, also establish cross-links. These are similar to propositional linkages but are used to convey connections between concepts in different map areas, rather than between immediately adjacent ones. Maps can be considered complete at this stage or can be refined and redrawn in final form (White, 2002). Use of concept maps in biology lessons not only reinforces knowledge construction in groups of peers, but also results in more complex and sophisticated maps (Brown, 2003). Figure 1 shows a concept map on respiration which was used in training teachers.

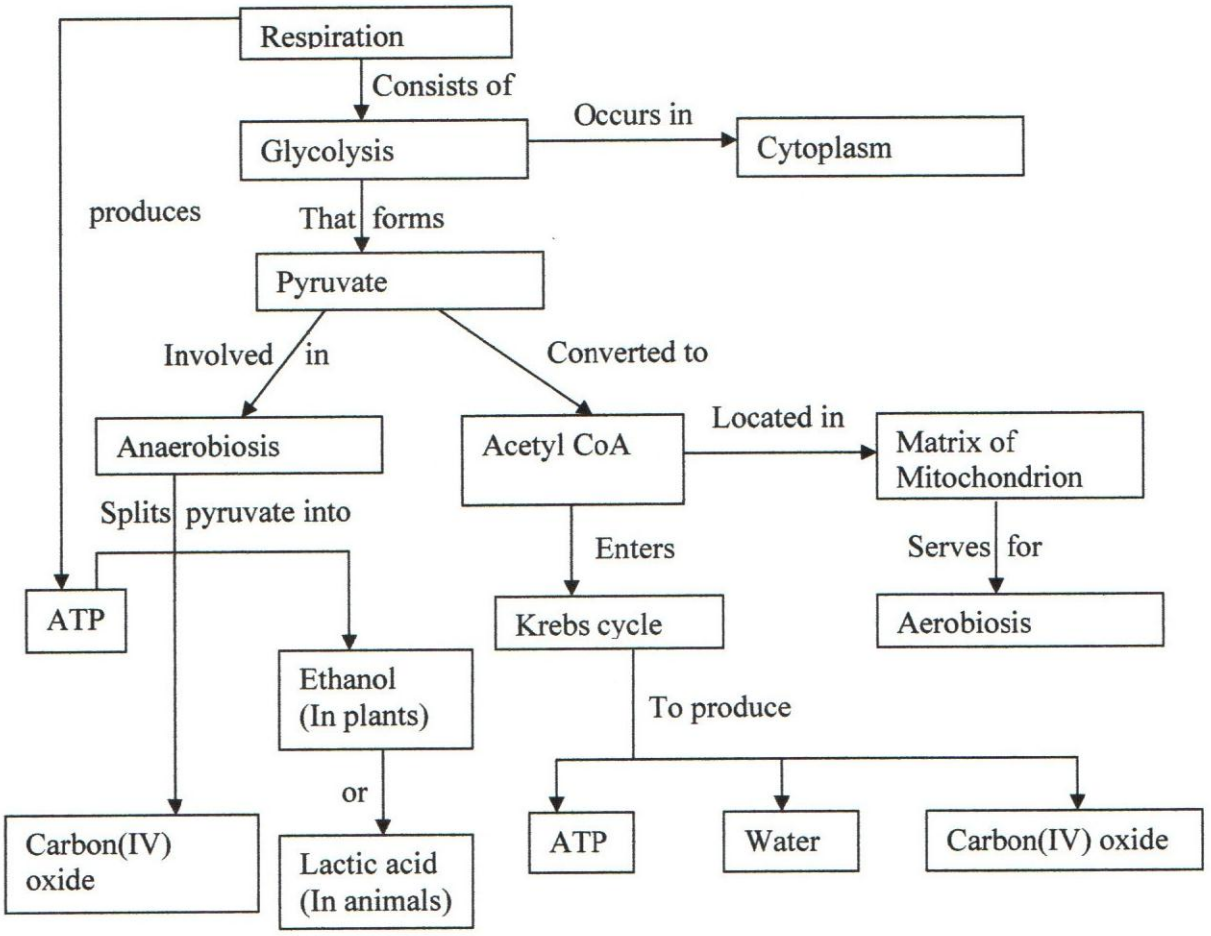


Figure 1: Concept map on respiration.
Source: Effects of concept mapping teaching strategy on student achievement (Keraro, Okere & Owino, 2010).

Keraro, Okere & Owino (2010) carried out a study on the effect of concept mapping teaching strategy on students' achievement in biology, they found that the teaching strategy enhanced students achievement and attitude in biology. Previous studies have suggested that the use of concept mapping in classes can help students to gain a more unified understanding of a topic, organize their knowledge for more effective problem solving and understand how they learn (Kinchin, 2000). In a study on effects of cooperative concept mapping teaching approach on students' motivation, Keraro, Wachanga & Orora (2007) found that students exposed to cooperative concept mapping had significantly higher motivation than those taught through regular methods. In this study, the influence of SMASSE INSET on teachers' classroom practices was investigated. The INSET had trained teachers on the use of concept maps in biology.

2.2.5 ASEI/PDSI approach

The ASEI/PDSI stands for activity focused teaching and learning, student centered learning, experiments and improvisation. A teacher should plan activities according to the principle of ASEI, do the planned activities, see how effectively the activity was done (evaluate), and improve on the whole process based on the evaluation (SMASSE, 2004*b*; Wambui, 2005; Ouko, 2004; JICA, 2005). Recent studies in science education emphasize that school science and mathematics teaching should be learner-centered. A teacher's role is that of a facilitator, guide, counselor, motivator, innovator and researcher. A teacher should use appropriate teaching methods and do research to know the subject matter well and needs of the learners. He/she should consider learners prior knowledge and practical experience and build new concepts at it while creating and sustaining interest in science. There should be as many activities during any one lesson as possible. These must be student-centered activities, involving a lot of improvisations in the experiments. The improvisation demystifies the sciences and mathematics. The learners would thus appreciate the ever-present Science in the environment (SMASSE, 2004b).

According to SMASSE (1999), science teachers displayed a general incompetence in practical skills, hence low frequency of experiments which they attributed to lack of resources and facilities. This anomaly could be corrected by incorporating new teaching approaches as emphasized by the SMASSE INSET.

2.2.6 Constructivist approach

Constructivism is a learning theory that suggests that learners construct knowledge out of their experiences (Wikipedia, 2009). Keraro (2008) asserts that constructivism is associated with pedagogical approaches that promote active learning or learning by doing. Learners construct meanings through active participation in own experiences. Learners have therefore to be active in the learning process. They should be able to actively construct meanings from experiences provided in science lessons (Driver & Bell, 1986; Keraro, 2002; Keraro, Okere & Mondoh, 2004; Kim, 2005).

The role of a teacher is to provide guidance by giving students challenges that will help refute their misconceptions. This can be achieved through; class discussions (peer group learning), students' experiments and demonstrations, use of audio-visual aids, charts, diagrams and models. Therefore, in constructivist learning, the role of a teacher is to provide learners with relevant experiences that allow them to construct their own meanings (Wikipedia, 2008; Keraro, 2008, SMASSE, 2004*b*). This approach involves a wider range of activities centered on helping students to learn science by; gaining new insights from the outcome of their investigations, modifying their pre-existing ideas in the lights of the new insights and constructing their understanding of a specific concept.

Learning activities provided in science lessons should enhance the ability to plan and carry out investigations in which students observe, compare, describe and express themselves (Jones, Reed & Weyers, 1994). Kim (2005) in a study comparing use of constructivists and traditional teaching methods found that using constructivism for 6^{th} graders resulted in better achievement than traditional teaching methods. Dogru (2007) compared science classrooms using teacher-centred approaches to those using students-centered constructivist methods. In their follow-up assessments later, they found that students who learned through constructivist methods showed better retention of knowledge than those who learned through traditional methods. Wambui (2005) reported that SMASSE was based on constructivism where students become more active in the learning process while teachers carefully guide the process with more meaningful learning activities. Unfortunately however, the majority of transactions taking place in the classrooms in our schools do not promote active learning (Keraro, 2008). The SMASSE INSET emphasized

on active learning. In this study, the influence of active learning that makes learners to actively construct meanings from experiences was investigated.

2.3 Teachers' attitudes

An attitude is a relatively stable organization of beliefs, feelings and behavior tendencies toward something or someone, the attitude object (Morris, 1996). A person's attitude influences behavior and early experiences give students enduring positive and negative attitudes towards particular objects. Attitudes are acquired or learned through experiences. Attitudes can therefore, be changed by exposure to new experiences and persuasive efforts. Attitudes may also be changed when new actions contradict pre-existing attitudes (cognitive dissonance) according to the cognitive consistency model (Oskamp, 1977; Morris, 1996).

Studies by Byrne and Johnstone (1988) show that desired attitude changes in science are unlikely to be achieved without the use of interactive approaches such as those employed in constructivist teaching. Conditions are arranged in such a way as to maximize interaction between learners and subject matter and also to ensure interaction between learners themselves.

In a study conducted by SMASSE (1999), it was established that teachers had negative attitudes towards teaching mathematics and sciences and thus put little or no effort in preparing lessons in these subjects. Creativity and improvisation were hardly visible in these lessons and learning facilities were hard to come by. The same attitude was observed among students. During class observations it was noted that teaching of sciences was teacher -centered. Most lessons were conducted through lecture method with very little active participation by students. Students were only actively involved in note taking, doing assignments, calculation on chalkboard and answering questions (Ouko, 2004; SMASSE, 2004*b*). However, one of the intentions of this study was to find out whether the SMASSE INSET influenced teachers attitude towards biology teaching and the INSET.

2.4 Teachers professional development

Teachers are perceived to be facilitators of learning rather than didactic source of all knowledge. It follows that teachers themselves should adopt this philosophy of lifelong learning in their own professional development. Assessment of teaching helps professional development of teachers

(Narula, 2007). O'sullivan, Jones and Reid (1990) assert that staff development is the activity of staff training that is a conscious institutional approach intended to improve the capability of staff to fulfill specified roles, particularly in relation to teaching. To distinguish between staff development and training, O'sulliavan et al define training as a gap between knowledge, skills and attitudes required in a job and the knowledge, skills and attitude of a person carrying out the job. Through a comparative analysis of what is required to perform a job well and the current extent to which an individual possesses those necessary characteristics, this training need is then turned into a learning need that the individual ought to satisfy in order to become better able to perform their job. Staff development has two important functions; Improvement of performance in the persons present job, prepare people for future opportunities, responsibilities and tasks.

According to Gibbons and Norman (1987), a teacher who is not developing professionally is unlikely to make significant improvements in classroom practice. Such attitudes as openness, confidence and initiative are essential as are skills in analysis, design and implementation. Equally important are experiences of alternative materials, approaches and program designs, and experiences in using them and developing new designs for the situations they are in.

Kydd, Crawford and Riches (1997) suggest that a teacher is the cause of students learning and teaching effectiveness is commensurate with students' grades. Practice is essentially the instrumental application of scientifically produced knowledge. Teachers gain their professional knowledge in formally taught and traditionally assessed courses and they learn how to apply it through periods of formal training. There is continuous research on effectiveness of teaching and learning methods/approaches. As such practicing teachers need to be updated on the current trends. Without in-service training such as SMASSE INSET during which such new developments are articulated, teachers may find it difficult to discard old practices for the new (SMASSE, 2004*a*). The INSETs success is judged by the competences that the teachers acquire or by the improvement in teachers' classroom practices.

2.5 In-Service Education and Training (INSET) and Professional Development

An INSET for teachers is a whole range of activities by which teachers can extend their personal education, develop their professional competence and improve their understanding of

educational principles and techniques. According to Hopkins (1986) a distinction has been made between INSET which is intended primarily to meet the wider professional development needs of individual teachers, for example, a Master of Education course and an INSET which is intended primarily to meet the needs of specific system like school based course or a teachers' centre course to train teachers to use new curriculum materials.

SMASSE INSET was meant to improve particular aspects of school practice which include; pedagogy, content mastery, attitude change, resources mobilization and management (SMASSE, 2004*a*). In-service Education and Training has received attention for three different reasons. One reason is its potential for stimulating professional development. Second is that, in-service education and training can improve school practice. Third is that, in-service education and training may be a viable strategy for implementing social policy (Hopkins, 1986).

Evaluation of school practices and the relationship of the changes to in-service education and training is an essential/part of the instructional process. As some of the case studies have shown, evaluation may be integrated into the educational activities where investigation and reflection analysis are part of the curriculum. Evidence from international case studies of school based INSET intended to stimulate professional development and to improve school practice suggests that evaluation is an essential component of professional development (Hopkins, 1986; Campbell, 1981).

Malcolm (1997) concludes that INSET promotes and supports systematic and sustainable high quality teaching and learning through effective school management and encouragement of the professional growth and development of teachers. Hopkins (1986) asserts that successful in-service programmes provide opportunities for participants to experience cognitive, attitudinal and behavioral change. It affords structured opportunities for teachers to communicate with each other about their attitudes and feeling to the new information and its implication for changes in their role. The effective in-service course also affords opportunities for systematically planning how the new information might be implemented in the classroom and for trying out new behavior within a 'safe climate'.

Hopkins (1986) noted that studies had shown that effective in-service programmes based on demonstrations, supervised trials and feedback are more likely to accomplish their goals than programmes which are based on theory. Teachers agree that they learn best from other teachers concerning job related skills and practices, but also agree that they need some outside help from consultants. The programmes in which teachers interact are more likely to accomplish their objectives. Programmes which provide different training experiences for different teachers, that is, are individualized, are more likely to accomplish their objectives. Programmes in which teachers participate as planners and decision- makers regarding in-service activities are more likely to have more success. Finally, teachers are more likely to benefit from in-service activities which are programme or project focused in which staff development is part and parcel of an overall plan to bring about improvement (Hopkins, 1986).

In-service education and training for teachers has been emphasized by the Ministry of Education. Government of Kenya(1999) Totally Integrated Quality and Training (TIQET) recommended that there should be a budgetary allocation for regular in-service training to be provided for so that in-service of teachers can be strengthened within the ministry and that in-servicing in academic and pedagogy be regularized and certified. In this study, the influence of the SMASSE INSET on teachers' classroom practice and students' achievement in biology in KCSE was investigated.

2.6 The SMASSE Project

SMASSE is an acronym for Strengthening of Mathematics and Sciences in Secondary Education. SMASSE Project is a joint venture between the Kenya government through Ministry of Education (MoE), and the Government of Japan through JICA initially on pilot basis. SMASSE Project is mainly involved in In-Service Training (INSET) of serving teachers in Mathematics and Science in Secondary Schools in Kenya (SMASSE, 1999). The System of operation is through the cascade system as illustrated in Figure 2.

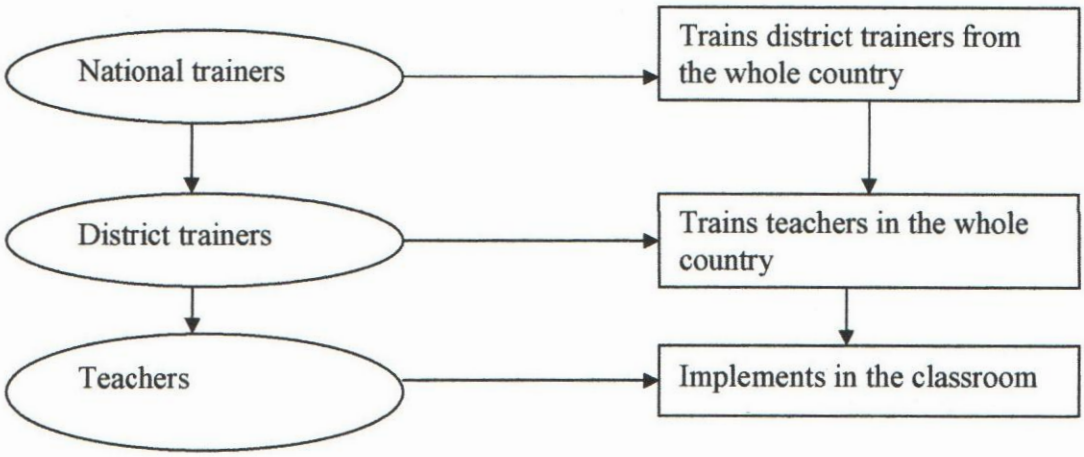


Figure 2: Cascade System of Training

Source: Rationale for INSET (SMASSE, 1999).

2.6.1 Why SMASSE?

SMASSE came into being in July 1998 when the consistently poor performance in Mathematics and Sciences (Biology, Chemistry and Physics) became a matter of serious concern (SMASSE, 1999). Broad curricula, lack of facilities and inadequate staffing were always cited as the major causes of the problem. Although dismal performance in these subjects had almost been accepted as the norm in some schools, the Ministry of Education (MoE) and other stakeholders felt there had to be an intervention, hence the Strengthening of Mathematics and Science in Secondary Education project (JICA, 2005). A survey by KNEC (2000) shows that students academic performance and interests in secondary school Biology is generally poor due to current methods of instruction and lack of resourses. Kiboss, Wekesa and Ndirangu (2006) have also attributed poor performance in biology to traditional methods of instruction and insufficient resources.

The SMASSE team conducted a baseline survey in 1998 in nine pilot districts (Kajiado,Gucha, Kakamega, Lugari, Butere-Mumias, Kisii, Murang'a, Maragua and Makueni) to determine the areas that needed intervention and came up with strategic plan of operation. Interviews were conducted with head teachers, teachers, students, parents and laboratory assistants. More data was collected by administering questionnaires to teachers and students, lesson observation and video recording of lessons for further analysis. From the results of the survey, it was evident that there were numerous problems in mathematics and science education. Among these were those

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problems within the scope of SMASSE operations and others beyond the scope of the project (SMASSE, 1999).

2.6.2 Problems Addressed by SMASSE Project

i) Attitude towards Science and Mathematics

According to SMASSE (1999), students' attitude was generally negative. This was attributed to low marks at admission, belief that the subjects are difficult, peer influence, lack of facilities, teacher absenteeism and theoretical approach to teaching. Teachers' attitude was generally neutral. They were reluctant to perform experiments especially in Chemistry and Biology which were deemed dangerous. In some cases experiments failed. Most practical sessions were merely teacher demonstrations. Headteachers' negative attitude was reflected in their development project priorities. Acquisition of text books, construction and equiping of laboratories were rarely ranked high. Most parents were not interested in their children's performance, least of all in Mathematics and Science. Progress reports were not a matter of concern. Some parents were found to be ignorant, others felt paying fees was their only role. PTAs were eager to construct prestigious structures to be seen to be development conscious, at the expense of basic teaching / learning resources (SMASSE, 1999; SMASSE, 2004*a*).

Other problems identified as being within the scope of SMASSE are;

ii) Inappropriate teaching methodology
iii) Content Mastery
iv) Inadequate Assignments
v) Few or no interactive fora for teachers
vi) Infrequent professional guidance by subject quality assurance and standards officers
vii) Missing link between primary and secondary school levels
viii) Lack of information about schools (SMASSE, 1999; SMASSE, 2004*a*).

2.6.3 SMASSE Intervention

According to SMASSE (2004*a*), the SMASSE Project, through In-Service Education and Training of serving teachers of Mathematics and Sciences, addresses the problems within its scope. The INSET curriculum was thus developed to upgrade/strengthen teacher competence by

addressing them through carefully selected topics, such areas of concern as: Attitude, pedagogy /teaching methodology, mastery of content, developing teaching/learning materials, administration and management

a. Teacher Attitudes towards Science

According to SMASSE (2004*a*), the INSET targeted teachers first because of the time they spend with students. The attitude of the teachers, (teacher centeredness, inability to carry out experiments and demonstrations successfully, low frequency of experiments, chalk and talk, being content driven and knowledge based) impacts negatively on students. Negative attitude among students is manifested in untidy/incomplete homework, frequent absenteeism/feigned illness, lack of attention in class, poor performance and low enrolment in optional science subjects, especially physics. Teachers had developed negative attitudes towards science subjects because of the problems they encounter in the process of teaching. Inadequate time allocation and inadequate equipment or science instructional materials contribute to teachers' negative attitudes. Some teachers consider and express openly that science subjects are hard or difficult to learn. If such an attitude is developed among students, they would automatically lack intrinsic motivation and become less interested in learning science (Changeiywo, 2004).Attitude change of Biology teachers was addressed by SMASSE INSET cycle one.

b. Pedagogy in Sciences

Teacher training curricular do not adequately address issues pertinent to secondary school teaching. Some theories in the curricula are often outdated and not applicable in the classroom. According to Ndirangu (2004), traditional instructional practices that centre on teacher dominated pedagogy predominate in our schools.

Most teaching is content/syllabus driven and covering the syllabus is interpreted to mean effective teaching. Lecture method becomes the method of choice even in science subjects because it allows wide coverage of ground in terms of content, although very little may be achieved in terms of learning. Changeiywo (2004) noted that science teaching was still dominated by the teacher, who, by large adopted a chalk-and-talk style of teaching that is heavily textbook oriented and does not encourage questions or students active participation.

Science learning in most schools has become an exercise of transmission of knowledge from textbooks to the learner. This practice necessitated the SMASSE intervention which advocated for active learning where students take an active part in the learning process while the teacher is a facilitator. The teacher is also involved in classroom management. Classroom management skills are used by teachers to ensure that classroom lessons run smoothly despite disruptive behavior by students. The goal of classroom management is to not only to maintain order but also to optimize student learning (Kauchak & Eggen, 2008). Active learning therefore, involves; Socratic dialogue which develops learner's high order thinking skills, class and group discussions, assignments, hands-on minds-on activities, co-operative learning, debates, role play and problem based learning (Muir-Leresche & Schull, 2006).

c. Mastery of Content in Science

In classrooms there are many categories of teachers. Firstly, there are teachers who have good content mastery. This is portrayed in their teaching as they take time to plan, think about the delivery process with their students in mind, are sequential in their teaching and most often student focused /centered (SMASSE, 2004*a*). Secondly, the teachers who 'lack' time in their teaching portray that they do not take time to plan and do not think about the delivery process. These teachers are not sequential in their teaching, are out of touch with the syllabus, aren't student focused/centered and in many cases confuse students. The third category is of those who lack content mastery. They cannot explain concepts satisfactorily and often mislead students unknowingly. Changeiywo (2004) adds that such teaching does not give learners a good background in science and hence students find it hard to grasp the concepts that come later in the course of learning. Students lose interest in science because teachers are unable to clearly explain scientific concepts and principles at earlier stages. Some teachers are poor in their pedagogical skills and as a result they fail to adapt a systematic approach in handling the class and to make a correct syllabus interpretation. In such cases students may not be adequately motivated to learn the subject.

SMASSE had all these factors in mind while preparing for the INSETS. During the INSETs, teachers were equipped with the necessary skills to develop teaching/learning (training)

materials, use limited resources efficiently and effectively and utilize materials in their environment, plan for effective teaching and learning of Mathematics and Sciences (JICA, 2005). Changeiywo (2004) postulates that improvisation and use of local materials to subsidize the available resources is expected. The science subjects should be presented in a manner that makes them interesting and meaningful to the learner through their emphasis on the application of knowledge and principles geared to the local environment. Indeed, learners should be actively engaged in all classroom activities.

A baseline survey conducted by SMASSE Project and the SMASSE curriculum review committee (SMASSE, 2004*a*) report that both teachers and students regarded teaching and learning of the following topics in the Biology syllabus as difficult; Excretion and Homeostasis, Reproduction, both sexual and asexual reproduction, and finally Respiration. The INSET addressed the topics and explored different ways of teaching them. Possible teaching aids were constructed; use of hands-on activities and improvisation was encouraged. Teachers also learnt how to involve learners in high order thinking skills like synthesis, analysis and evaluation (SMASSE, 2004*a*).

2.6.4 Good Practices for Effective Classroom Practices

a) ASEI /PDSI Paradigm Shift

According to SMASSE (2004*a*), the SMASSE team came up with the Activity, Student centered, Experiment, and Improvisation (ASEI) movement to upgrade the various aspects of teaching and learning. There are four basic principles inherent in this, which guide SMASSE INSET activities aimed at a shift as follows:

Pre –ASEI (Before INSET)

A shift from knowledge/content –based approach, few teacher demonstrations, theoretical or lecture method (chalk and talk/talk and talk), teacher – centered approach to;

ASEI-Condition (After INSET)

Activity-focused teaching/learning, Student-focused /centered learning, Experiment or research based approach and Improvisation. Changeiywo (2004) asserts that hands-on practical work by students is important since it ensures learning science by doing rather than merely learning about

it. However this calls for well equipped science laboratories which may be lacking in many schools in the rural areas.

PDSI Approach:

To achieve the ASEI condition, SMASSE came up with the **P**lan, **D**o, **S**ee and **I**mprove (PDSI) approach to teaching and learning.

• **P**lan

Apart from schemes of work and lesson plans, the teacher carefully plans and tries out the Teaching / Learning activities, materials and examples before the lesson. Emphasis is on how instructional activities will enable learners to:- Understand individual concepts and connections among them, get the rationale/value for the lesson, retain the learning and apply it in real life situations ,get rid of learning difficulties and misconceptions, and have more interest in the lessons.

• **D**o

The teacher carries out the planned lesson / activity as planned. Teachers are encouraged to; be innovative in lesson presentation, present lessons in varied interesting ways to arouse learners' interest e.g. through role play, storytelling; ensure active learner participation, facilitate the teaching/learning, deal with students' questions and misconceptions, and reinforce learning at each step. During INSETS, Teachers carry out peer teaching on the ASEI lessons and later actualize in their classrooms.

• **S**ee **(Lesson study)**

The teacher evaluates the teaching and learning process during and after lesson, using various techniques and feedback from students. Teachers also allow their colleagues to observe their lessons and offer feedback, see the good practices in the lesson and strengthen them ,see mistakes made in earlier lesson and avoid earlier mistakes in future lessons. In the process teachers become more open to evaluation by fellow teachers, school administrators, quality and standards assurance officers and Students

• **I**mprove

Reflect on the performance, evaluation report and effectiveness in achieving the objectives. These lessons enable the teacher to; see the good practices in the lesson and strengthen them, see mistakes made in earlier lesson, avoid earlier mistakes in future lessons. The teacher makes

use of such information in planning the next lesson to enhance performance and student learning (Njuguna, 1999).

b) Climbing Learning Approach

Other than ASEI and PDSI approach SMASSE has borrowed other important practices in the classroom like the Climbing Learning Approach. According to Saito and Kim (1998), the climbing learning approach was developed by Professor Noboru Saito of Naruto University of Education, Japan. This learning approach utilizes three items, that is, a concept map, a table of the reason for arrow lines and a research card. These are used during the lesson instruction. Students are supposed to fill in the space of the concept-map the explanation of the learning elements, the formula, the examples and self made problems and answers. In the process a teacher makes the students understand the content and meaning of each learning element tightly. Thereby having the student extend the existing knowledge and reconstruct it. The other teaching learning tools in this method is the type of the reason for arrow lines, where the students write the reason for arrows in the concept map. This activity is to enhance the students' understanding of interrelation of learning elements. The third tool is the research card where the students write any questionable issues. These are how, why and what issues (Saito & Kim, 1998).

2.6.5 Why the SMASSE Teaching Approaches are Good Practices

Through these approaches, SMASSE Project has had a positive impact on skills, knowledge and attitudes in the teaching and learning of mathematics and science. Other than focusing on Kenya, SMASSE focuses on the African region through SMASSE-Western, Eastern, Central and Southern Africa (WECSA) as a regional association of mathematics and science educators. It was started in 2001 for the purpose of strengthening the quality of teaching and learning of mathematics and sciences in member countries. Member countries have adopted SMASSE's ASEI movement and PDSI approach as a way of improving classroom practice (SMASSE, 2004*a*).

As a follow-up, SMASSE Kenya personnel conducted Monitoring and Evaluation of application and impact of the principles of ASEI movement and PDSI approach in Kenya's nine pilot

districts. The evaluation was also conducted in the classrooms in Malawi, Zambia, Rwanda and Zimbabwe. The observations on the teachers and the learners after being exposed to the INSET showed a positive impact on their attitudes and performance in mathematics and sciences (JICA, 2005).

The approaches learned at SMASSE INSET encourage the Biology teachers to promote active learning. Muir-leresche and Schull (2006) contend that active learning encourages students to be proactive and solve problems. The students read, write, discuss, critique, question, practice and act out or predict outcomes. Most important students engage in such high-order thinking tasks as analysis, synthesis and evaluation. Therefore strategies promoting active learning are instructional activities involving students in doing things and thinking about what they are doing. This ultimately improves their performance. It was the intention of this study to find out whether the approaches learnt at the SMASSE INSET encouraged the biology teachers to promote active learning and improve students' performance. This was done by observing biology teachers in class.

2.7 Theoretical Framework

The constructivists' theory of learning is the theoretical model that was used to guide this study. The constructivist theory suggests that, learners construct knowledge out of their own experiences. The theory is associated with pedagogical approaches that promote active learning or learning by doing (Wikipedia, 2009). In the constructivists' framework, learning is an active process in which learners proceed in their own ways to build representations of content for themselves. According to Keraro (2002), learning involves active processing of information as learners try to use what they already know to construct meaning out of new experiences. The meaning constructed therefore not only depends on the features of the new experience but also on the interpretive schemes that are brought to bear on it. Driver and Bell (1986) suggest that constructivist learning involves construction of meanings. Meanings constructed by learners from what they see or hear may or may not be those intended. Construction of meaning is influenced to a large extent by the learners' existing prior knowledge and the learning experiences provided.

Most approaches that have grown from constructivism, suggest that, learning is accomplished best using hands-on approach. Learners learn by experimentation, and not by being told what will happen. They are left to make own observations, inferences, and conclusions. According to SMASSE (2004*b*), the ASEI-PDSI approach extols the virtues of teaching/learning that is first and foremost activity based. The activities are hands-on (manipulation), minds-on (discussions/reflactions) and effective utilization and using materials available in learner's environment to improve learning of mathematics and science.

De Vries (2002) suggests that teachers constantly assess the knowledge their students have gained to make sure that the students' perceptions of new knowledge are what the teacher had intended. The teachers' role is not only to observe and assess but also to engage with the students while they are completing activities, wandering around and posing questions to the students for promotion of reasoning. Keraro (2008) describes teacher's role as that of facilitating learners to organize their own experiences successfully and in a way that would enable them to construct their own meanings. The teachers' professional development in SMASSE INSET involved change of attitude, applying ASEI-PDSI approach when teaching and improving classroom practices. The SMASSE INSET of Biology teachers encouraged use of interactive approaches and actively involving pupils in the learning process. Therefore, in this study, the influence of active learning was evaluated.

Conceptual Framework

The dependent variable is the main variable that lends itself for investigation as a viable factor. (Mathooko, Mathooko & Mathooko, 2007). In this study the dependent variables were; Biology teachers' classroom practice, teachers' attitudes towards Biology teaching and approaches emphasized in the INSET and the students' K.C.S.E Biology performance. The independent variable was the one that influenced the dependent variable in either positive or negative way. In this study, the independent variable was the SMASSE INSET for Biology teachers. The perceived interactions of the independent and dependent variables are diagrammatically presented in figure 3.

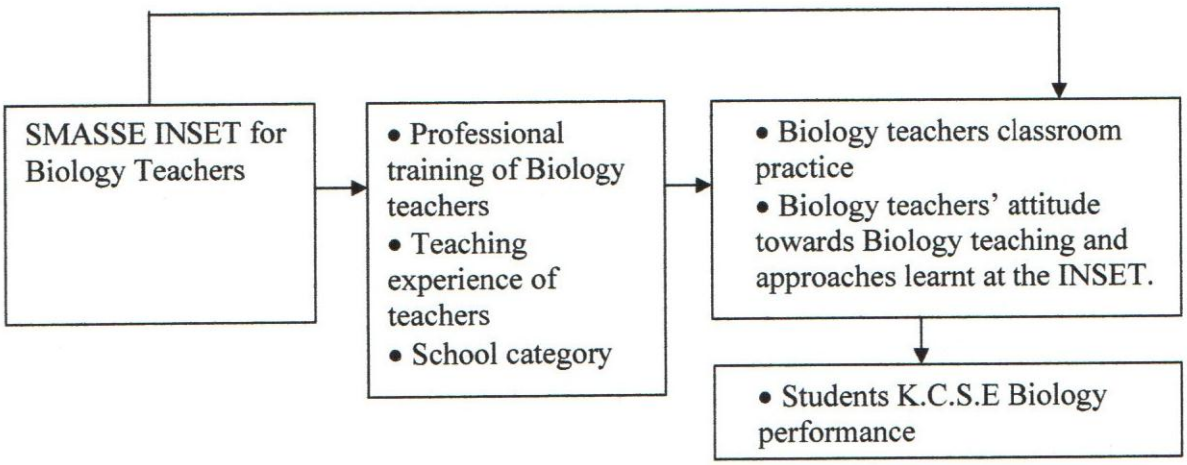


Figure 3: Conceptual framework showing the relationship of variables
Source: The Researcher

The INSET was perceived to have a positive influence on the biology teachers' classroom practice and their attitudes towards Biology teaching. This in turn is perceived to have impacted positively on students' K.C.S.E biology performance. The extraneous variables were possible independent variables that could have an effect on the dependent variables (Fraenkel & Wallen, 2000). In this study, the extraneous variables were; Biology teachers' professional training, teaching experience of teachers and the school category. The school category was controlled by purposively selecting both provincial and district schools. The study involved qualified graduate and diploma Biology teachers with a minimum of three years teaching experience in order to control the teacher variables. These teachers had attended the SMASSE INSET.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter deals with the procedures that were used to carry out the study. It details and systematizes the various steps that were followed in the entire research. It includes the research design, the area of study, population, sample size and sampling procedures, instrumentation, validity and reliability of research instruments, data collection and data analysis.

3.2 Research Design

This was a qualitative and quantitative study in which cross-sectional survey research design was used. This design is appropriate in a study where information is collected from a sample that has been drawn from a predetermined population. The information is collected at just one point in time, although the time it takes to collect all of the data desired may take from a day to a few weeks or more (Frankel & Wallen, 2000). This study adopted the design because the data was collected from teachers who had attended the SMASSE INSET. Orodho (2009) and Kathuri & Pals (1993), recommend use of descriptive information from a broad sample. Data from a broad sample of teachers was collected in order to determine the influence of SMASSE INSET on Teachers Classroom Practice, their attitudes and students achievement in biology in KCSE.

3.3 Study Location

This study was conducted in Nyandurua County of central province. The two districts in the county have 110 secondary schools both public and private with a teaching force of 541 Mathematics and Science teachers. Table 1 shows the school categories in the two districts of Nyandarua County.

Table 1:

Schools in Nyandarua County

District	Public		Private
	Provincial	District	
Nyandarua North	4	37	11
Nyandarua South	5	46	7

Source: The Researcher

Nine of the schools are provincial schools, 83 are district and 18 are private schools. The county was purposively selected to constitute the study area because a majority of the mathematics and science teachers in the secondary schools had by the time this study was conducted participated in the SMASSE INSET.

3.4 Target Population and Accessible Population

The target population are all the individuals or subjects that conform to specific criteria and to which findings of the study may be generalized (Frankel & Wallen, 2000; Ingule & Gatumu, 1990). Target population is a large population from which a sample population is to be selected (Mugenda & Mugenda, 1999). For the purpose of this study, the target populations were all the secondary school Biology teachers and secondary school students in Nyandarua County. The accessible population was 160 Biology teachers who had participated in the SMASSE INSET in the county. The teachers had basic training in either diploma in Education or Bachelor of Education and Bachelor of Science with post graduate diploma holders. The teachers had a minimum of three years teaching experience.

3.5 Sample Size and Sampling Procedures

In this study, a total of 89 Biology teachers and 30 schools were used. The samples provided reasonable and representative samples of the accessible population. Thirty secondary schools were purposively selected. According to Frankel and Wallen (2000), a researcher can use personal judgment depending on the specific purpose to select a sample. The researcher selects the respondents and then picks only those who best meet the purpose of study (Kathuri & Pals, 1993; Borg & Gall, 1989). For sample to be representative, it should not be less than twenty to thirty individuals (Mugenda & Mugenda, 1999). For the purpose of this study a sample of thirty schools was purposively selected as 7 provincial and 23 district schools which had KCSE Biology results since the year 2000. Private schools were not sampled because of high turnover of the teachers. The study sample of teachers therefore comprised of 89 subjects out of the target population of 160 Biology teachers. The 89 Biology teachers, that is, 50 males and 39 females who participated in the SMASSE INSET were selected from the 30 secondary schools. The sample represented 55.6 percent of the population and therefore adequate for the study (Mugenda & Mugenda, 1999)

3.6 Instrumentation

This study used three instruments for data collection namely: Biology Teachers Questionnaire (BTQ), Biology Lesson Observation Schedule (BLOS) and a performance table. The questionnaire offered advantage of uniformity to all respondents (Mugenda & Mugenda, 1999). The respondent recorded a written response of each questionnaire item.

The Biology Teachers Questionnaire (BTQ) was developed by the researcher and had three sections. Section one collected demographic data on the background of the respondents, which included their district, category of school, gender, basic training, years of experience, the teaching load and the percentage allocation of time to three aspects of teaching biology. The section had seven items. The last item was open ended. Section two sought to assess the influence of SMASSE INSET on teachers' classroom practice. The section had 14 items on the areas a biology teacher focus on in the process of delivering ASEI-PDSI lesson. This section had a minimum score of 14 and a maximum score of 42. The responses were scored on a 3-point Likert scale. Section three was an adapted questionnaire and modified to measure Biology teachers' attitudes towards Biology teaching and the INSET. This section of the questionnaire was adapted from an instrument that had been used to collect data on pre-service students' attitudes towards chemistry teaching (Wachanga, Ngari & Muchiri, 2003). It was adapted to suit the purpose of the study and used for data collection. It had 17 likert type items on interest towards teaching Biology, attitudes towards resources used in teaching Biology, attitudes towards SMASSE INSET of Biology teachers and value of Biology. The response was assigned scores between 1 and 5 which was used to determine the measures of attributes using descriptive statistics. Teachers were required to indicate whether they Strongly Agree, Agree, Undecided or Strongly Disagree with the statements. Section three of the questionnaire had a minimum score of 17 and a maximum score of 85.

The Biology Lesson Observation Schedule (BLOS) had 16 likert type items on teaching procedure, methodology/ fundamental technique and class management. The observation was scored on a five point scale ranging from very good to poor. The minimum and maximum scores are varied with the sub-sections. The lesson observation schedule was adapted from the SMASSE monitoring and evaluation lesson observation instrument. It was used to assess

ASEI/PDSI lesson implementation in course of the in-service education and training (SMASSE 2004*b*).

The third instrument was a performance table developed by the researcher and was used to collect data on students KCSE Biology performance over the years from 2000 to 2007. The table showed the school code, school category, years, number of candidates and Biology KCSE mean grade.

3.6.1 Validity of Research Instruments

According to Fraenkel and Wallen (2000) validity is the degree to which correct inferences can be made based on results from an instrument. Experts examined the instruments logically to determine if the elements represented were those that made up the content (Kathuri & Pals 1993). Five experts in curriculum and instruction from the Department of Curriculum Instruction and Educational Management at Egerton University were consulted to ensure the content validity of the research instruments.

3.6.2 Reliability of Research Instruments

Reliability is the degree to which scores obtained with an instrument give consistent results. After piloting in ten schools, two provincial and the other eight district schools within Nyandarua, the reliability was determined using the Cronbach alpha coefficient. An alpha value of 0.7 and above is an acceptable reliability level for research purposes (Hayes, 2000; Fraenkel & Warren, 2000). Biology Teachers Questionnaire (BTQ) section (ii) on perceptions and section (iii) on attitudes were found to have reliabilities of 0.70 and 0.70 respectively. Biology Lesson Observation Schedule (BLOS) was found to have a reliability coefficient of 0.82. All these instruments therefore met the standards required for this study.

3.7 Data Collection Procedures

After getting an introduction letter from the Graduate School, Egerton University, a research permit was obtained from the National Council of Science and Technology for conducting the research. The researcher later travelled to the District Education offices to inform the offices of the intention to carry out the study. The researcher was granted introductory letters authorizing visits to the schools involved in the study and informed principals of the intended study. On

different days within the months of May and June in the year 2011, the researcher travelled to individual Schools and administered questionnaires to the selected respondents and also filled in the Biology lesson observation schedule. Heads of science departments of the selected schools filled in the K.C.S.E Biology Performance form. The questionnaires and the K.C.S.E Biology Performance Form were then collected for analysis.

3.8 Data Analysis

In this study, quantitative and qualitative data were generated from Biology Teachers Questionnaire (BTQ) and Biology Lesson Observation Schedule (BLOS). Data generated from the instruments were analyzed both qualitatively and quantitatively. Descriptive statistics were used to analyze qualitative data which involved use of means, frequencies and percentages. For quantitative data, inferential statistics, that is, paired sample t- test was used to analyse data and test the research hypothesis. The level of significance was determined at $\alpha = 0.05$. A computer program, Statistical Package for Social Sciences (SPSS) aided in data analyses.

Table 2:

Summary of Data Analysis

	Objective/hypothesis	**Independent Variable**	**Dependant Variable**	**Statistical Method of Analysis used**
1.	To determine the attitudes of Biology teachers towards the Biology teaching and the SMASSE INSET.	SMASSE In-service education and training	Teachers Attitudes towards biology teaching and the INSET	Descriptive statistics
2.	To evaluate the influence of SMASSE INSET on Biology teachers' classroom practices.	SMASSE In-service education and training	Biology teachers' classroom practices.	Descriptive statistics

3	To assess whether the SMASSE INSET has had any impact on students' achievement in Biology in KCSE.	SMASSE In-service education and training	students' achievement in Biology in KCSE.	Descriptive statistics
Ho	**Hypothesis** There is no statistically significant difference in students' achievement in biology in K.C.S.E between the period before and after SMASSE INSET at alpha level of 0.05.	SMASSE In-service education and training	students' achievement in Biology in KCSE.	t-test

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents results, interpretation and discussion of the findings of the study on the "Influence of SMASSE INSET on Biology Teachers' Classroom Practice, Attitudes and Students' Achievement in Nyandarua county Secondary Schools, Kenya". The objectives of the study were:

i) To determine the attitudes of Biology teachers towards the Biology teaching and the SMASSE INSET.
ii) To evaluate the influence of SMASSE INSET on Biology teachers' classroom practices
iii) To assess whether the SMASSE INSET has had any impact on students' achievement in Biology in KCSE.

The chapter is divided into six sections including the demographic characteristics of the sampled respondents, attitudes towards teaching Biology, SMASSE INSET and teaching procedure, SMASSE INSET and teaching methodology, SMASSE INSET and classroom management, and SMASSE INSET and academic performance in Biology. Results are analyzed using both descriptive and inferential statistics.

4.2 Demographic characteristics of the respondents

This section briefly describes the demographic characteristics of the sampled respondents involved in this study. Such a description is important in providing a clear understanding of the subjects included in the study. The demographic characteristics included school district, category of the school, gender, professional training, teaching experience, teaching load, and the percentage allocation of time to three aspects of teaching biology.

4.2.1 Distribution of the sampled teachers

The study was conducted in 30 secondary schools in Nyandarua North and Nyandarua South districts. The 89 sampled teachers were distributed in the two districts as shown in Table 3.

Table 3:

Distribution of the biology teachers by district

District	Frequency	Percent
Nyandarua North	40	44.9
Nyandarua South	49	55.1
Total	89	100.0

Table 3 shows that 55.1 percent of the teachers were drawn from Nyandarua South district, while 44.9 percent were drawn from Nyandarua North district. The variations in the number of sampled teachers per district were attributed to the general variations in the number of Biology teachers in these districts.

4.2.2 Distribution of biology teachers by school category

The secondary schools were divided into two categories, including provincial and district schools. Table 4 illustrates the distribution of the sampled teachers in the schools by their category.

Table 4:

Distribution of the teachers by their school categories

Category	Frequency	Percent
Provincial	28	31.5
District	61	68.5
Total	89	100.0

Table 4 indicates that 31.5 percent of the sampled teachers were drawn from provincial schools while 68.5 percent came from district schools. The variation in the number of teachers drawn from each category was based on the number of schools in each category and the number of SMASSE Biology trained teachers in that category. The two districts had more of district schools than provincial schools.

4.2.3 Biology teachers' gender

The teachers sampled were both males and females as shown in Table 5.

Table 5:
Distributon of the teachers by gender

Gender	Frequency	Percent
Male	50	56.2
Female	39	43.8
Total	89	100.0

When the sample teachers were asked about their gender, 56.2 percent were males while 43.8 percent were females. The gender disparities depict the overall imbalance between male and female teachers. There were more male teachers than female teachers teaching Biology in the study area. Few female teachers end up pursuing science-based careers including teaching Biology.

4.2.4 Academic qualification of biology teachers

The study also established that the teachers varied in their highest level of professional teaching qualifications as illustrated in Table 6.

Table 6:

Highest academic qualification of biology teachers

Professional training	Frequency	Percent
BEd	48	54.5
Post Graduate Dip in Educ	16	18.2
diploma	24	26.9
masters	1	1.1
Total	89	100.0

Table 6 indicates that 54.5% of the teachers had a Bachelors degree in education. The remaining 18.2%, 26.9% and 1.1% had Post graduate diploma in education, diploma in education and Masters Degree, respectively. This suggests that the sampled teachers had sufficient professional qualifications to undertake their Biology teaching responsibilities and meet the educational needs of students at secondary school level.

4.2.5 Teaching experience

Effectiveness in teaching and handling of students academic needs will also depend on the experience of the teachers concerned. Table 7 depicts the number of years that the teachers had served as biology teachers.

Table 7:

Number of years in teaching profession

The number of years I have taught Biology	Frequency	Percent
3 - 6 years	15	17.0
7 - 10 years	34	38.2
11 - 14 years	20	22.7
15 years and above	20	22.7
Total	89	100.0

Table 7 indicates that 83 percent of the teachers had taught Biology for more than 6 years. Out of this, 38.2 percent had taught for 7-10 years, 22.7 percent had taught for 11-14 years while 22.7 percent had done so for 15 years and more. The remaining 17 percent had taught for a period of 3-6 years. This suggests a wide range of teaching experience in schools mixing new and old teachers. This was critical for continuity and succession in teaching Biology. The new teachers were still fresh from college and thus very receptive to new ideas, while the older teachers had the necessary hands-on experience to understand the dynamics involved in teaching and learning Biology. Therefore all these teachers had long teaching experiences to make them effective teachers.

4.2.6 Total teaching load of the teachers per week

In addition to the teaching experience and professional training, the effectiveness of a teacher also depends on the teaching load allocated. In this study, the respondents were asked about their total teaching load per week. Table 8 illustrates the distribution of teachers according to their teaching load per week.

Table 8:

Total teaching load of the teachers per week

Weekly teaching workload in lessons	Frequency	Percent
12 – 15	6	6.7
16 – 19	2	2.2
20 – 23	38	42.7
24 – 27	28	31.5
28 lessons and above	15	16.9
Total	89	100.0

Table 8 shows that majority 74.2% of the sample teachers had a weekly teaching load of 20-27 lessons, with 42.7 percent having 20-23 lessons while 31.5 percent had 24-27 lessons. The remaining 6.7 percent had 12-15 lessons, 2.2 had 16-19 lessons while 16.9 percent had 28 lessons and more. The 74.2 percent of the teachers who had between 20-27 lessons per week were regarded to be teaching within the recommended workload. Those with a load below limits were found to have administrative responsibilities in their schools. The 16.9 percent of the teachers with more than 27 lessons per week were over-utilized because of scarcity of teachers in some schools. This could affect their classroom practice due to poor lessons preparation. On a whole, however, 91.1% of the teachers had the stipulated teaching load.

4.2.7 Percentage allocation of time to three aspects of teaching biology

From the workload per week, an effective Biology teacher should balance the allocation of time in three aspects including demonstration, pupils' desk experiments and theory work. Table 9 illustrates the percentage distribution of teachers' allocation of time in the three aspects.

Table 9:

Percentage allocation of time to three aspects of teaching biology

Aspects of teaching	*N*	*Mean percentage time*	*SD.*	*Minimum*	*Maximum*
Demonstrations	89	23.53	8.650	5	50
Pupils' desk experiments	89	27.34	11.699	0	70
Theory work	89	49.14	13.960	20	70
Total		100			

Table 9 shows that more time was allocated to theory work (49.14%), followed by desk experiments (27.34%) and lastly demonstration (23.53%). This was more likely to influence the teaching approach and methodology used by the teacher while teaching. Effective experiments help to achieve objectives of lessons which are evidenced by students' ability to make deductions from the practical work, solve related problems and verify predictions. These results indicate that the learners were exposed to some practical work through experiments and demonstrations. Initially, low frequency of experiments was noted with the main reason given by the teachers as lack of facilities (SMASSE, 2004a).Active participation of students in classes could have a positive impact on their performance.

4.3 Attitude towards teaching biology and the SMASSE INSET

The first objective sought to determine the attitudes of Biology teachers towards the Biology teaching and the approaches learnt in the SMASSE INSET. The level of attitude was assessed from a series of 17 statements seeking respondent's agreement or disagreement with various aspects of their teaching Biology and approaches learnt in SMASSE INSET. Out of the 17 statements, four captured various aspects of the approaches learnt in SMASSE while the rest of the statements were on the aspects of teaching Biology.

Responses to the 17 statements were measured on a likert scale ranging from 1 to 5 (where 1 = strongly disagree - SD, 2 = disagree - D, 3 = undecided - U, 4 = agree - A, and 5 = strongly agree - SA). The higher the score, the more positive was the attitude of the teachers towards teaching Biology and the approaches learnt in SMASSE INSET programme, and vice versa. For each statement, an average mean score was computed for the general assessment and variation among the respondents. Table 10 highlights the distribution of their responses on the statements.

Table 10:

Assessment of the aspects of teaching biology and the SMASSE INSET

Statement	*Mean*	SD
Teaching Biology		
A Biology teacher profession should be for both male and female teachers	**4.87**	0.409
An effective Biology teacher should have a	**4.73**	0.557

favourable attitude towards Biology teaching		
Biology teaching demands considerable knowledge in ones area of teaching	**4.64**	0.483
Teaching of Biology should create interest in careers based on biological sciences	**4.55**	0.569
Teaching Biology is interesting	**4.53**	0.502
A Biology teacher should link his/her teaching with the students' immediate environment	**4.44**	0.698
Learners in Biology perform practical work hence develop various skills	**4.41**	0.530
Biology teaching should develop learners' critical thinking ability	**4.35**	0.535
I feel proud being a Biology teacher	**4.35**	0.863
Biology teaching does not deal with static information	**4.35**	0.710
Biology contributes much to nation building	**4.30**	0.736
Biology teaching is a promising career	**3.92**	0.900
A lot of teaching and learning resources are required for Biology teaching	**3.09**	1.249
The SMASSE INSET		
A Biology teacher needs to keep up with modern methods of teaching students	**4.55**	0.672
The In-service training for Biology teachers is justified	**4.35**	0.629
To keep up with trends in the teaching profession a teacher should take a refresher course	**4.35**	0.627
There is much link between SMASSE INSET teaching methods and teaching needs in real classrooms	**4.17**	0.648

N = 89

Table 10 indicates that the teachers were positive in their assessment of various aspects of teaching Biology and approaches learnt in the SMASSE INSET programme. For the aspects of teaching Biology, the respondents rated all the 13 statements at least above mean score (3.00) with mean scores of between M = 3.09 and M = 4.87. The respondents reported that teaching Biology can be done by male and female, it requires a favourable attitude towards teaching it, it demands considerable knowledge in ones area of teaching, should create interest in careers based on biological sciences, and its interesting to teach biology. They also observed that a Biology teacher should link teaching with the students' immediate environment, develop critical thinking ability, deal with dynamic information and contribute to nation building; and learners should perform practical work. The respondents also reported that biology teaching is a

promising career. They further reported that biology teaching did not require a lot of teaching and learning resources. These results suggest that the teachers were satisfied with and enjoyed teaching Biology. Such teachers were therefore expected to register high academic performance if the students also worked hard and develop a positive attitude towards the subject.

Table 10 also revealed that that the respondents were highly satisfied with all the four statements about the approaches learnt in the INSET and used in teaching Biology. The respondents rated them above average with mean scores ranging from M = 4.17 and M = 4.55. They observed that a Biology teacher needed to keep up with modern methods of teaching by taking a refresher course to keep up with trends in teaching, in-service training for biology teachers was justified, and there was a link between SMASSE INSET teaching methods and teaching needs in real classrooms. This suggests that the teachers were satisfied with the approaches that they learnt in the SMASSE INSET. They found the approaches applicable and relevant to teaching and learning Biology. This was in line with a report by JICA (2005) which indicates that SMASSE project advocates for Activity, Students, Experiment and Improvisation (ASEI) movement principle. Using the principle, the quality of classroom activities was critical to achieving effective teaching and learning. The approaches of INSET had promoted understanding of concepts, enhance development of skills and increases the retention of knowledge gained. This was then expected to upgrade the performance of the students in Biology and other Sciences.

In any school environment, the 13 statements on teaching Biology and 4 on approaches learnt in the INSET interact and cumulatively influence the overall attitudes of the teachers towards teaching and the approaches learnt. Thus, the response to each of the 17 constituent statements were scored on a scale of 1, indicating least level of attitude, to 5, indicating highest level of attitude toward teaching of Biology and approaches learnt in the SMASSE INSET. The individual statement scores were summed up to form an attitude index score for each respondent. The index score varied between 17, indicating the least overall attitude, and 85, indicating the highest overall attitude towards teaching Biology and approaches learnt in the SMASSE INSET. The higher the score, the more positive was the overall attitude of the teachers toward teaching Biology and approaches learnt in the SMASSE INSET, and vice versa. The index score was later collapsed into three ordinal categories in order to differentiate between the overall levels of

attitudes among the respondents. This included a score of 17-39 meaning negative attitude, a score of 40-62 indicating average/moderate attitude and a score of 63-85 indicating positive attitude. Table 11 depicts the overall attitude of the teachers towards teaching Biology and approaches learnt in SMASSE INSET programme.

Table 11:

Attitude towards teaching biology and the SMASSE INSET

	Overall attitude		*Teaching Biology*		*SMASSE INSET*	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Attitude						
Negative	0	0.0	0	0.0	0	0.0
Average/moderate	1	1.1	1	1.1	5	5.6
Positive	88	98.9	88	98.9	84	94.4
Total	89	100.0	89	100.0	89	100.0

Table 11 indicates that on the overall, 98.9 percent of the sampled teachers had a positive attitude toward teaching Biology and approaches learnt in the INSET. Separately, 98.9 percent had a positive attitude towards teaching Biology while 94.4 percent had a positive attitude towards approaches learnt in the INSET. This suggests that the teachers had a positive attitude towards not only teaching of Biology, but also the approaches learnt. Other than the SMASSE INSET, the attitude could also be influenced by the professional training and teaching experience of teachers which were controlled by selecting trained teachers with teaching experience of more than three years.

4.4 SMASSE INSET and teachers' classroom practices

The second objective aimed at evaluating the influence of SMASSE INSET on biology teachers' classroom practices. These practices include; teaching procedure, fundamental technique or methodology and the classroom management. The objective was based on the premise that SMASSE INSET aimed at enabling teachers to share experiences, mentor each other, update their skills and interact with innovative approaches and practices that create interest and inspire confidence in the learners. The INSET was expected to make a positive influence on the teaching procedures, methodology and teachers' classroom management.

4.4.1 SMASSE INSET and teaching procedures

In this study, the influence of the INSET on teaching procedure was assessed by teachers self-reporting their frequency of utilization of various aspects of teaching procedures learnt during the SMASSE INSETs. The teachers' rating was based on their long-term assessment and the general teaching and learning environment in the school. In addition, an observation schedule was used to confirm these aspects of teaching procedures in class.

The teachers were requested to rate the 5 statements on the frequency of use of teaching procedures learnt from the INSET. Responses to these statements were measured on a three-point likert scale ranging from 1 to 3 (where 1 = not frequent – NF, 2 = frequent - F, and 3= very frequent- VF). The higher the score, the more frequent was that aspect of teaching procedure used by the teacher, and vice versa. For each statement, average mean score was computed so as to assess the general assessment and variation among the respondents. Table 12 presents the distribution of their responses on the statements.

Table 12:

Frequency of use of aspects of teaching procedure

	Mean	SD
Teacher talks and ask learners questions	2.1011	.72370
Teacher motivates learners	2.1011	.69159
Teacher guides learners in carrying out practical activities	2.0000	.69085
teacher caters for different abilities of the learners	1.9438	.69674
Teacher concludes lesson by summarizing the main points	2.0899	.77812
Mean of means of influence of SMASSE-INSET on biology teachers' teaching procedure	**2.0472**	**.38497**

N=89

Table 12 indicates that the teachers frequently utilized the teaching procedures learnt in the INSET in their classes. They rated all the five aspects of teaching procedures 2.05 with mean scores of between $\overline{X}$ = 1.94 and $\overline{X}$ = 2.10. The respondents reported that they frequently talked and asked learners questions, summarized lessons by mentioning the main points, motivated learners, guided learners in carrying out practical activities, and catered for different abilities of

the learners. These findings suggest that the teachers motivated the students to actively participate in class during teaching. This was aimed at boosting learners' concentration and grasp of the concepts taught.

The overall influence of SMASSE INSET on teaching procedure depends on the cumulative interaction and influence of the five aspects of teaching procedure. Therefore, the response to each of the 5 constituent aspects of teaching procedure were scored on a scale of 1, indicating least frequency, to 3, indicating highest frequency of use in class. The individual statement scores were summed up to form a teaching procedure index scores for each respondent. The index score varied between 5, indicating the least overall impact, and 15, indicating the highest overall influence of SMASSE INSET on teaching procedures. The higher the score, the more was the influence of the INSET on teaching procedures used by Biology teachers, and vice versa. The index score was later collapsed into three ordinal categories in order to differentiate between the overall levels of impact on teaching procedures among the respondents. This included a score of 5-8 meaning below average influence, a score of 9-11 indicating average/moderate influence and a score of 12-15 indicating high influence. Table 13 depicts the overall influence of SMASSE INSET on teaching procedures of Biology teachers.

Table 13:

Influence of SMASSE on teaching procedures in biology

Influence	*Frequency*	*Percent*
Below average	21	23.6
Average/Moderate	45	50.6
Above average	23	25.8
Total	89	100.0

Table 13 indicates that overall, SMASSE INSET had moderate influence on teaching procedures used by Biology teachers in the sampled schools. Out of this, 50.6 percent of the teachers had witnessed moderate influence while 25.8 percent had more influence on their teaching procedures. This suggests that teachers were frequently practicing and implementing the teaching procedures that they learnt in the SMASSE INSET in the course of their teaching.

The teachers' self-reporting of the impact of SMASSE INSET on teaching procedures was further confirmed by the researcher using an observation schedule. In the observation, 8 statements were extracted from the five aspects that teachers had self-reported on teaching procedures. The researcher assessed the level of satisfaction with the extent to which these aspects of teaching procedures were being practiced by the teachers in class. Responses to these 8 statements were measured on a five-point likert scale ranging from 1 to 5 (where 1 = poor – P, 2 = fair – F, 3 = moderate - M, 4 = good - G and 5 = very good - VG). The higher the score, the more satisfied was the researcher with the use of that particular aspect of teaching procedure in class, and vice versa. For each statement, average mean score was computed so as to assess the general assessment and variation among the respondents. Table 14 highlights the distribution of their responses on the statements.

Table 14:

Satisfaction with observed aspects of teaching procedure

	Mean	SD
Clarity and feasibility of lesson objectives	4.0562	.77400
Appropriate introduction which is stimulating and helps learners to focus on content	3.9775	.85250
Appropriate content	4.2697	.68696
Encourages all students to participate	4.2247	.93848
Language - clear and unambiguous instruction	4.0787	.80092
Emphasis on main concept	4.0337	.76052
Lesson summary/captures main points covered	3.8068	.84225
Achievement of set objectives	3.8652	.78612
Mean of means of teaching procedure	**4.0337**	**.43414**

N=89

Results in table 14 confirm that teachers were practicing the various aspects of teaching procedures learnt from SMASSE INSET. It was observed that the teachers had appropriate content, encouraged all students to participate, emphasized on main concepts, used clear and unambiguous instruction, and achieved set objectives. In addition, there was appropriate introduction which stimulated and helped learners to focus on the content of the lesson and

lesson summary captured main points covered. This confirmed that indeed the teachers were practically adopting effective teaching procedures in their teaching.

4.4.2 SMASSE INSET and teaching methodology

Other than teaching procedures, the second objective also aimed at evaluating the influence of SMASSE INSET on Biology teachers' teaching methodology. The objective was premised on the fact that the main aim of SMASSE INSET was to address the poor performance in Mathematics and Sciences by changing the teaching methodology that was previously being used. The INSET was expected to introduce more student-centered teaching methodology to replace the otherwise lecture method that had been mostly adopted. In this study, the impact of the INSET on teaching methodology was assessed by teachers self-reporting the frequency to which they utilized various aspects of the recommended student-centered methodology. The teachers' rating of the frequency was based on their long-term assessment and the general teaching and learning environment in the school. In addition, an observation schedule was used to confirm these aspects of teaching methodology in class. The observations were based on the researcher's one day assessment of the adoption of the various aspects of student-centered teaching methodology.

The teachers were requested to rate a series of 5 statements seeking respondent's on the frequency of use of the various aspects of the teaching methodology learnt from the INSET. Responses to these statements were measured on a three-point likert scale ranging from 1 to 3 (where 1 = not frequent – NF, 2 = frequent - F, and very frequent- VF). The higher the score, the more frequent was that aspect of the teaching methodology used by the teacher, and vice versa. For each statement, average mean score was computed so as to assess the general assessment and variation among the respondents. Table 15 highlights the distribution of their responses on the statements.

Table15:

Frequency of use of aspects of teaching methodology

	Mean	SD
Learners interact with equipments as lessons progress	1.9438	.55102

Teacher use a wide range of teaching resources in lesson presentation	1.9551	.85160
Teacher uses improvised and locally available materials	1.9775	.62117
Teacher offers learners opportunity to enjoy the scientific process	2.1236	.49590
Teachers involves students actively in practical work	2.4773	.70200
Mean of means of impact of SMASSE-INSET on biology teachers' teaching fundamental techniques/methodology	**2.0899**	**.78567**

N=89

Table 15 indicates that overall, the teachers frequently utilized various aspects of the teaching methodology learnt in the INSET in their classes. They rated all the five aspects of teaching methodology about 2.09 with mean scores of between $\overline{X} = 1.94$ and $\overline{X} = 2.48$. The respondents reported that they frequently involved students actively in practical work, offered learners opportunity to enjoy the scientific process, made use of a wide range of teaching resources in lesson presentation, used improvised and locally available materials, and interacted with equipment as lessons progress. These findings suggest that the teachers encouraged more of student-centered teaching methods. This was expected to motivate the students to actively participate in class during teaching. This was aimed at boosting learners' concentration and grasp of the concepts being taught.

The overall influence of SMASSE INSET on teaching methodology depends on the cumulative interaction and influence of the five aspects of teaching methodology. Therefore, the response to each of the 5 constituent aspects of teaching methodology were scored on a scale of 1, indicating least frequency, to 3, indicating highest frequency of use in class. The individual statement scores summed up to form a teaching methodology index score for each respondent. The index score varied between 5, indicating the least overall influence, and 15, indicating the highest overall influence of SMASSE INSET on teaching methodology. The higher the score, the more was the influence of the INSET on teaching methodology used by Biology teachers (more of student-centered method), and vice versa (more of lecture method). The index score was later collapsed into three ordinal categories in order to differentiate between the overall levels of influence on teaching methodology among the respondents. This included a score of 5-8 meaning

less influence, a score of 9-11 indicating average/moderate influence and a score of 12-15 indicating above average influence. Table 16 depicts the overall influence of SMASSE INSET on teaching methodology of Biology teachers.

Table 16:

Influence of SMASSE on teaching methodology in biology

Influence	*Frequency*	*Percent*
Below average	17	19.1
Average/Moderate	52	58.4
Above average	20	22.5
Total	89	100.0

Table 16 indicates that overall, SMASSE INSET had moderate influence on teaching methodology used by Biology teachers in the sampled schools. Out of this, 58.4 percent of the teachers had witnessed moderate influence while 22.5 percent had more influence on their teaching methodology.

As explained earlier, the teachers' self-reporting of the influence of SMASSE INSET on teaching procedures was further investigated by the researcher using an observation schedule. In the observation, statements on the aspects of teaching methodology were used. The researcher assessed the level of satisfaction with the extent to which these aspects of teaching methodology were being practiced by the teachers in class. Responses to these 4 statements were measured on a five-point likert scale ranging from 1 to 5 (where 1 = poor – P, 2 = fair – F, 3 = moderate - M, 4 = good - G and 5 = very good - VG). The higher the score, the more satisfied was the researcher with the use of that particular aspect of teaching methodology in class, and vice versa. For each statement, average mean score was computed so as to assess the general assessment and variation among the respondents. Table 17 highlights the distribution of their responses on the statements.

Table 17:

Satisfaction with observed aspects of teaching methodology

	Mean	SD
Students involvement through questioning and discussion	3.8090	.99859
Students involvement in Hands -on/minds-on activities	3.5056	1.00140
Appropriateness of demonstrations, teaching aids and improvised materials	3.6629	.97635
Appropriateness of teacher's attitude and expression	3.9213	.74200
Mean of means of fundamental techniques	**3.7247**	**.59597**

N=89

Table 17 shows that teachers were practicing the various aspects of teaching methodology that they learnt from SMASSE INSET. It was observed that teachers were emphasizing more on student centered methods and discouraging pure lecture methods. This was done by involving through questioning, discussion and hands-on or minds-on activities. In addition, the teachers were emphasizing on appropriateness of demonstrations, teaching aids, improvised materials, and teacher's attitude and expression. This suggests that SMASSE INSET had enabled teachers to involve the students more during teaching.

4.4.3 SMASSE INSET and classroom management

The second objective aimed at evaluating the influence of SMASSE INSET on Biology teachers' classroom management. The objective was premised on the fact that a teacher who implemented what was learnt in the SMASSE INSET was expected to improve in particular aspects of classroom practice including pedagogy, content mastery, attitude change, resources mobilization and management. In this study, the influence of the INSET on teachers' classroom management was assessed by teachers self-reporting the frequency with which they utilized various aspects of classroom management as specified by SMASSE. The teachers' rating of the frequency was based on their long-term assessment and the general teaching and learning environment in the school. In addition, an observation schedule was used to confirm these aspects of classroom

management. The observations were based on the researcher's one day assessment of the aspects of classroom management.

The teachers were requested to rate a series of statements seeking respondent's on the frequency of implementation of various aspects of classroom management learnt from the INSET. Responses to these statements were measured on a three-point likert scale ranging from 1 to 3 (where 1 = not frequent – NF, 2 = frequent - F, and very frequent- VF). The higher the score, the more frequent was that aspect of classroom management implemented by the teacher, and vice versa. For each statement, average mean score was computed so as to assess the general assessment and variation among the respondents. Table 18 highlights the distribution of their responses on the statements.

Table 18:

Frequency of implementation of aspects of classroom management

	Mean	SD
Teacher controls and handles disruptive behaviour well	2.0674	.80901
Teacher sets up scene for the next lesson	1.9213	.80092
Teacher acknowledges learners responses	2.1348	.75665
Teacher assesses students practical work	2.1685	.62588
Mean of means of influence of SMASSE-INSET on biology teachers' classroom management	**2.0730**	**.47703**

N=89

Table 18 indicates that the teachers implemented the aspects of classroom management learnt in the INSET in their classes. They rated all the four aspects of classroom management about 2.07 with mean scores of between $\overline{X}$ = 1.91 and $\overline{X}$ = 2.17. The respondents reported that teachers' frequently assessed students' practical work, acknowledged learners' responses, controlled and handled disruptive behaviour well, and set up scene for next lesson. These findings suggest that the teachers created conducive teaching and learning environments that facilitated effective classroom management. This was likely to motivate the students to actively participate in class during teaching.

The overall influence of SMASSE INSET on classroom management depends on the cumulative interaction and influence of the four aspects of effective classroom management. Therefore, the response to each of the 4 constituent aspects of classroom management were scored on a scale of 1, indicating least frequency, to 3, indicating highest frequency of use in class. The individual statement scores were summed up to form a classroom management index score for each respondent. The index score varied between 4, indicating the least overall influence, and 12, indicating the highest overall influence of SMASSE INSET on classroom management. The higher the score, the more was the influence of the INSET on classroom management implemented by Biology teachers, and vice versa. The index score was later collapsed into three ordinal categories in order to differentiate between the overall levels of influence on classroom management among the respondents. This included a score of 4-6 meaning below average influence, a score of 7-9 indicating average/moderate influence and a score of 10-12 indicating more influence. Table 19 depicts the overall influence of SMASSE INSET on classroom management by Biology teachers.

Table 19:

Influence of SMASSE on classroom management by biology teachers

Influence	*Frequency*	*Percent*
Below average	17	19.1
Average/Moderate	44	49.4
Above average	28	31.5
Total	89	100.0

Table 19 indicates that overall, SMASSE INSET had at least moderate influence on classroom management practiced by Biology teachers in the sampled schools. Out of this, 49.4 percent of the teachers had witnessed moderate influence while 31.5 percent had more influence on their classroom management. This suggests that teachers were frequently practicing and implementing the effective classroom management that they learnt in the SMASSE INSET in the course of their teaching. The frequent use of such procedures was expected to create a good teaching and learning environment that can motivate students to concentrate in class. This would then promote active learning.

The teachers' self-reporting of the influence of SMASSE INSET on classroom management was also confirmed by the researcher using an observation schedule. In the observation, statements were extracted from the four aspects that teachers had self-reported on classroom management. The researcher assessed the level of satisfaction with the extent to which these aspects of classroom management procedures were being practiced by the teachers in class. Responses to these statements were measured on a five-point likert scale ranging from 1 to 5 (where 1 = poor – P, 2 = fair – F, 3 = moderate - M, 4 = good - G and 5 = very good - VG). The higher the score, the more satisfied was the researcher with the use of that particular aspect of classroom management in class, and vice versa. For each statement, average mean score was computed so as to assess the general assessment and variation among the respondents. Table 20 highlights the distribution of their responses on the statements.

Table 20:

Satisfaction with observed aspects of classroom management

	Mean	SD
Distribution of time in the lesson	3.9101	.83449
Class control	4.3820	.71519
Use of students opinion and ideas	3.6742	.83632
Evaluation of lesson by the teacher	3.5114	.89692
Mean of means of classroom management	**3.8596**	**.58382**

N=89

Table 20 shows that teachers were practicing the various aspects of classroom management learnt from SMASSE INSET. It was observed that the teachers were effective in distributing time in the lesson, controlled class, used of student's opinions/ ideas, and evaluated lesson. This confirmed that indeed the teachers were practically adopting effective classroom management.

4.5 SMASSE INSET and Students' Achievement in Biology in KCSE.

The third objective aimed at assessing whether the SMASSE INSET had an impact on students' achievement in biology in KCSE. The objective was premised on the assumption that holding other factors constant, the introduction of SMASSE INSET was aimed at improving academic

performance in Mathematics and Sciences in Secondary schools in the country. Therefore it was expected that classes taught by teachers who underwent SMASSE training were expected to record improved academic performance compared to the case before the INSET.

The study began by assessing the academic performance in Biology in schools taught by teachers with SMASSE training before and after the INSET. Assessment of academic performance in Biology was based on KCSE biology performance in the last four years before the INSET (2000 to 2003) and four years after the INSET (2004 to 2007). KCSE mean scores were used because of standardization. The 30 schools reported the academic performance in mean scores out of a possible 12 points. Table 21 shows the individual school means over the eight year period.

Table 21:

Schools mean scores over the 8 years

	Mean score before SMASSE					Mean score after SMASSE				
SCHOOL	2000	2001	2002	2003	MEAN	2004	2005	2006	2007	MEAN
1	4.588	4.890	4.736	4.479	**4.673**	5.450	4.495	4.826	6.543	**5.329**
2	7.509	8.000	7.397	7.244	**7.538**	8.842	8.572	7.764	8.427	**8.401**
3	6.692	4.638	4.044	4.262	**4.909**	6.248	4.444	7.077	6.989	**6.190**
4	6.639	8.041	7.479	7.122	**7.320**	7.313	7.128	6.895	8.613	**7.487**
5	6.360	8.059	6.258	5.975	**6.663**	9.000	7.718	4.840	7.671	**7.307**
6	5.503	7.659	6.224	6.398	**6.446**	7.731	7.149	4.977	7.699	**6.889**
7	5.124	7.625	7.794	7.944	**7.122**	8.560	6.836	6.352	6.918	**7.167**
8	2.000	2.909	2.460	2.838	**2.552**	3.750	3.575	3.323	2.855	**3.376**
9	4.809	4.177	3.743	3.769	**4.125**	5.129	3.870	3.108	5.517	**4.406**
10	4.806	6.281	5.415	6.409	**5.728**	7.291	6.785	6.711	7.738	**7.131**
11	4.200	5.261	5.911	3.800	**4.793**	7.286	5.640	5.796	4.209	**5.733**
12	3.735	3.939	3.152	4.349	**3.794**	5.642	5.083	3.511	4.400	**4.659**
13	3.667	3.347	2.613	3.355	**3.246**	4.712	4.390	2.912	3.200	**3.804**
14	3.410	4.308	3.648	4.042	**3.852**	4.652	5.333	4.033	3.929	**4.487**
15	2.576	3.419	3.800	3.579	**3.344**	3.850	3.847	3.633	3.639	**3.742**
16	3.213	4.708	3.564	4.362	**3.962**	4.576	4.131	5.132	6.200	**5.010**
17	3.021	4.111	3.394	3.791	**3.579**	5.467	4.490	4.322	4.645	**4.731**
18	3.000	4.119	3.143	3.394	**3.414**	5.148	4.659	3.600	3.491	**4.225**
19	2.426	2.964	2.209	3.286	**2.721**	5.452	5.000	4.133	4.077	**4.666**
20	2.674	4.811	4.314	3.735	**3.884**	5.095	3.246	3.967	3.681	**3.997**

21	4.816	5.461	4.161	4.228	**4.667**	6.659	4.932	5.317	4.329	**5.309**
22	3.000	3.404	2.978	2.914	**3.074**	3.393	2.843	2.756	2.390	**2.846**
23	2.352	2.609	2.826	3.667	**2.864**	4.230	3.121	3.936	3.333	**3.655**
24	2.207	2.429	2.310	3.519	**2.616**	4.083	3.023	2.222	3.762	**3.273**
25	2.936	3.000	4.357	4.061	**3.589**	5.158	4.341	4.318	3.694	**4.378**
26	3.045	4.231	4.094	3.794	**3.791**	4.893	3.889	3.542	3.889	**4.053**
27	3.650	4.564	4.539	2.444	**3.799**	4.674	4.698	5.344	4.879	**4.899**
28	3.205	4.216	3.439	2.284	**3.286**	3.270	4.034	3.460	3.901	**3.666**
29	3.857	3.600	2.419	3.529	**3.351**	6.778	4.069	3.039	3.310	**4.299**
30	2.741	2.532	3.645	3.262	**3.045**	4.395	4.044	3.241	3.822	**3.876**
	3.925	**4.644**	**4.202**	**4.261**	**4.258**	**5.624**	**4.846**	**4.470**	**4.925**	**4.966**

Table 21 shows the trend of the school biology mean scores over the two time periods. The individual schools show that the mean scores were higher in the 4 years after the SMASSE INSET was introduced. Table 22 summarizes the academic performance in Biology before and after SMASSE INSET.

Table 22:

KCSE average means scores in biology before and after the INSET

	Mean score before SMASSE	*Mean score after SMASSE*
N	30	30
Mean	4.2585	4.9650
S D	1.45233	1.44322
Minimum	2.56	2.85
Maximum	7.54	8.40

Tables 21 and 22 indicate that before the introduction of SMASSE INSET, academic achievement in Biology was shown by a mean score of 4.2585, SD =1.45233 with a minimum of 2.56 and a maximum of 7.54. After the introduction of SMASSE INSET, academic achievement in Biology was 4.9650, SD =1.44322 with a minimum of 2.85 and a maximum of 8.40. Comparing with the possible 12 points, the mean scores in the two time periods seems to be below average in the 30 schools. However, there was a wide disparity between the poorest performing schools and highest performing schools in the two occasions.

To establish whether the SMASSE INSET had any statistically significant effect on the students' K.C.S.E Biology performance, the null hypothesis, "There is no statistically significant difference in students' achievement in Biology in KCSE between the period before and after the SMASSE INSET" was tested. To do this, the Pair-wise (related) samples t-test was used to establish whether there was any significant difference in academic performance in Biology in KCSE before and after the introduction of SMASSE INSET. Related sample t-test was used to compare the mean scores in KCSE in Biology in two time periods (before and after the introduction of SMASSE INSET) so as see whether they differed significantly or not. For it to be used, the grouping variable: the two time periods (before and after SMASSE INSET) was a nominal variable, while the test variable, that is, academic performance mean scores was an interval variable measured in the actual scores. Table 23 summarizes the output of the t-test.

Table 23:

Comparison of students' achievement in biology in KCSE before and after SMASSE INSET

Period	*N*	*KCSE mean score*	*S D*	*t-value*	*Df*	*Sig. (2 tailed)*
Before INSET	30	4.2585	1.45233	8.736	29	0.000
After INSET	30	4.9650	1.44322			

Table 23 indicates that the average mean score in Biology after the introduction of SMASSE INSET of $\overline{X} = 4.9650$ was higher compared to that before introduction of SMASSE INSET of $\overline{X} = 4.2585$ in the 30 sampled schools. This suggests that although below the expected average, academic performance in Biology in KCSE after the introduction of SMASSE INSET had improved by 0.70645. This was further supported by a t-test that yielded 8.736. Since p (0.000) < 0.05 significance level, null hypothesis was rejected and concluded that there was a statistically significant difference in students' achievement in biology in KCSE between the period before and after the SMASSE INSET. This was attributed to the positive changes in the practices of the teachers after the application of the ASEI/PDSI principle learnt from SMASSE.

4.6 Discussion

4.6.1 Attitudes of Biology Teachers towards Biology Teaching and the SMASSE INSET.

The results of this study indicate that on the overall, 98.9 percent of the sampled teachers had a positive attitude toward teaching Biology and approaches learnt in the INSET. This suggests that the SMASSE INSET programme had changed the attitude of teachers towards not only their teaching of Biology, but also the approaches learnt. Such teachers were therefore more likely to record higher levels of performance. One of the objectives of SMASSE INSET was that those teachers who participated in the programme were expected to change their attitudes towards learning Biology through the learnt approaches. Such teachers were therefore expected to handle and teach the subject better than they previously did.

These findings are supported by previous studies which had indicated that before the introduction of SMASSE INSET, majority of the teachers had negative attitude in teaching Biology and other science subjects. According to SMASSE (2004a), a SMASSE baseline study found out that many teachers had a negative attitude towards teaching in general and teaching of Biology, Mathematics and other Sciences. They were reluctant to perform experiments, especially in chemistry. SMASSE (2004a), Ballone and Czerniak (2001) add that this negative attitude of the teachers had a strong influence on students' attitude toward the same subjects and ultimate achievement.

According to SMASSE (2004a), the first cycle of the SMASSE INSET was organized to specifically address the issue of teachers' attitude change towards teaching of Biology and other Sciences and towards their students and teaching environment. The findings of this study suggest that the SMASSE INSET programme was useful in changing the attitude of the teachers not only in using student centered approaches, but also in the teaching of Biology and other Sciences. The findings agree with previous studies such as Somers and Sikorova (2002), Mohanty (2002), Harris, Busher and Wise (2001), Jenkins (2000), Hewson (2000), which showed that there is evidence that teachers do change their practices as a result of in-service education and training.

These results were in line with Somers and Sikorova (2002) who observed that there is a link between the impact of an INSET and the quality of training provided. ADEA (2005) added that teachers who go through INSET develop their profession by sharing experiences, mentoring each other, updating their skills and interacting with innovative approaches and practices that create

interest and inspire confidence in the learners. According to JICA (2005), SMASSE project advocates for the use of locally available materials to improvise in case there is shortage of conventional resources. All these improve the teachers' attitudes towards teaching Biology.

4.6.2 Influence of SMASSE INSET on biology teachers' classroom practice.

The results of this study indicate that teachers were practicing and implementing the teaching procedures that they learnt in the SMASSE INSET in the course of their teaching. The frequent use of such procedures was expected to motivate learners to concentrate in class activities. This thus, would then promote active learning. These findings support previous studies such as Muir-leresche and Schull (2006) who contended that teachers who engage learners in active learning encourage them to be proactive and solve problems. This signifies the positive influence of SMASSE since the situation was worse before the introduction of the INSET. According to SMASSE (2004a) baseline study, previously teaching/learning process was predominantly teacher centered. Most lessons were carried out through lecture method, with very little participation by the students other than in note taking and doing assignments.

The results of this study also suggest that teachers were practicing and implementing student-centered teaching methodology that they learnt in the SMASSE INSET in the course of their teaching. Initially, low frequency of experiments was noted with the main reason given by the teachers as lack of facilities (SMASSE, 2004a). The teachers made learners to accumulate a great deal of unrelated facts, skills, formulae, laws, and procedures without any attempt to relate them to their previous knowledge and experiences. They were not given the opportunity to reinforce and apply the concepts learnt during the lessons through practice and consolidation (SMASSE, 2004a). Students therefore had become passive recipients of knowledge with very little or no active involvement. However, according to JICA (2005) the introduction of the SMASSE project changed this and advocated for more of student centered methodology in what is referred to as ASEI movement principle. ASEI is an acronym for Activity, Students, Experiment and Improvisation. In the ASEI movement, the quality of classroom activities is considered critical to achieving effective teaching and learning.

The results of this study have also shown that the SMASSE INSET had a moderate influence on classroom management implemented by Biology teachers in the sampled schools. Teachers were frequently practicing and implementing the effective classroom management that they learnt in the SMASSE INSET in the course of their teaching. The frequent use of such procedures was expected to create effective teaching and learning environment that can motivate students to concentrate in class. This would then promote active learning. These findings suggest that the teachers created conducive teaching and learning environments that facilitated effective classroom management. This was likely to motivate the students to actively participate in class activities.

These findings agree with other studies such as Berliner (1988) and Brophy & Good (1986) which show that the time that the teacher has to take to correct misbehavior caused by poor classroom management skills results in a lower rate of academic engagement in the classroom. Effective classroom management involves clear communication of behavioral and academic expectations, as well as a cooperative learning environment. The teacher should therefore be involved in classroom management. Classroom management practices are used by teachers to ensure that classroom lessons run smoothly despite disruptive behavior by students. The goal of classroom management is to maintain order and also optimize student learning (Kauchak & Eggen, 2008).

4.6.3 Impact of SMASSE INSET on students achievement in biology

The results of this study have shown that there was a statistically significant difference in students' achievement in biology in KCSE between the period before and after the SMASSE INSET. The academic performance in Biology in KCSE after the introduction of SMASSE INSET had improved by a mean score index of 0.70645. This difference though minimal was significant. Holding all other factors constant, like school resources and students' characteristics, the improvement may be attributed to the positive changes in the practices of the teachers after the application of the ASEI/PDSI principle learnt from SMASSE.

These findings support previous studies such as those of Donoughe (1981) which indicated that INSET leads to changes in practices which benefits students in terms of academic achievement

in the targeted subjects. Hopkins (1986) attributes this to improved teaching and learning. SMASSE (2004*a*) observed that the introduction of ASEI/PDSI had upgraded various aspects of teaching and learning which in turn improve academic performance in the targeted subjects. The approaches learnt at SMASSE INSET encouraged the Biology teachers to promote active learning. Muir-leresche and Schull (2006) summed up that active learning encourages students to be proactive and solve problems. The students read, write, discuss, critique, question, practice and act out or predict outcomes. Most important students engage in such high-order thinking tasks as analysis, synthesis and evaluation. Therefore strategies promoting active learning are instructional activities involving students in doing things and thinking about what they are doing. This ultimately improves their performance.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the major findings, conclusions, implications and recommendations drawn from the conclusions. The study sought to evaluate the influence of SMASSE Programme on Biology teachers' classroom practice, attitudes and students' achievement in Nyandarua County Secondary Schools, Kenya.

Both primary and secondary data were used to study and understand SMASSE INSET programme and its impact on teaching and learning. Primary data was collected using three sets of instruments including a questionnaire (BTQ) and an observation schedule (BLOS) and KCSE performance schedule. A sample of 89 Biology teachers trained in the SMASSE INSET was drawn from 110 secondary schools. Secondary data was collected from documented information about SMASSE INSET programme from the study area, country and elsewhere. The collected data were analyzed using descriptive and inferential statistics with the aid of SPSS version 17.0 for Windows.

5.2 Summary of the Findings

Based on the results of this study, the following major research findings are presented:

(i) The sampled teachers had a positive attitude toward teaching Biology and approaches learnt in the INSET.

(ii) SMASSE INSET has had an influence on classroom practices used by biology teachers in the sampled schools.

(iii) There was a statistically significant difference in students' achievement in biology in KCSE between the period before and after the SMASSE INSET.

5.3 Conclusions

This study is considered useful in analyzing the influence of SMASSE INSET on biology teachers' classroom practices, attitudes and students performance in biology. Based on the summary findings, the study concludes that:

(i) The SMASSE INSET programme has positively influenced the attitude of teachers towards not only their teaching of Biology, but also the approaches learnt.

(ii) The use of ASEI/PDSI approach in teaching biology as learnt in the INSET had a positive influence on teachers' classroom practices. They are practicing and implementing the practices that they learnt in the SMASSE INSET in the course of their teaching. This has changed the teaching and learning environment in the schools and ultimately students' performance in Biology.

(iii) The SMASSE INSET programme has had a marked and positive impact on the students' achievement in biology in KCSE. This was attributed to the positive changes in the practices of the teachers after the application of the ASEI/PDSI approach learnt at the INSET.

5.4 Implications

The study established a positive influence of SMASSE INSET Programme on Biology teachers' classroom practice, attitudes and students' achievement in Nyandarua county Secondary Schools, Kenya. The positive impact would in turn influence the attitudes, interests and performance of students in Biology, mathematics and other science subjects. This implies that exposing biology teachers to SMASSE INSET is a good practice since it influenced positively teachers' attitude towards biology teaching and the INSET. The concerned agencies including school management, science teachers, and students could use such information to come up with long-lasting strategies in enhancing attitudes and performance in biology and other science subjects.

The findings of this study have also indicated that biology teachers' attendance of the SMASSE INSET has influenced positively their classroom teaching practices. The teachers observed were using the ASEI/PDSI approach of teaching in their biology lessons as learnt at the INSET. This in turn improved the students' achievement in biology in KCSE. This implies that the use of ASEI/PDSI approach is a good practice and should be used in biology teaching and in other science subjects at secondary schools level. Since the use of ASEI/PDSI approach of teaching improved the students' performance, the Education authorities in their effort to make biology teachers more effective should encourage the use of this strategy. In addition, the teacher training

institutions should incorporate ASEI/PDSI teaching strategy in their training curriculum in order to produce effective teachers in biology and other science subjects.

Finally, this study established that the SMASSE INSET improved the students' achievement in biology in KCSE. This implies that the SMASSE INSET is a good programme since it had a positive impact on students' achievement in biology in KCSE. Efforts should be made to ensure that what was learnt in the INSET is implemented. Finally, the teacher educators and SMASSE INSETs organizers should evaluate their courses and identify other effective teaching methodologies in teaching and learning of biology.

5.5 Recommendations

In view of the above conclusions, this study makes the following recommendations:

(i) Biology teachers' educators which include teacher training colleges and universities should incorporate ASEI–PDSI approach in their teaching.

(ii) The ASEI-PDSI approach should be mainstreamed in science teacher education programmes.

(iii) Mechanisms should be put in place in all schools by the Ministry of Education to strengthen the SMASSE INSET.

(iv) The capacity of SMASSE programme in teacher training should be enhanced for continuity of quality in-service education and training of science teachers.

5.5.1 Suggestions for Further Research

The educational issues such as poor attitudes, lack of interest and academic performance in Biology, Mathematics and other science subjects has attracted a lot of interest and attention from stakeholders. The following areas of research were found wanting although the scope of this study could not accommodate them:

(i) A study should be carried out to determine the learners attitude towards biology learning

(ii) Research should be carried out to determine the attitude of school principals towards the SMASSE INSET and the teaching of biology.

(iii) Research should be carried out to assess the challenges encountered by the biology teachers in the course of teaching using the approaches learnt at the SMASSE INSET.

(iv) A study should be carried out to determine the role of the education administration and quality assurance officers in the implementation and adoption of the principles, skills and knowledge of SMASSE INSET programme.

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APPENDICES

APPENDIX A. BIOLOGY TEACHER'S QUESTIONNAIRE (BTQ)

Dear respondent,

The following questionnaire is meant to elicit data on a research entitled **Influence of SMASSE In-service Education and training of Biology Teachers**. Due to your position and duty as a Biology teacher who has undergone the in-service training, you have been chosen to participate in this study. You are assured that the information you shall give will be treated with confidentiality, and it shall not be used for any other purpose other than the academic use for which it is intended. Please give honest information as required.

Thank you very much for your co-operation.

.SECTION ONE – BACKGROUND INFORMATION

(Please tick where appropriate).

1. In which of the following districts does your school fall?

   Nyandarua North [✓] Nyandarua South [ ]

2. Category of your school

   Provincial [ ] District [✓]

3. Gender

   Male [ ] Female [✓]

4. What is your professional training?

   B. Ed. [ ] Post Graduate Dip. in Ed. [✓] Diploma [ ] Others (specify)……

5. For how many years have you taught Biology?

   3 - 6 [ ] 7 -10 [✓] 11 -14 [ ] 15 and above [ ]

6. What is your total teaching load in lessons per week?

   12- 15 [ ] 16 – 19 [ ] 20 – 23 [ ] 24– 27 [ ] 28 and above [ ]

7. When teaching Biology, estimate the percentage of time you spend on the following:

(a) Demonstration _____

(b) Pupils desk experiments _____

(c) Theory work _____

SECTION TWO: PERCEPTION OF THE INFLUENCE OF SMASSE ON CLASSROOM PRACTICE:

Below are activities the Biology teachers engage their classes in while delivering ASEI-PDSI lesson. Please indicate how frequent you use each of them on a scale of 1-3.

3 - Very frequent

2- Frequent

1 - Not frequent

	1	2	3
8. Learners interact with equipment as lessons progress	☐	☐	☐
9. Teacher controls and handles disruptive behaviour well	☐	☐	☐
10. Teacher talks and ask learners questions	☐	☐	☐
11. Teacher makes use of a wide range of teaching resources in lesson presentation.	☐	☐	☐
12. Teacher uses improvised and locally available materials	☐	☐	☐
13. Teacher offers learners opportunity to enjoy the scientific process	☐	☐	☐
14. Teacher motivates learners	☐	☐	☐

15. Teacher guides learners in carrying out practical activities.			
16. Teacher caters for different abilities of the learners			
17. Teacher involves students actively in practical work			
18. Teacher concludes lesson by summarizing the main points			
19. Teacher sets up scene for next lesson			
20. Teacher acknowledges learners responses			
21. Teacher assesses students practical work			

SECTION THREE: ATTITUDES TOWARDS BIOLOGY TEACHING AND THE APPROACHES LEARNT AT THE INSET

The following statement relate to opinions towards Biology teaching and the SMASSE INSET. Please indicate the extent of your agreement or disagreement with each statement by ticking one of the five choices per each item that reflects your opinion.

SA- Strongly Agree; **A**- Agree; **U**- Undecided; **D**-Disagree; **SD**- Strongly Disagree.

		SA	A	U	D	SD
22	Teaching Biology is interesting.					
23	Biology Teaching should develop learners' critical thinking ability.					
24	The In-service training for Biology teachers is justified.					
25	A lot of teaching and learning resources are required for Biology teaching in Kenyan Schools.					
26	Biology teaching demands considerable knowledge in ones area of teaching.					
27	An effective Biology teacher should have a favourable attitude towards Biology teaching.					
28	Biology teaching is a promising career.					
29	A Biology teacher needs to keep up with modern methods of teaching students.					
30	Teaching of Biology should create interest in careers based on biological sciences.					
31	I feel proud being a Biology teacher					
32	Biology contributes much to nation building.					

33	A Biology teacher should link his/her teaching with the students' immediate environment.					
34	A Biology teacher profession should be for both male and female teachers					
35	There is much link between SMASSE INSET teaching methods and teaching needs in real classrooms					
36	To keep up with treads in the teaching profession a teacher should take a refresher course					
37	Biology teaching does not deal with static information					
38	Learners in Biology perform practical work hence develop various skills.					

APPENDIX B: BIOLOGY LESSON OBSERVATION SCHEDULE (BLOS)

SCHOOL .....

LESSON TOPIC .....

CLASS ..... NUMBER OF STUDENTS.....

Indicate the assessment of the following aspects of the lesson by placing a tick in the appropriate box on the rating scale 5 to 1.

Rating scale: **5** -Very good; **4**-Good; **3** - Satisfactory; **2**-Fair**; 1**- Poor

		Rating scale				
		5	**4**	**3**	**2**	**1**
I	**Teaching procedure**					
1.	Clarity and feasibility of lesson objectives					
2.	Appropriate introduction which is stimulating and helps learners to focus on the content of the lesson.					
3.	Appropriate content					
4.	Encourages all students to participate					
5.	Language – clear and unambiguous instruction					
6.	Emphasis on main concept					
7.	Lesson summary/captures main points covered					
8.	Achievement of set objectives					
II	**Fundamental Technique / methodology**					
9.	Students involvement through questioning and discussion					
10.	Students involvement in Hands –on/minds-on activities					
11.	Appropriateness of demonstrations, teaching aids and improvised materials					
12	Appropriateness of teacher's attitude and expression					

III	**Management**					
13.	Distribution of time in the lesson					
14.	Class control					
15.	Use of student's opinions/ ideas					
16.	Evaluation of lesson by the teacher					

APPENDIX C: SCHOOLS BIOLOGY KCSE PERFORMANCE

SCHOOL CODE: _____

SCHOOL CATEGORY: Provincial ☐ District ☐

YEARS	NO. OF CANDIDATES	BIOLOGY K.C.S.E RESULTS	
		MEAN SCORE	MEAN GRADE
2000			
2001			
2002			
2003			
2004			
2005			
2006			
2007			

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Date: **4th February 2011**

Peter Ngure Macharia
Egerton University
P. O. Box 536 - 20115
EGERTON

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Impact pf SMASSE programme on Biology teachers' classroom practice, attitudes and students' achievement in Nyandarua Districts secondary schools, Kenya"*** I am pleased to inform you that you have been authorized to undertake research **in Nyandarua District** for a period ending ***30th June 2011.***

You are advised to report to **the District Commissioner and the District Education Officer, Nyandarua District** before embarking on the research project.

On completion of the research, you are expected to submit **one hard copy and one soft copy** of the research report/thesis to our office.

P. N. NYAKUNDI
FOR: SECRETARY/CEO

Copy to:

The District Commissioner
Nyandarua District

The District Education Officer
Nyandarua District