TEACHING AND LEARNING BIOLOGY BY SMASSE PROJECT AMONG SECONDARY SCHOOLS IN MBEERE SOUTH DISTRICT, EMBU COUNTY, KENYA.

BY:

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A RESEARCH PROJECT REPORT SUBMITTED TO THE SCHOOL OF EDUCATION IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTERS OF EDUCATION IN THE DEPARTMENT OF EDUCATIONAL MANAGEMENT, POLICY AND CURRICULUM STUDIES, KENYATTA UNIVERSITY.

JUNE 2012
DECLARATION

This is my original work and has not been presented for any of the study programme in any university.

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This research project report is dedicated to the Creator, the Almighty God, who gave me the physical and mental strength to undertake and accomplish it in the prescribed period of time.
ACKNOWLEDGEMENTS

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GOD BLESS YOU ALL

THANK YOU
ABSTRACT

The Dakar conference of 2000 was concerned with the quality of education and emphasized education for all by 2015 since the UN had declared education a human right. With the increased demand for in-service education and training, SMASSE project was launched in 1998 as a joint technical co-operation between the Government of Kenya through the Ministry of Education and Japan through JICA. Despite the enormous resources geared towards in-servicing of Biology teachers to apply the ASEI / PDSI concept i.e. Activity, Student, Experiment, Improvise / Plan, Do, See, Improve in the teaching and learning of Biology, very little is known about the challenges of teaching and learning of Biology by SMASSE project in Mbeere South District with the view of enhancing its implementation in the classroom. The key objectives governing this study were to find out the extent to which ASEI/PDSI concept was understood by the teachers with reference to the teaching of Biology, to find out how the ASEI/ PDSI approach to the teaching of Biology was being implemented in the classroom setting, to assess students' attitude towards Biology, to find out the availability of the resources and physical facilities present in the school that aided in the teaching and learning of Biology by SMASSE project and to determine the interest of the learners towards doing Biology practicals in the laboratory by themselves. The study was guided by Piaget's theory of cognitive development and Bruner's theory of learning experiences. The study utilized random sampling for students, purposive sampling for schools and non-random sampling of convenience for the teachers all under descriptive survey design. The study was conducted in secondary schools, form 4 level in Mbeere South District, Embu County, Kenya. The total population of schools in this district was 37 with 38 Biology teachers who had been trained in SMASSE and a total population of 1364 students in form 4. The sample size constituted 4 schools, 4 teachers who are SMASSE trained and 136 students both girls and boys whose teachers were SMASSE trained. The research instruments included teachers' questionnaires, students' questionnaires and researcher's observation guideline which was used by the researcher to collect data by observing the physical resources in the schools under study that aided in the teaching and learning of Biology by SMASSE project. The questionnaires were piloted in a secondary school not in the sample to establish their reliability. The validity of the tools was established by members of the supervisory group to this study. Authority was sought from the Ministry of Education and the Principals of the sample school to allow the researcher to collect data on different days in each school. Qualitative data collected was converted into Quantative data and analyzed through the Statistical Package for Social Sciences in form of tables of frequencies and percentages. It was expected that the study would contribute to knowledge regarding improvement of teaching and learning Biology by SMASSE project in the secondary schools in Mbeere South District, Embu County, Kenya. The findings of the study indicated that, there was partial implementation of the ASEI/ PDSI principles. The students' attitude Biology varied within different individuals and their performance in class was average. Their participation in practicals was above average. The availability and reliability of resources and physical facilities greatly influenced the pedagogy. The major challenges affecting the teaching and learning of Biology through the SMASSE approach was inadequate time, large classes, negative
attitude towards Science, unequipped laboratories, unqualified lab technicians, inadequate funds to buy learning resources, high workload and pressure to cover the syllabi. The researcher recommended follow up of SMASSE activities by quality assurance and standards officers, incorporating laboratory technicians in SMASSE programs, improvisation where resources are not available, motivation of teachers, training Head teachers on SMASSE principles and finally introducing SMASSE approach into primary schools in the county under study.
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ABBREVIATIONS AND ACRONYMS

AIDS: Acquired Immuno Deficiency Syndrome

ASEI: Activity, Student, Experiment, Improvisation

CEMASTEA: Center for Mathematics, Science and Technology Education in Africa

HIV: Human Immunodeficiency Virus

HOTS: High Order Thinking Skills

ICT: Information Communication Technology

INSET: In-service Education and Training

IT: Information Technology

JICA: Japan International Cooperation Agency

KCSE: Kenya Certificate Secondary Education

KNEC: Kenya National Examination Council

KSTC: Kenya Science Teachers College

MoEST: Ministry Of Education, Science and Technology

M/S: Mathematics and Sciences

PDM: Project Design Matrix

PDSI: Plan, Do, See, Improve

SACMEQ: South African Consortium for Monitoring Education Quality

SMASSE: Strengthening of Mathematics and Sciences in Secondary Education

SPIAS: SMASSE Project Impact Assessment Survey.

T/L: Teaching & Learning
WECSA: Western, Eastern, Central and South Africa.
1.1 Introduction

This chapter presents the Background to the Study, Statement of the Problem, Purpose of the Study, Objectives, Research Questions, Assumptions, Limitations, Delimitations, Significance of the Study, Theoretical Framework, Conceptual Framework and Operational Definitions of Central Terms.

1.2 Background to the Study

The Dakar conference of 2000 advocated for education for all to be achieved by 2015. This would greatly contribute to realizing the dream of many African developing countries to be industrialized by 2030 and Kenya is no exception. However looking at the KCSE performance of Mathematics and science subjects at secondary school level in Kenya, the vision to be industrialized is in doubt because the performance of students in these subjects has been very poor. The Daily Nation (4/3/10) indicates that Biology is one of the subjects with the highest number of candidates at 299,302 and had a lowly mean mark of 27.20 percent in the KCSE in year 2009.

Improving the performance in science is a great societal need in Kenya as it produces quality scientists, agriculturists, engineers, teachers among others. Due to continued poor performance of the science subjects in the past which could have been caused by students negative attitude, the type of the National curriculum, readability of the kind of textbooks used and the kind of pedagogy approaches employed by the science teachers, the Kenya government in collaboration with the government of Japan through Japan International Co-operation Agency started a project known as SMASSE – Strengthening Mathematics and Science in Secondary Education. According to Mwangi
(2004) the overall Goal of SMASSE was: To contribute towards upgrading the capacity of young Kenyans in the field of mathematics and science. The main purpose of SMASSE was to strengthen the quality of mathematics and science education mainly Physics, Chemistry and Biology at secondary schools in Kenya through in-service training of serving teachers.

Mwangi (2004) Indicates that the project was officially launched on February 27th 1998. Offices were set up at the Ministry of Education Headquarters and at K.S.T.C. The phase 1 of SMASSE project was started in July 1998 and piloted in nine Districts namely Kisii, Gucha, Butere-Mumias, Kakamega, Lugari, Makuene, Maragua, Murang’a and Kajiando districts. Piloting was extended to 6 other districts in 2001 after mid term evaluation of the project. These were Meru South, Kilifi, Taita –Taveta, Baringo, Kiambu and Garissa. The project was sponsored jointly by MoEST and JICA.

Upon the end of phase I in May 2003, phase II was launched to cover the whole country. The main aim of the second phase was to enhance the capacity of District INSET centres and ultimately developing them into Science Resource Centres. For a teacher to be fully in- serviced, SMASSE came up with four cycles. However additional INSETS at all levels have been proposed to meet emerging issues after JICA withdraws with the completion of the 4 cycles it introduced. Generally the government of Kenya contributed 45% and JICA 55% to the SMASSE project expenditure. SMASSE project had three main sources of funds which included JICA, MoEST and the District Heads’ Associations.

Funds from JICA catered for the Kenyan counterparts training in Japan, secondment of long term and short term experts to SMASSE, provision of training materials and science equipment at National and district levels. At National level currently at CEMASTEA senior teachers from districts were trained (16 per district – 4 per subject) and became trainers. At district level the trainers
carried out INSET activities to train the trainees at a residential centre. Finally, it catered for local expenses for Japanese experts. The Ministry of Education, Science and Technology by then provided funds that catered for salaries for Kenyan counterparts attached to the project, travel and subsistence allowances for Kenyan counterparts outside Nairobi, training materials for INSETS, accommodation and meals for the National INSETS, assistance to district SMASSE account and provision of office for the National INSET unit. The heads’ association in the districts, through DEB’s authority raised funds towards the project’s activities. These funds were directed towards accommodation for trainers and trainees at district level.

So far in Mbeere District trainers have conducted INSET cycles since 2004 when cycle 1 was started and completed the 4th cycle in year 2007. There after another INSET was conducted in year 2009 as a result of immerging issues with respect to the fact that most newly employed teachers and those on study leave between 2004 and 2007 had not been in serviced in all the 4 cycles. The INSET cycle 1 in April 2004 focused mainly on attaining positive attitude in learners and teachers.

Mwangi (2004) indicates negative attitude as one of the key Baseline findings of 1998 survey as the main contributing factor to the poor performance in mathematics and sciences.

The INSET sessions in cycle 1 were therefore used to enlighten participants on issues that strongly influence how they perceive and conduct their teaching activities. The topics covered included, INSET Objective and Guideline for participants where 90% attendance was the benchmark for certification, Report on Baseline Studies, Attitude towards mathematics and sciences, ASEI Movement, PDSI Approach, Teaching approaches and methods in Mathematics and Science, Adolescents psychology, Stress and stress management, Work planning in Biology topics which
included Classification, Ecology, Cell Structure and Cell Physiology, Student Centered Approach and finally Gender Issues. In addition, the four individual subject departments covered areas which pose challenges to both learners and teachers so as to create positive attitude towards mathematics and science. The focus was more on theoretical pedagogical issues in mathematics and science education.

According to Arunga (2007) the cycle 2 conducted in April 2005 had a practical/activity oriented approach. The hands–on activities that can enhance effective classroom practices in different topics were handled in different subjects. These activities were designed to provide participants with opportunities for ‘doing’ as opposed to ‘being told’. Theory work was translated into practice through actual performance of suitable experiment/practical work using ASEI lesson planning and peer teaching. Most of the hands-on activities and improvisation carried out were simple enough to be carried out in the classroom i.e. implemented in the classroom situation. The main emphasis was practical approach to teaching rather than the traditional theoretical approach. The main topics covered in cycle 2 included SMASSE Management, SMASSE PDM i.e. Project Design Matrix, ASEI/PDSI Instrumental Design, Team building, Resource utilization for effective teaching and learning of Mathematics and Science, Practical work for effective T/L of M/S, Peer Teaching in various INSET individual disciplines/subjects in the topics of Excretion and Homeostasis, Stimulus and Response and Respiration in Biology and Preparation of common laboratory reagents.

According to SMASSE (2004) the 3rd cycle of the SMASSE INSET in April 2006 focused on INSET VALUES acquired in cycles 1 and 2 into effective classroom practices. The participants were provided with an opportunity to implement ASEI/PDSI paradigm. The process is known as
Actualization of ASEI. Actualization in cycle 3 gave the participants an opportunity to plan together an ASEI lesson and observe its implementation in the actual classroom situation, then together discuss the lesson taught and critique so that they can teach the improved lesson hopefully better than the previous one. This removes the artificiality of peer teaching, experiences of ASEI/PDSI in a real classroom situation and in so doing promoting team teaching among teachers.

The main topics covered in cycle 3 included, Teaching and activities for subject specific topics of which the topics covered in Biology were Support and Movement, Genetics and Evolution, Actualization of ASEI/PDSI, Summative Assessment and Evaluation in Biology, Resources and Facilities which were also covered in cycles 1 & 2 included for further expanding the capacity and experiences of trainers and trainees in resource mobilization, utilization and improvisation for teaching and learning of Biology. In Mbeere Actualization of cycle 3 was done in Nyangwa Boys, Gategi Girls and Kanyuambora Secondary Schools in May 2006.

The 4th cycle in April 2007, focused entirely on enhancing and sustaining ASEI/PDSI. SMASSE project had so for enabled the realization of institutionalized regular INSET system. It was hoped that the system would be maintained in the districts because the performance of mathematics and sciences was and is still a challenge. However the evaluation of SMASSE project 2007 revealed some improved attitude in most subjects. So the key objectives of cycle 4 were first to enhance and sustain ASEI/PDSI, secondly to reinforce the practice of ASEI/PDSI in topic areas of concern in each of the subjects, thirdly to provide classroom opportunities for further practice of ASEI/PDSI in lesson actualization and lastly the Implementation of ASEI/PDSI and development of H.O.T.S – High Order Thinking Skills.
The topics covered in cycle 4 included, Teaching and activities for subject specific topics of which the topics were covered included Growth and Development, Transport in plants & animals, Nutrition in plants and Animals, The Resources of High Order Thinking Skills in Biology, Actualization of ASEI and Concept Mapping in Biology. The Actualization of ASEI was conducted in Karaba, Mayori and Karangare Secondary Schools in May 2007.

The 5th cycle in August 2009 in Mbeere district was organized by the district trainers to help in the implementation of the Biology SMASSE INSET curriculum. The topics selected were in line with the cycle theme and designed to help participants to sustain and practice the principles of ASEI/PDSI after JICA withdrew after completing the 4 cycles. Some topics covered included emerging issues not incorporated in the first four cycles for example Difficult Terminologies in Biology, Emerging issues in Testing at the National examinations like inclusion of photographs in Biology paper three, Stress and stress management in relation to emerging issues, ICT Integration in education for Development, SPIAS 2003-2008 in Mbeere district and Communication skills. Currently, CEMASTEA has brought primary education on board and is developing lessons in ICT integration in Mathematics and Science education.

However very little is known on the challenges of teaching and learning by SMASSE project of Mathematics and Sciences hence the need to research on the same in the teaching and learning of Biology in the Secondary Schools in Mbeere South District, Embu County.

1.3 Statement of the Problem
Despite the fact that the Ministry of Education in Kenya in collaboration with the Japan International Co-operation Agency having invested a lot in terms of financial and material resources to in-service Biology teachers throughout the four official cycles by applying the ASEI/PDSI in-service programs to strengthen the teaching and learning of Mathematics and Sciences in our Secondary Schools and Actualizing that approach, very little is known about the challenges teachers and learners face in the implementation of the SMASSE project in the classrooms. It is for this reason that the researcher wanted to determine challenges of teaching and learning Biology as suggested by SMASSE project among secondary schools in Mbeere South District, Embu County.

1.4 Purpose of the Study

The purpose of the study was therefore to analyze the challenges of teaching and learning of Biology by SMASSE project approach in secondary schools in Mbeere South district with the view of enhancing its implementation in the classroom.

1.5 Objectives of the Study

The objectives of the study were:-
1. To find out the extent to which ASEI/PDSI concept was understood by teachers with reference to the teaching of Biology.

2. To find out how the ASEI/PDSI approach to the teaching of Biology was being implemented in the classroom setting.

3. To identify students’ attitude towards Biology.

4. To find out the availability and reliability of the resources and physical facilities present in the school that aided in the teaching and learning of Biology.

5. To determine the interest of the learners towards performing Biology practical in the laboratory by themselves.

1.6 Research Questions

1. Do the Biology teachers understand the meaning of ASEI/PDSI concept?

2. How do teachers involve their students in practical activities using improvised materials and do they improve their practical lessons so as to improve in the subsequent lessons?

3. Do students like Biology as compared to other subjects in the school and how do they perform in both theoretical and practical work in Biology?

4. How does the availability of the resources and physical facilities in the school contribute to the learners’ performance in Biology?

5. Are students motivated to learn Biology by performing Biology tasks on their own like doing assignments or doing Biology practical without being coerced by the teacher?

1.7 Assumptions
The study assumed that all the schools were on session throughout the 14 weeks in the term and covered same syllabi, that all the Biology teachers had successfully undergone the four SMASSE INSETS, that the National and District trainers were competent in the delivery of INSET content, that the conventional learning materials and resources were available and if not, materials for improvisation were within reach, that all respondents were co-operative and provided reliable responses, there was prompt syllabus coverage by the time the students sit for their termly examinations, that the teachers under study had been teaching the students in the study from form one, and that the responses given by the respondents were true and free from external influences.

1.8 Limitations

The study limited itself to only one District, Mbeere South District. For a more conclusive result, all the Districts in Kenya would have been studied. However this was not possible due to financial constraints as Kenyatta University College does not offer any funds for projects in this kind of course work. Time factor limited the fine-tuning of the study as the researcher had other responsibilities at work place. Poor infrastructure hindered access to most rural schools. Lastly it would be illogical to collect data in all the schools in the country.

1.9 Delimitations

The study further limited itself to sampled schools in the district since it’s a hardship area with poor infrastructure to most of the schools found there. Although all the Science and
Mathematics teachers attended the SMASSE INSETS, the study confined itself to Biology because that is the area of specialization of the researcher. Although all students are supposed to be taught using the SMASSE project approach guideline, only a few students were sampled out of the total population due to the high unmanageable total population figures per school.

1.10 Significance

The research findings provided the necessary feedback to the Mbeere South District Planning Committee which is the major sponsor of the District SMASSE INSETS with a view of improving it for example extending similar INSETS to other subjects since the results highlighted the major challenges teachers and learners face in implementing SMASSE and also the necessary recommendations. The District Planning Committee also obtained a feedback on whether the objectives of SMASSE project were being realized in the Secondary Schools in Mbeere South District. The findings were also of great significance to the District trainers who were involved in imparting new pedagogical approaches to their trainees. The findings enabled teachers in Mbeere South District to act with confidence on the implementation of the ASEI/PDSI approach. Finally, the study also provoked discussion and encouraged further research by other scholars and students interested in pedagogical issues in teacher education and project evaluation.

1.11 Theoretical Framework

The study was based on Piaget’s Theory of Intellectual Development which states that a child does not receive information passively and thoughts are not simply the products of direct teaching or by
imitation of others. Neither is cognitive progress seen as primarily a product of maturation of the brain. Knowledge is acquired and thinking processes become more complex and efficient as a consequence of the maturing child’s interactions with the world. Piaget’s central thesis is that the individual is active, curious and inventive throughout the life cycle. A person constructs concepts from the experiences the person gains. This conforms with the basis of activity approach to teaching in SMASSE where students are exposed to various Biological practical or ‘hands-on’ activities to actively learn from those experiences.

According to Piaget’s Theory of cognitive development, a child’s cognitive development is influenced by the environment as well as the cognitive structure the child has accumulated from the past experiences which will influence the way the child perceives reality. For this reason the entry behavior of the student is very crucial when the teacher is planning for a lesson. This is because the teacher should take into consideration that some learners are high achievers, others are middle achievers while others are low achievers although every child at least must have some prior knowledge about a certain topic or subtopic to be taught.

Bruner (1986) postulates that the teacher should build on the past experiences of the learner and assist him to inco-operate the new experiences. The learner selects and transforms information, constructs hypotheses and makes decisions relying on a cognitive structure which provides meaning and organization to experiences and allows the individual to go beyond the information given. This idea is in line with ASEI/PDSI approach proposed by SMASSE project in the teaching and learning of Sciences and Mathematics, which is based on the fact that students construct their own meaning from the Science world. The learners must be given an opportunity to construct scientific
knowledge through the interaction of their practical observation, prior knowledge they have and their mental ability. The ASEI principle of SMASSE project advocates for activity filled learning environment, where the learner’s interest, understanding and retention of knowledge is enhanced. This is in line with Piaget’s Theory of Intellectual development, which posits that knowledge is not passively acquired but is discovered and constructed by the child’s activities.

According to Ireri (2004), the proponents of the ASEI idea suggest that learning especially in Biology, which is a science, should be learner centred with learners being actively involved in the learning process. The teacher corrects any misconceptions and inadequacies the learner may have in their mental perceptions on scientific knowledge. Therefore, this study was guided by the two theories developed by Jean Piaget and Bruner in order to analyze the challenges facing teachers and learners on the teaching and learning of Biology by SMASSE project approach in secondary schools in Mbeere South District. The research evaluated how teachers and students were challenged by the ASEI/PDSI approach as advocated by SMASSE INSETS

1.12 Conceptual Framework

Fig 1.1 shows a conceptual framework on the interaction of physical facilities and human resources and their output.

<table>
<thead>
<tr>
<th>Physical facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate laboratories</td>
</tr>
<tr>
<td>Adequate lab equipments</td>
</tr>
<tr>
<td>Adequate lab chemicals</td>
</tr>
<tr>
<td>Improvised equipments</td>
</tr>
<tr>
<td>ASEI lesson plan</td>
</tr>
<tr>
<td>PDSI concept</td>
</tr>
<tr>
<td>Adequate time</td>
</tr>
</tbody>
</table>
Human Resources
- Intrinsically motivated learners
- Curious learners
- Inquisitive learners
- Competent teachers
- Motivated teachers
- Team working teachers
- Innovative teachers

Input
- Planning
- Improvisation
- Discussions
- Demonstrations
- Drawings
- Modelling

Output
- Better performing students
- Demystified science
- Developed positive attitude
- Interesting learning
- Improved performance
- Confidence in teachers

Input Diagram:
- Human Resources

Output Diagram:
- Input
- Better performing students
- Demystified science
- Developed positive attitude
- Interesting learning
- Improved performance
- Confidence in teachers
Better physical facilities enhance delivery of content to learners and when coupled with motivated teachers and learners the output is positive. Lack of such facilities poses a lot of challenges to the teaching and learning of Biology in the secondary schools all over the country.

According to Ireri (2004) ASEI is an acronym for Activity, Student –Centred, Experiment, and Improvisation which is an initiative whose focus is to assist teachers reflect on their strategies and acquire skills for effective teaching and efficient learning to occur. It’s an approach in a classroom setting that advocates for actively engaging the learners in the construction of knowledge. The learners may engage in hands-on activities which involves psychomotor i.e. manipulation skills, minds-on activities which entails cognitive i.e. intellectual thinking and reasoning, hearts-on entailing the affective aspects i.e. those that stir up the learner’s interest/feelings about the subject and mouths-on which involves communicative skills i.e. discussions. All these activities should be student’s centered to increase participation of the learner. They should be carefully selected, sequenced and directed to provide meaningful experiences to the learner.

Carefully thought out practical activities assist the learners to hypothesize, make conjectures, discover, verify and validate laws and reinforce new concepts or ideas thereby developing the scientific and mathematical cultures. This ensures the development of a stable body of knowledge in the learners. In performing experiments, the movement advocates for inco-operating improvisation which is important where conventional equipment/apparatus or chemicals/materials are not available or in order to perform scaled down experiments. ASEI also advocates for integration of practical work with theory lessons by providing a bridge to enhance learning. Improvisation also
creates awareness in the teacher of the unlimited opportunities that exist in seeking and using locally available resources.

According to Njagi (2004) PDSI is a cyclic approach that carries the ASEI movement and involves planning which requires taking time to come up with appropriate activities that will enhance effective learning using the resources available. The requirements of an ASEI lesson plan are pupils’ previous knowledge, number of students and class organization, facilities and resources available, time available, students’ activities and each student’s involvement in the lesson, lesson assignment and lesson evaluation by both the teacher and the learner.

The doing part is shared between the teacher and the learner’s where the teacher’s role is facilitation and not dispenser of knowledge. The learner is supposed to actively participate in the learning activities. The teacher should be innovative to captivate the learners for example telling a relevant story, linking learners’ previous experiences. The learner should be able to link between the activity and concept being taught.

The seeing deals with seeing how effective the activity was and whether it happened as planned. This encourages the teacher to include a feedback mechanism in his/her lessons and teaching functions. It involves evaluation of the lesson which is key to improvement of lesson delivery students’ answers to questions, explanation of concepts, ability to follow procedures and get results. Improvement is done by incorporating information obtained from feedback during and after lessons. This is a continuous activity which ensures that the teacher’s skills improve and confidence
increases as the instructional programmes are enriched. Effective teaching requires one to continually seek to improve, reflect on and refine instructional practice. This is only possible if one adopts the ASEI/PDSI approach in teaching. This approach promotes effective teaching practices and efficient learning. Its impact on the learners may include, acquisition of positive attitude, actively involved students, arousing interest and curiosity, showing responsiveness, increased enrolment in sciences especially in Biology, improved performances in exams, linkage of theory to practical work, asking questions in Biology, Biology discussions beyond class time, attending classes punctually and doing assignments completely and accurately.

According to Arunga (2007) the impact of ASEI/PDSI on teachers may include, planning lessons better and more consistently, positive attitude change, confident, effective and efficient teachers, improved methodology, showing and appreciating teamwork, enhanced ability to improvise, attend to student's needs more, makes teaching interesting by use of teaching aids and models, demystifies science and corrects misconceptions about concepts in Biology.
1.13 Operational Definitions of Central Terms

**Attitude:** Refers to positive or negative feeling and behaving in a certain way towards a given subject.

**In-service:** Any programme of systematized activities that contribute to professional growth and competence of staff members during the time of their service to an institution.

**Knowledge:** Information and understanding about a subject which a person has in his/her mind.

**Pedagogy:** Refers to the study and theory of the methods and principles of teaching.

**Performance:** Improvement in mean score.

**Skills:** A type of art and craft that comes about as a result of some special training.

**Trainee:** Biology teacher who attended SMASSE INSETS.

**Trainer:** Refers to a person in charge of training of the trainees.
CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter deals with the review of related literature on INSET evaluation, Teaching and learning science, Resource centres and issues in implementing science programmes all which fall under conceptual literature. The empirical literature reviewed is based on ASEI/PDSI Concept, Challenges to Effective Implementation of ASEI/PDSI Concept, Students’ Attitude Towards Biology, Resources and Physical Facilities Availability and the Interest of the Learners to Performing Biology Practical and Summary.

2.2 INSETS: The In-service Education of Teachers training may take as full time or as part time study during the potentially continuous professional life of a teacher. In-service Education may consist of a carefully planned, sustained work over a lengthy period leading to further qualification in the form of an advanced certificate, diploma or higher degree. It may equally be casual study, pursued irregularly in the evenings or during school vocations and in no sense leading to measurable recognition for purposes of salary or promotion. This type of education helps acquaint the practicing teacher with the latest innovations in the curriculum of his subject area. In this way the teacher is mostly able to cope with new demands in his area of specialization as well as new approaches and
methodologies intended to enhance teaching and learning. In-service training is justified because of the explosion in knowledge and the need to have teachers kept abreast of new developments in knowledge.

According to Shiundu & Omulando (1992:232) there is no teacher who can claim to be fully equipped in knowledge sufficient to last him through his teaching career. However promotion on the basis of In-service training has been criticized for producing teachers who cannot cope with the higher levels of education, especially when they are promoted to higher status and expected to teach higher classes without sufficient grounding in the Academic areas pertinent to the classes they are teaching.

Arunga (2007) is in agreement with Mugiri (1981) that once a programme has been introduced in an education system there’s need for continual monitoring.

Olembo et al (1992) seems to agree with Mugiri and Omulando that evaluation is a basic tool for improving the quality of in-service education. Constant follow up or feedback of experiences and activities should be sought through the questions participants ask, the attitudes they display and their expressions. This is done to update or supplement the existing curriculum materials for quality control to ensure curriculum effectiveness beyond the trial stage or to facilitate the development of a new programme.
Evaluation is a basic tool for improving the quality of In-service education so as to have feedback of experiences and activities practiced in the actual field after the teachers undergo INSET training. This helps to provide future actions and information to individuals responsible for evaluating in-service education programmes. However evaluation of In-service training to ascertain the success or failure of such courses is in many cases not conducted. In addition there is little following up of the participants of the courses.

In the development of science curriculum programmes decisions have to be made at the policy, planning and development, institutional and instructional levels. This calls for accurate information hence there is need for continuous gathering and dissemination of information or the development and implementation of curricula to different interest groups.

According to SMASSE project (2004) the rationale for INSET is necessitated by various factors that include Curriculum change which may be due to policy change in education responding to society needs, change in teaching approaches/methodologies which are required to teach new curricula because new research brings forth better teaching methods like change from teacher-centered to student-centered approach, teachers’ professional development, follow-up since the good practices learnt/acquired in colleges/universities are soon forgotten due to absence of follow-up, discouragement by colleagues and frustrations encountered in course of duty, rising cost of education necessitates to get the best out of investment in education hence facilities and resources in education must therefore be utilized optimally, technology advancement has brought Information Technology (IT) revolution. Capacity building in this area is critical so as not to risk total isolation from global family.
Finally emerging issues necessitates teachers to acquire knowledge or information in areas such as HIV/AIDS, drug abuse, deviant behaviour, unrest in schools, cult worship and environmental pollution. Therefore SMASSE project identified the various areas as contributory to the state of affairs which includes Attitude, Pedagogy, Content and Resource Mobilization and Management, which formed the basis of the four years of SMASSE INSET curriculum. Its guiding principles were ASEI which is implemented on the PDSI approach so that corrective measures are taken in subsequent cycles of activities to avoid major disruptions. The Teaching and learning of Biology is based on ASEI concept. Biology can be achieved by applying various approaches which includes the Activity oriented approach, Experimental approach, Improvisation in teaching of Biology and Student centered approach in learning Biology. According to SMASSE project (2004) these are curriculum designs that emphasize the learner. They focus on the needs, interests and experiences of the learner. They are highly flexible with many options available for learners. However the teacher should be available to guide the learner.

The teaching of Biology ought to be oriented more towards the experimental/enquiry approach where learners take center stage in identifying problems, formulating hypothesis, carrying out investigation, analyzing the data and arriving at conclusions. This helps the learner to develop High Order Thinking Skills i.e. HOTS in Biology, which is a Science subject.

Piaget’s (1969) believed that knowledge is not passively acquired, but is discovered and instructed by the activity of the child. “All knowledge is tied to action and knowing an object or an event is to use it by assimilating it into an action scheme.
Ministry of Education (1976) considers experimental approach to teaching of science at all levels in order to encourage careful observation and accurate recording, develop manipulative skills, arouse and maintain interest and an attitude of curiosity in learners, show what is meant by scientific experimentation and the proper use of control and presentation of data to students and finally to verify scientific and principles already taught.

The Ministry of Education (1973) recommends that whenever it is possible science double lessons be taught in the lab. Science teachers particularly Biology teachers should make full use of available learning equipments and improvise the necessary learning aids using locally available, low or no cost materials to assist students understand the concept of science. This can effectively support the activity based child centered science. It is also an important aspect of learning because when learning resources are inadequate, the teaching approaches tend to be teacher centered, killing the interest of students in the subject. Where resources and facilities are available, a qualified and motivated teacher uses learner-centered teaching approach. This has the stimulus variation, curiosity, imagination, critical thinking, keeps the lesson exciting and captivating to the youth learner. All these should occur in a conducive learning environment, which is very crucial.

Arunga (2007) posits that the learning environment consists of the physical, social and psychological dimensions and their complex networking provide the learning environment in a school sets the tone of the school and often accounts for the differences observed in schools and attitude towards sciences.
Smith (1970) revealed that the experimental method of teaching was much effective than the traditional or lecture method of teaching in helping disadvantaged students to understand the methods and nature of science and to develop critical thinking ability.

Babu (2005) recognizes the need for science teachers to make full use of the available learning equipments and improvise the necessary learning aids using locally available, low/no cost materials to assist students understand the concept of science. The activity based child can easily be functioned by using improvised materials.

Shiundu and Omulando (1992) define a Resource Centre as a place where resources are assembled and systematically arranged for utilization. In the educational context it is a place where a variety of learning resources are centrally collected and systematically arranged for educational use. A Resource Centre consists of buildings, staff, hardware, machines, software like books, films, pictures. The main purpose of a Resource Centre is to produce and make available audio-visual aids and other valuable resources for learning so that improved conditions for learning are generated.

There are three types of Resource Centres namely School or College Resource Centre that serves members of that institution, a Regional Resource Centre to serve members in a zone, division, district or province and lastly a Central Resource Centre serves members in a country. Most of the INSET Centres were upgraded to become Regional Resource Centres within the District to serve other neighbouring schools with the following services: offering information services, learning system, resource production, consultancy services, training teachers and curriculum improvement.
However there are general challenges that hinder implementation of science programmes like SMASSE project. These barriers can be identified as the Psychological conflict which involves the inability of the human beings to accept change i.e. retaining the status quo. Implementation of the ASEI lesson plans has proved almost impossible to most science teachers Secondly the Practical conflicts which may be in decision making about teaching and learning strategies to be adopted, the adequacy of resources in the school i.e. human and physical materials, intellectual ability and interest of students due to demands and pressures of new projects.

Motivation plays a significant role in the implementation of science curricular programmes at the institutional level. Mugiri (1981) discovered that teachers did not implement a change or an innovation unless there were rewards for doing so. This is extrinsic motivation. For motivation, I would suggest intrinsic motivation since its long lasting as opposed to the extrinsic motivation or incentives in the implementation of science programmes. SMASSE teachers are quite demotivated since no incentive like a pay rise was given to them.

2.3 ASEI/PDSI Concept Impact Survey

A report in the SMASSE Western, Eastern, Central and South Africa magazine (2005) indicated that the study of impact of SMASSE training was conducted in Malawi, Rwanda, Zambia and Zimbabwe by the monitory and evaluation task team of SMASSE – WECSA in collaboration with southern Africa consortium for monitoring education quality (SACMEQ) using evaluation tools consisting of three components listed below, to see the effectiveness and adaptability of the approach. First, there was the Lesson observation instrument, then the ASEI/PDSI checklist and finally the questionnaire for
extent of student participation in the lesson. These documents were the same ones used in Mbeere District in 2006 to find out the progress and effectiveness of Actualization of the ASEI/PDSI concept, which was found to be partially implemented necessitating another chance of Actualization in cycle 4.

The report in the SMASSE WECSA magazine had also revealed that although the ASEI lesson skills acquired during the training were found to be practiced by the ASEI trained teachers, the degree of mastery of ASEI practice was found to be insufficient. It was revealed that there was a significant difference in classroom lesson delivery between an ASEI trained and untrained teachers at 5% level. The students of an ASEI trained teacher showed a 5% level participation in class work. This approach stems to require more effort for the improvement.

The lesson observation instrument revealed that retention of the attained status of ASEI lesson practice by teachers could be achieved through continued exposure to the ASEI based training. The KNEC results implied that the training has produced positive effects in teaching and learning of mathematics and sciences. In order to understand and implement ASEI/PDSI principles fully, the participants need to develop lesson study skills. It is expected that when the lesson study skills are well understood, it should go a long way to improve the concept of team teaching in individual schools so as to assist the learners achieve the expected cognitive growth.

SMASSE project (2005) indicated that during Actualization of ASEI/PDSI in cycle 3, the focus was on the aspect to be observed during lesson delivery, emphasis in cycle 4 was on the enhancement of lesson study skills based on the previous experience, development of activities that foster high order
thinking skills and hence improve the students’ cognitive growth. If ASEI/PDSI approach is effectively implemented it has the following benefits: enhances student centred focus for learning, provides an opportunity to study students, their reactions and how they learn, increases a teacher’s knowledge of the subject matter and instruction, increases teachers’ ability to observe students, enhances collaboration as teacher work on lessons in groups, enables teachers to share resources and ideas, improves motivation and efficiency due to the understanding that improvement is possible, makes teachers better at anticipating student responses, it is a form of continuous professional development for teachers and lastly it leads to improved quality of lesson plans. The quality of teaching is the single most important factor in a student academic success regardless of the child’s social or economic status.

**Who makes a good teacher? Someone who knows the subject, conveys knowledge effectively and communicates in a language that children can understand.** (Unicef 2003:12)

### 2.4 Implementation of ASEI/PDSI Concept

Nui and Wahome (2006) reported from the SMASSE Project Impact Assessment Survey of 2004 that students were actively involved in the learning process. However it was noted that none of the teachers had a written work plan but judging from the flow of the lesson, it was evident that teachers knew what they intended to do.
The findings of this study were echoed by Jangaa (2005) who says that teachers prepare lesson plans as a matter of requirement and only do it when followed by administrators. This means science teachers have not embraced the ASEI lesson plan format, an indication that a lot more needs to be done in encouraging the teachers to use it. This however contradicts the SPIAS results of 2004 which claimed that teachers planned better and more consistently after attending SMASSE INSETS. Mbeere District teachers (2006) tried to actualize the ASEI lesson plan in cycles 3 and 4 but the major complaint was that it was not possible to implement it 100% due to various hindrances like too much workload, lack of time for planning, abstract topics, resistance to change, lack of teamwork, inadequate physical facilities and resources.

2.5 Students’ Attitude Towards Biology

SMASSE project adaptation by Muriuki (2004) describes attitude as ways of thinking or feeling about something or somebody usually reflected in a person’s behaviour. They are descriptions of a person’s readiness to respond in a certain way to some stimulus. Attitudes are acquired through experiences in our environment and learned in the same way as skills and habits. There are two types of exhibited attitudes i.e. positive attitude if the response shows acceptance or negative attitude is the response shows dislike and defense.

A person needs approval, feeling of importance security and independence so as to develop a positive attitude. Some attitudes have many habits associated with them while others have a few. Sometimes the only action associated with attitude is a verbal expression like; I hate Mathematics or Sciences are difficult. This verbal expression can be referred to as an opinion. Sometimes an
attitude may have an action component which may include a variety of act tendencies such as coming to class late, sleeping during the lesson, not feeling bothered by low scores, refusing to participate during lessons and not revising mathematics or science tests. Mostly the Science subjects and Mathematics are performed poorly in K.C.S.E. not because they are difficult subjects but because learners develop negative attitude about them hence shielding away from them. The science subjects however are taught due to the two main reasons which are to think about things clearly in a logical fashion weighing up the evidence before thinking of making a decision and to be able to argue for positive scientific development. There are various reasons that may have led to negative attitude in learners towards Mathematics and Sciences. They include poor performance during National exams and so students consider it a waste of time to concentrate on subjects they will not pass, anticipation of positive outcome enhances the tendency to action while anticipation of negative outcomes blocks or inhibits the action.

This is an idea supported by two psychologists Birch and Veroff, too much theoretical teaching of mathematics and sciences make them appear too abstract and boring, unpromising job market discourages students, at times teachers instill negative attitude in students by expecting some students to pass and others to fail and showing it openly e.g. in mixed schools where teachers expects boys to pass in sciences more than girls and finally social-cultural attitudes. Traditionally difficult tasks are seen as male domain leading to many girls to give up in sciences. Teachers are therefore supposed to change the negative attitude of the learner to positive attitude so that they may perform better in Mathematics and science subjects.
The teacher should be having positive attitude himself and be highly motivated in order to succeed. They help learners to develop self-confidence in themselves and the subject i.e. student becomes self-reliant. This is effective if the teacher creates a rapport with the learners by being too close with them e.g. by knowing their names and addressing them by name makes them feel close to the teacher hence anything said by the teacher will have effect on the learner hence making learning easy and interesting. The teacher should also create a conducive environment for the learner e.g. greeting them before the lesson. Secondly involve students in learning, encourage questions and answers from your students and never ridicule a student on his answer but encourage participation and investigation, and thirdly proper planning by applying PDSI approach which involves preparing the lesson thoroughly, building self confidence, varying activities in the lesson, trying to entertain learners to create a relaxed environment, summarizing the key points of your lesson and improving your lesson by varying the approach or allowing students to evaluate you, allowing criticism and improving on them, allowing other teachers to attend your lesson and make their observations and take their comments positively.

Attitude of learners should be changed from negative to positive by addressing the issue all the way from teachers training institutions to the schools. This can be done through change of approach in methodology, in-service training, seminars, conferences at district, national or even regional level; focus should also be directed to the learners, parents and the community.

Njuguna (1991) concedes that students attitude towards Biology and the Biology instructional programs are difficult to define since the pupil can only be expected to give qualifying or personal
views or feelings which differ from one pupil to another.

2.6 Physical Facilities and Resources

Muriithi et al (2004) from their paper on Resources and facilities for teaching and learning of Biology defines a resource as any source of information or support that the teacher uses to make teaching more effective and meaningful to the learner. A facility provides the teacher with the conducive environment in which to carry out effecting teaching. Due to the nature of the current overloaded curriculum, teachers tend to concentrate on giving information to their students. This also is reflected by the text books used that lack illustrations too, posing danger to the learners as they tend to do more reading than experiencing.

Therefore the teacher should enrich his/her teaching resources by buying, improvising, collecting or constructing. The kind of resources a biology teacher would require are textbooks and journals/magazines, photographs, models, specimens motion pictures, apparatus, charts and chemicals. On the selection of appropriate books one should consider various guidelines which includes coverage of subject matter should be both deep and broad in syllabus coverage and be having current information so as to apply the ASEI/PDSI concept effectively, cost of which a class textbook should be of reasonable cost and durability should not be sacrificed too in order to purchase many copies, logical and simple presentation for learners to acquire coherent knowledge, overloaded textbooks are not good as may contain irrelevant details, textbook terminologies should be to the level the learner can understand, illustration should be available throughout the book, large, clear and well labeled, should have practice revision exercise at the end of each topic and
finally appearance of the book should be of reasonable size with large enough print. Since no book meets all the above criteria, a teacher should have more than one reference book.

Journals and Magazines like local dailies, Journal of Biological education, newsletters from research institutions and museums etc gives the most recent findings and discoveries in Biology and should therefore be availed to schools as they widen the scope of understanding for both the teacher and the students. There are many apparatus a Biology teacher can use and this promotes student centred activities in a classroom. They include light microscopes, dissection kit, Bunsen burners, thermometers, glass slides/cover slips, beaker/test tubes, petri dishes/watch glasses/white tiles, reagent bottles, droppers, balances. Some cannot be improvised as they may compromise the accuracy of results as per ASEI approach, though some apparatus can be improvised. In deciding the kind of apparatus to use there are various factors to consider e.g. cost of the item, age or academic competence of the learner, objectives of the topic, availability/suitable alternatives, durability and storage.

Chemicals require to be used carefully to avoid dangers, use of recommended concentrations and properly cleaned apparatus used. Some chemicals include Benedict’s solution, Iodine solution, methylated spirit, sodium hydroxide, pyrogallol, copper sulphate etc. These chemicals assist learners to perform various Biological practical. Charts are pictorial designs which can be drawn or permanent charts as they are very effective when used.

Models are scaled representations of objects which can be larger, smaller or same size with real objective. Photographs can be taken from outdoor features like of mangrove swamps to teach
ecology, honeycombs, Birds beaks & feet, plant specimens like cactus, pine bearing cones or acacia or even animals in their natural surroundings. Motion Pictures can be used. Real specimens are very many and the best to teach and learn Biology as they make Biology real. Such specimens include mammalian organs like heart, eye, tooth, lungs, seeds, fruits, flowers, leaves, roots, insects, worms, lizards, snakes, frogs, fish and gills.

According to Amanuel (2009) facilities include laboratory, botanical garden, aquarium, vivarium, school museum, green house, darkroom and national parks. A Laboratory is an instructional facility for an effective science programme where development of scientific skills and attitudes are greatly facilitated. It’s an important facility in a school and if present it should be well equipped with facilities that would enhance the teaching/learning of Biology i.e. with enough water, drainage system, ventilations, furniture, fire extinguisher, prep room fume chamber, emergency door, chalkboard/Duster/chalk, storage room, source of heat, Basic reagents and lab coats. It’s more effective to teach ASEI/PDSI concepts of SMASSE project in such a laboratory.

However where there is no lab, the Biology practical can be conducted in the classroom or even outside the classroom. Every Biology teacher should however be well conversant with the safety, maintenance, management and organization of a Biology laboratory. Botanical gardens are important as they help the learner put theory into practice. It should be adjacent to the laboratory for easy access. Various plants are planted here or even a box especially in towns where there are no spaces for such to illustrate a number of Biological concepts e.g. types of pollination, types of flowers.
School Museum provides some concrete reality of some of the theoretical information that learners receive in class. Aquarium/pond is for keeping living water plants and animals kept in order to study their life histories and habits and includes algae, fish, lilies, tadpoles among others. Vivaria are enclosures for keeping and observing terrestrial animals and plants indoors so as to study them. Green houses act as a device for controlling climatic conditions keeping plants green by reducing dehydration in hot conditions. Darkrooms are needed in Biological work for experiments involving light-dark responses e.g. photosynthesis and photography. National Parks are places where students can be taken for biological studies out of the classroom. However a teacher may not be able to use all the above facilities but can decide on which ones are more applicable to the situation in his/her school. The Biology teacher can combine several facilities and Resources to make the teaching/learning of Biology more interesting and thus motivating to students. Team work is necessary to come up with good ideas.

According to Beynon (1997) facilities and resources well chosen contribute to proper pedagogical approaches of teaching where more student centred activities are dominant in a Biology class. Femsa (2003) supports this by noting that resources and facilities play a critical role in effective teaching and learning of science and Mathematics. It is therefore very important that teachers and students make use of available materials to improvise learning resources not available in their schools.

2.7 Interest in ‘Hands-On’/Practical Activities
Mugo et al (2005) concedes that practical work approach to teaching/learning of Science enables learners to get more interested in the subject matter by seeing or by performing for themselves and their enthusiasm in learning of the subject is enhanced. It also simplifies conceptualization of ideas various studies reveal that in the practical region of continuum the teaching/learning process is carried out through activities which includes Demonstration/Illustration experiments, Standard experiments/exercises, Discovery/Enquiry experiments, Research type experiments, Problem solving/project work and Fieldwork activities. The use of practical work approach came into being in the late 19th century.

Two scientists by the name Levinson and Joan Solomon observes that until the late 19th century the science concepts were rigidly formulated, dry as chalk dust, emphatically underlined on the writing board, to be learnt and reproduced by rote. In the early days of use of practical work approach in science education the objective was simply to present to the learners the concepts and theories along with their proofs as efficiently as possible. There was very little attempt to cultivate the scientism in the learners Solomon observes that, thereafter attitudes changed and people like Baden Powel tried to stimulate initiative and self-reliance in the young through his invention of scouting movement.

Others like Henry Edward Armstrong attempted to instill similar spirit into the conduct of school experiment. From the SMASSE pre-INSET evaluation 2001 the science teachers felt and accepted that practical work is a primary approach in the teaching/learning of science. However much more time should be spent on the practical work as it gives learners the joy of doing science. The shortage of resources and facilities however do limit how science is taught, hence a lot of
innovativeness and improvisation do assist a lot. In a nutshell, practical work enhances the eight aspects of science attitudes viz. curiosity, open mindedness, objectivity, intellectual honesty, rationality, willingness to suspend judgment, humility and relevance to life. These aims are achieved by use of any one or a combination of the different types of practical work.

According to Effandi et al (2007) teachers think that students lack skills to work in groups. However demonstrations are conducted for a group of learners by the teacher and the teacher may prefer this type of experiments when there is a serious risk of flammable materials or acid, learners do not know the proper procedures, there is only one piece of the equipment, the device is delicate and the teacher wants to stop after a step to discuss observations made.

The negative aspects of demonstration experiments are that the learner does not handle things, deny learners chance to stop and ponder, learners may not see demonstrations well if they are too many and they deprive learners chance to make mistakes, experience, frustrations and failures that generate scientific generalizations. The standard exercises of experiments are done by learners themselves to illustrate a concept. These are the key types of experiments as per SMASSE project objectives.

The learner is able to handle, manipulate and practice use of apparatus and find things out for themselves. Since these types of experiments are well defined in terms of requirements, procedures and assembling of apparatus, they deny learners the opportunity to develop problem solving skills, designing experimental procedures and to choose/improvise experimental materials. The discovery experiments or enquiry experiments, the teacher directs the approach to the experiment but the
learner develops the procedure. This helps learners to imagine, be curious and argumentative in the lesson. Examples of discovery, experiment includes the exploratory experiment, inductive, deductive skill development and process development experiments. The problems associated with this type of experiment are: it involves a lot of planning, it involves a lot of resources, it demands that teachers be widely read, low syllabus coverage and fast learners may view it as waste of time and boring.

The Research type experiments are those set by examination bodies to senior classes and they are intended to develop the learners ability to follow instructions, enable learners to decide upon and to make necessary observation/measurements and enables learners to arrive at a reasonable conclusion through suitable analysis.

According to Freeman (2007) students learn better when they are directly involved in problem solving or following their own lines of inquiry. However achieving this type of learning is difficult even for experienced science teachers yet they continue to be central to achieving high quality teaching. The problems associated with these types of experiments are related to preparation aspects. Fieldwork activities involve activities outside the confines of the laboratory. It’s very inspiring and activities involved are lasting and more meaningful as they are real-life situations. Project work involves some investigational work and in depth study to reach a solution and occupying the pupil for an extended period of time.

In the findings of the challenges towards implementing the ASEI/PDSI approach, the Biology group in their discussion during Actualization in cycle 3 (2006) Mbeere District, came up with the following challenges: discouragement to the teacher when good results are not realized thereafter, time taken
for planning is not enough due to the large workloads of the teacher, most lab assistants are not qualified hence cannot effectively assist in the preparation of practical work, status quo, being new change teachers are reluctant to implement it, teachers negative attitude due to poor motivation in terms of monetary terms and towards INSETS, some topics or subtopics are very abstract hence limits ‘Hands-on’ activities, some learners shy away from performing practical work, due to large syllabus, teachers focus on methods geared towards syllabus coverage and tend to ignore ‘hands-on’ activities, absenteeism of learners hinder continuity in learning, shifting Biology teachers to another subject, over planning if learners abilities are not known, most lessons before improvement as per PDSI are better than the improved lessons, insufficient learning resources, undisciplined students impede smooth learning in the classroom, general laxity and lack of morale among teachers, lack of team work among teachers and lack of creativity in teachers with low morale.

Christiana et al (1996) states that poor morale of teachers as exhibited by poor teaching and shortage of good teachers is due to low salary and the frequencies of non-payment of teachers. It finally affects proper implementation of ASEI/PDSI.

2.8 Summary

The review of related literature supports this research by providing the information that evaluation of insets is of paramount importance in following progress of new programmes like SMASSE project discussed here. It also highlights the factors that necessitate the INSET and purpose of Resource centres. The new trends in the teaching and learning of science have also been mentioned.
However from the impact studies carried out in Kenya, very little seems to be known about whether the ASEI/PDSI concept is being used by teachers in their classroom practices. Whether the capability of students in science has improved is also not known. According to the SMASSE – WECSA impact survey carried out in other African countries SMASSE has made a positive impact in the teaching and learning of science.

It was however concluded that a lot still needs to be done. On the basis of the findings of the SMASSE-WECSA survey, the researcher found it necessary to find out why the ASEI/PDSI principle is not fully implemented in the classroom, learners attitude towards their performances in learning of Biology and utilization of resources and facilities.

It was hoped from the findings that we would be able to point out the key areas that interfere with effective teaching and learning of Biology by SMASSE project approach in Mbeere South District even after introduction of SMASSE and possibly come up with intervention measures in order to see our learners perform better in sciences and mathematics.
CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter contains the Design and Locale of the Study, the Target Population and Subjectivity, Sampling Techniques, Research Instruments, Data Collection Techniques and Data Analysis plan.

3.2 Design and Locale

The study adopted an exploratory approach using a descriptive survey to analyze the challenges of teaching and learning of Biology by SMASSE project approach in secondary schools in Mbeere South district. Arunga (2007) observed that surveys are conducted to establish the nature of existing conditions. This is in agreement with Borg (1989) who says that surveys collects data about variables or subjects as they are found in a social system or society i.e. the researcher can observe, inspect the variables or actions as they are or as they happen. The research came up with ways of enhancing the implementation of the ASEI/PDSI concept of SMASSE.

The locale of this proposed study was Mbeere South District in Embu County, Kenya. See Appendix 8 showing a sketch map of the locale. This district was chosen for various reasons. First, it had a large number of secondary schools. Secondly, it had many different categories of public schools for example day mixed, boys boarding, girls boarding, day mixed and boarding schools. Thirdly, some schools in this new district were upcoming schools with less equipped laboratories or none hence it was interesting to establish whether the teachers were improvising learning materials and finally the
researcher’s work station was located in this hardship district hence was interested to see how Biology teachers improvised learning resources.

3.3 Target Population and Subjectivity

The district for the proposed study had a total of 37 secondary schools all which have sent Biology teachers to the SMASSE INSETS. The number of Biology teachers who attended the INSETS was 38. Most schools sent one Biology teacher to the INSETS except a few double stream schools which sent more than one teacher. The student population in the above mentioned schools in the form 4 class was 1,364 both boys and girls.

Table 3.1 shows the target population

<table>
<thead>
<tr>
<th>Target</th>
<th>Total number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of schools</td>
<td>37</td>
</tr>
<tr>
<td>Number of Biology teachers</td>
<td>38</td>
</tr>
<tr>
<td>Number of form four students</td>
<td>1364</td>
</tr>
</tbody>
</table>

3.4 Sampling Techniques

Out of the 38 Biology teachers in Mbeere South district who attended SMASSE, the researcher intended to sample 10%. i.e. 10% of 38 = 4 teachers of the target population. They filled the teachers’ questionnaires. Out of the 1,364 students, only 10% were sampled i.e. 10% of 1,364 = 136
students. This was then divided into the 4 schools forming the 10% of 34 schools to have a sample of 136/4 = 34 students per school. The 4 schools sampled purposively were one boys’ boarding, one girls’ boarding, 1 mixed day and boarding and one mixed day school. In the mixed schools of the 34 students who were to fill the student questionnaires, 17 were be girls and 17 were to be boys. So in total, 68 girls and 68 boys formed the sample of the students’ population. These students whose teachers attended SMASSE were sampled using random sampling technique where simple random numbers table generated by the computer at random for 3 digits since my P (total population) is a 3 digit value of 136 students while S (sample) is 34 per school was considered. The teacher population of 4 was small hence non-random sampling technique of convenience sampling was applied as the curriculum coordinator availed the form 4 Biology teacher who had gone through the SMASSE INSET.

According to Gay (1992) the minimum acceptable sample of survey is between 10% and 20% for a small population. He observes that a researcher selects the sample due to various limitations that may not allow researching the whole population drawn.

<table>
<thead>
<tr>
<th>Target</th>
<th>Target size</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of schools</td>
<td>34</td>
<td>4</td>
</tr>
<tr>
<td>Number of Biology teachers</td>
<td>38</td>
<td>4</td>
</tr>
<tr>
<td>Number of students –boys</td>
<td>682</td>
<td>68</td>
</tr>
<tr>
<td>Number of students- girls</td>
<td>682</td>
<td>68</td>
</tr>
</tbody>
</table>

Table 3.2 shows number of samples
Table 3.3 shows the number of schools in different categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys boarding</td>
<td>1</td>
</tr>
<tr>
<td>Girls boarding</td>
<td>1</td>
</tr>
<tr>
<td>Mixed day and boarding</td>
<td>1</td>
</tr>
<tr>
<td>Mixed day school</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4</strong></td>
</tr>
</tbody>
</table>

### 3.5 Research Instruments

The study used the following instruments in data collection: one, teacher challenges and ASEI/PDSI implementation questionnaire. The SMASSE ASEI/PDSI checklist and lesson observation guidelines may make teachers nervous as they know the researcher and may not behave the way they normally behave. This is because when workers are under observation they tend to exaggerate their working. However the key issues from the checklist and observation guide were incorporated into the questionnaire. Two, student assessment and participation incorporated questionnaire and three, observation guidelines on the utilization of resources and physical facilities. The observation guidelines on the utilization of resource and facilities helped establish whether they influenced the teaching methodologies of the teacher from the pre-SMASSE condition of teacher centred approach.
to student centred SMASSE approach. The student assessment and participation questionnaire sought to obtain the students perception of their teacher’s classroom delivery with a view of establishing whether their attitude towards Biology is positive or negative. This is in line with the ASEI concept. The teachers’ questionnaire attempted to find out the challenges experienced by teachers while implementing the ASEI/PDSI approach to teaching/learning of Biology and how best to implement the approach. They were also required to explain the extent to which they implemented the ASEI/PDSI concept. The piloting of these research instruments was carried out with a SMASSE Biology teacher in a mixed school not in the sample in Mbeere South District and also to her form 4 students in order to capture both girls and boys so as to establish their reliability. The validity of the instruments was established by the University supervisory group to this project.

Orodho (2008) notes that piloting of the instrument is important as it measures the reliability and validity of the tools. This helps the researcher to check on unclear question if they are left unanswered, insufficient space if there is too much clustering of the responses, clustered questions and also wrong phrasing of questions if respondents give very different responses to same questions. It also reveals if the anticipated analytical techniques are appropriate. The questionnaires were administered to the respective identical subjects named above, by test-retest techniques, responses analyzed and kept, then same questionnaires given to same group after two weeks and responses analyzed. Then a correlation coefficient for the two responses was calculated.

According to Arunga (2007), valid questionnaires measure the extent to which it’s supposed to measure while a reliable one gives consistency of the observation of the outcome. For the teachers’ questionnaires the difference (d) in ranking of the scores per item was 4 for the 10 items, relevant to
the respondent and for the student, it was 5 for the 11 items relevant to the respondent. Spearman Rank Order Correlation Coefficient was used to work out the Correlation. The following working shows the results.

For students, $r = 1 - \frac{6\sum d^2}{N(N^2-1)}$

$= 1 - \frac{6 \times 5^2}{11(11^2-1)}$

$= 1 - \frac{150}{1320}$

$= 1 - 0.114$

$= 0.886$

For teachers, $r = 1 - \frac{6\sum d^2}{N(N^2-1)}$

$= 1 - \frac{6 \times 4^2}{10(10^2-1)}$

$= 1 - \frac{96}{1320}$

$= 1 - 0.073$

$= 0.927$
\[
10(99) = 1 - 0.097 = 0.903
\]

The respondents’ responses correlated highly.

### 3.6 Techniques in Data Collection

The researcher visited the four schools on different dates after prior confirmation with their principals. She had to introduce herself first and explain the purpose of her visit and followed the right chain of command for example procurement of the research permit from the ministry of education headquarters and written authority from the Provincial Director of education as well as the District Director of Education. The researcher was well versed with the logistical, Ethical, Human relations as well as the legal issues in research.

On the data collection day, the researcher issued the 34 students’ participation and assessment questionnaires and guided them on the instructions on how to fill them and also reassured them of the confidentiality of the information given, with the help from the principal. The issues that arose and needed clarification were dealt with in a face to face dialogue with the students and finally collected all the students’ questionnaires.
Meanwhile the SMASSE trained Biology teachers filled their challenges and ASEI/PDSI implementation questionnaires and handed them over directly to the researcher. Then the researcher filled the observation guide on the utilization of resources and facilities in the school. The questionnaires filled were serialized to check on actual number filled from the total expected to be filled and any anomalies noted down and their reasons as revealed in chapter four.
3.7 Data Analysis Plan

The raw data was edited to improve its quality of coding. Editing involved condensing the large amounts of field data into few manageable groups and tables for further analysis. The qualitative data from open ended questions’ responses were tallied converted to quantitative data and recorded in frequency and percentage tables. Qualitative data on findings about attitude of learners’ interests in Biology and challenges learners face in learning Biology were analyzed in tables of frequencies and percentages. The findings from the analysis of the availability and reliability of the physical facilities and resources were converted into quantative data and analyzed by Statistical Package for Social Sciences.
CHAPTER FOUR

FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter presents the findings and discussions of the study as per the data collected through students’ questionnaires, teachers’ questionnaires and the researcher’s observation guideline. The study intended to assess the challenges of teaching and learning biology by SMASSE project among secondary school in Mbeere region of Embu County, Kenya. The objectives of the study were to find out the extent to which ASEI/PDSI concept was understood by teachers with reference to teaching Biology, to find out how the ASEI/PDSI approach to the teaching of Biology was being implemented in the classroom setting, to identify students’ attitude towards Biology influences their achievement in class performance, to find out the availability and reliability of the resources and physical facilities present in the school in relation to the teaching of Biology and to determine the interest of the learners towards performing Biology practical in the laboratory by themselves and the challenge they face.

The researcher administered questionnaires to the respondents at different days and collected them after two days since the student respondents were doing end of term one exams. Due to this and the fact that some of the sample school did not have the target number of respondent, a students’ questionnaire return rate of 123(90%) out of 136(100%) was recorded. The teachers’ questionnaire return rate of 4(100%) same case with the researchers observation guideline of 4(100%) were achieved. The qualitative data was translated into quantitative data and all data was coded and entered in SPSS for analysis and the generated output was presented in frequency and percentage.
tables. Interpretations and conclusions were made based on the results obtained and the findings of the study are presented in the sections that follow.

4.2 Demographic variables

The respondents in the study were Biology, SMASSE trained teachers both males and females, form 4 Biology students both males and females and the researcher herself who contributed to the study through information obtained from the researchers observation guideline on the physical facilities & resources.

4.2.1 Respondents Gender

It was necessary to establish the gender of the respondents so as to establish the percentage of each gender so as to establish whether there was gender parity. This is because both genders are implementers and beneficiaries of the program under study this is shown in table 4.1

<table>
<thead>
<tr>
<th>Table 4.1: Respondents gender (N= 123)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
</tbody>
</table>
Table 4.1 shows the number of teachers surveyed were equal hence no discrepancy in gender proportion for the study as the males were 2(50%) against 2(50%) females. However, the female students were more 74(60%) more than males 49(40%) indicating some little imbalance in the information gathered. This was due to the fact that most form four classes have more girls than boys.

4.3 ASEI/ PDSI Concept

The first objective was to find out the extent to which ASEI PDSI was understood by teachers with reference to teaching Biology.

4.3.1 ASEI Lesson Plan

Table 4.2 reveals the extent to which Biology teachers plan their lessons according to ASEI approach lesson plan.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Freq</th>
<th>%</th>
<th>Females</th>
<th>Freq</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>1</td>
<td>25</td>
<td></td>
<td>1</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.2: ASEI Lesson Plan (N= 4)
ASEI is acronym for Activity, Student, Experiment, Improvisation. The findings generally reveal that teachers 2(50%) have not embraced the use of ASEI lesson plan. This is in agreement with the SMASSE- WECSA report (2005) which revealed that although the ASEI Lesson skills acquired during the INSET training were found to be practiced by ASEI trained teachers, the degree of mastery of ASEI practice was found to be insufficient. Secondly the findings of this study are in agreement too with Jangaa (2005) who postulates that teachers prepare lesson plans as a matter of requirement and only do it when followed by administrators. However, 2(50%) of the teachers plan their lessons by ASEI approach.

### 4.3.2 Improvisation of Resources

Improvisation is an aspect in ASEI where teachers improvise resources to make teaching effective where conventional resources are not adequate. Table 4.3 reveals the findings.

<table>
<thead>
<tr>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freq</td>
<td>%</td>
</tr>
<tr>
<td>Yes</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 4.3: Improvisation of Biology Resources (N= 4)
Table 4.3 reveals that all teachers (100%) improvise the Biology resources. This enhances learning. This is in agreement with SMASSE requirement in the ASEI movement that requires learners to be taught experimental work by improvisation of resources where they are lacking or inadequate. It also agrees with Femsa (2003) that lacking resources should be improvised to enhance learning.

4.3.3 Methodology of Learning Biology in Class.

Pedagogy varies from one level to another. The sampled teachers revealed the methods they use in class to teach Biology as table 4.4 reveals.

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th></th>
<th>Female</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
<td>Freq</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discussion</td>
<td>2</td>
<td>50</td>
<td>1</td>
<td>25</td>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>Practical</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>25</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Lecture</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2</td>
<td>50</td>
<td>2</td>
<td>50</td>
<td>4</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4.4: Biology lesson teaching methods (N= 4)
The table 4.4 reveals that most teachers 3(75%) use discussion method in their Biology class/lessons and 1(25%) use practical. However, nobody 0(0%) uses lecture method as it is outdated in this era of SMASSE.

4.3.4 Team Teaching

Another important aspect to determine whether teachers in Biology understand the concepts of PDSI- Plan Do See Improve is to do team work which involves planning a lesson together, teaching the same lesson. This requires team teaching, however the findings of team teaching are revealed in the table 4.5.

<table>
<thead>
<tr>
<th>Table 4.5: Team teaching (N= 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Freq</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

The table 4.5 reveals that all teachers 4(100%) do not team teach. This shows that very little is known about the plan, do, see, and improve approach of SMASSE by the teachers. The findings on
team teaching are not in agreement with Njagi (2004) who postulates that PDSI is a cyclic approach that carries the ASEI movement and involves planning which requires taking time to come up with appropriate activities that will enhance effective learning using the resources available.

4.3.5 Conclusion

The ASEI/ PDSI consent is not understood 100% by the Biology teachers. This is because from the findings on the assessment of the extent to which ASEI/ PDSI concept is understood by teachers, the following conclusions are prominent. First, most teachers 2(50%) do not plan the biology lessons using the ASEI lesson plan approach since they do not understand it 100%. Secondly, all teachers 4(100%) improvise biology resources for effective teaching and learning of biology. Thirdly, the biology teachers 3(75%) are using learner- centered pedagogical approaches and have drifted away from the teacher centered approach of lecture method which is still used by 1(25%) of teachers. Lastly team teaching has not been embraced by biology teachers since all the respondents 4(100%) indicated that they do not team teach hence PDSI approach is not well understood how it should be done.

4.3.6 Recommendations

The District planning committee should issue guideline to make the ASEI/ PDSI concept mandatory. This can be done by integrating the concept in district SMASSE INSETS. Secondly, the district quality assurance and standard officers should ensure continuity of SMASSE programme in the region and be SMASSE compliant to assist teachers. Third, the teachers should be motivated with incentives like considering SMASSE certificates so that they can own up the concept for better understanding.
Fourth, teachers should share workload evenly to create time to plan their lessons a per the ASEI lesson plan. Lastly teachers can team up with teachers in other centres for team teaching so as to embrace and understand the PDSI approach where they would plan do, see weaknesses in their lessons & improve together as a team. Principals can employ BOG teachers to assist in team working.

4.4 Implementation of the ASEI / PDSI Concept

The second objective of the study was to find out how the ASEI/ PDSI approach to the teaching of Biology was being implemented in the classroom setting. According to SMASSE project (2005) if ASEI / PDSI approach is effectively implemented, it enhances student centered focus for learning, provides an opportunity to study students, their reactions and how they learn, increases teachers knowledge of the subject matter, enhances teacher collaboration, improves motivation and develops teachers professionally and lastly it leads to improved quality of lesson plan.

4.4.1 Handling Biology practical

The SMASSE project requires learners to have “hands –on” activities and the lessons to be learner centred. However teachers handle biology lessons differently as shown in table 4.5.

<table>
<thead>
<tr>
<th>Table 4.6: Handling Biology practical lesson</th>
<th>(N=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>Female</td>
</tr>
<tr>
<td>Freq</td>
<td>%</td>
</tr>
</tbody>
</table>

69
Table 4.6 reveals that 4(100%) of the teachers rely on demonstration and exercises to handle Biology practical lessons. However none of the teachers 0(0%) embrace discovery method of teaching Biology. From the researcher’s observation guideline, teachers were seen to apply other methodologies of teaching as table 4.7 reveals.

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Male Freq</th>
<th>Male %</th>
<th>Female Freq</th>
<th>Female %</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstration</td>
<td>2</td>
<td>50</td>
<td>2</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>Exercise</td>
<td>2</td>
<td>50</td>
<td>2</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>Discovery</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 4.7: Other Pedagogies Observed (N=4)

- **Practicals through group activities**: 2 (50%) Male and 2 (50%) Female, 4 (100%) Total.
- **Peer teaching**: 2 (50%) Male and 2 (50%) Female, 4 (100%) Total.
- **Brain storming**: 1 (25%) Male and 1 (25%) Female, 2 (50%) Total.
- **Question/Answer**: 1 (25%) Male and 1 (25%) Female, 2 (50%) Total.

Table 4.7 revealed the most common pedagogy in handling biology Practicals was through group discussion 4(100%) and by peer teaching 4(100%). This shows that the lessons are student centered. This is in agreement with Nui and Wahome (2006) report of SMASSE project impact assessment.
survey (2004) that students taught through SMASSE project were actively involved in the learning process. It’s also in agreement with Smith (1970) who reveals that experimental pedagogy was much effective than lecturer method in helping disadvantaged students to understand science and develop critical thinking ability.

4.4.2 Work load of Biology Teachers

Thorough preparation of the ASEI/ lesson plans and implementing the ASEI/PDSI approach requires proper preparation by the teacher. Table 4.8 reveals the responses of the commitment of the teachers.

<table>
<thead>
<tr>
<th>No. of classes taught Biology</th>
<th>Male</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freq</td>
<td>%</td>
<td>Freq</td>
</tr>
<tr>
<td>3</td>
<td>1 25</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>2 50</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>1 25</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weekly workload (lessons)</th>
<th>Male</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freq</td>
<td>%</td>
<td>Freq</td>
</tr>
<tr>
<td>18</td>
<td>1 25</td>
<td>1</td>
</tr>
<tr>
<td>27</td>
<td>2 50</td>
<td>1</td>
</tr>
<tr>
<td>23</td>
<td>1 25</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 4.8 reveals that biology teachers have many classes with the highest number being 5 for 1(25%) of the teachers. Over 3(75%) of the teachers have more than twenty lessons per week which is too much workload. This is in agreement with Mbeere District teachers (2006) who unraveled too much work load being one of the major complains to implement ASEI lesson plan Actualization to 100%

4.4.3 Factors hindering ASEI/PDSI Activities in Teaching Biology

Arunga (2007) is in agreement with Mugiri (1981) that once a programme has been introduced in an education system, there is need for continual monitoring so as to unravel the challenges and come up with remedies.

Mugiri (1981) discovered that teachers did not implement a challenge or innovation unless there were rewards for doing so. The study then to find from Biology teachers the reasons as to why they do not implement SMASSE project in teaching & learning Biology and the findings were as shown in the following sections.

4.4.3.1 Focusing on Students and Use of learner-centred Approach

SMASSE recommends learner- centred approach of learning. Table 4.9 reveals the hindrances to a learner-centred approach in Biology.
Table 4.9: Hindrances to a Learner Focused Approach (N=4)

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
</tr>
<tr>
<td>Lack of adequate facilities</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Large class size</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Inadequate time</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Time consuming</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Heavy workload</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Students too weak to work alone</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Pressure of syllabus coverage</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Some topics too theoretical</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Inadequate time and heavy teachers’ workload are ranked as the major hindrances 2(50%) to a learner-centred approach. This is in agreement with Mbeere District teachers report (2006) that inadequate time and too many lessons hinder teacher from preparing ASEI lessons plans pressure to
cover the syllabus also featured as the students in form four should cover the syllabus by 30th June of every year in the region under study.

4.4.3.2: Designing of Research based Approach to experimentation

In addition to experiment, research project can also be used to learn Biology. The hindrances to the designing of research based approach to experimentation are revealed in table 4.10.

Table 4.10: Hindrance to Designing a Research based Approach to experimentation.

(N=4)

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate time</td>
<td>1</td>
<td>25</td>
<td>1</td>
<td>25</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>Lack of materials / funds</td>
<td>1</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Lack of motivation from Admin</td>
<td>1</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Low cognitive ability of learners</td>
<td>1</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Heavy workload</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>50</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>Laziness</td>
<td>1</td>
<td>25</td>
<td>1</td>
<td>50</td>
<td>2</td>
<td>50</td>
</tr>
</tbody>
</table>
Inadequate time 2(50%) heavy workload 2(50%) features again as the key hindrances to Designing of Research based approach to experimentation, Lack of funds. Lack of motivation and laziness also features as key hindrances.

4.4.3.3 Using Improvisation in Absence of Convention

The hindrance to the improvisation in absence of conventional equipment is revealed in table 4.11
Table 4.11: Hindrance to Improvisation

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
<td>Freq</td>
<td>%</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Lack of time</td>
<td>2</td>
<td>50</td>
<td>1</td>
<td>25</td>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>Lack of motivation from administration</td>
<td>1</td>
<td>25</td>
<td>1</td>
<td>25</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>Too much workload</td>
<td>2</td>
<td>50</td>
<td>1</td>
<td>25</td>
<td>2</td>
<td>75</td>
</tr>
<tr>
<td>Lack of qualified lab technicians</td>
<td>2</td>
<td>50</td>
<td>1</td>
<td>25</td>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>Inefficiency of improvisation</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>50</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>Lack of materials</td>
<td>1</td>
<td>25</td>
<td>1</td>
<td>25</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>Lack of creativity by the teacher</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>25</td>
<td>1</td>
<td>25</td>
</tr>
</tbody>
</table>

This study has revealed that teachers improvise equipments but the key hindrances to improvisation of materials/ equipments as revealed in table 4.11 include lack of time from 3(75%) of teachers respondent, too much workload also from 3(75%) of the teachers respondent and lack of qualified lab technicians revealed by 3(75%) of the teachers respondents. This is in disagreement with Babu (2005) who postulates that teachers should improvise the necessary learning materials/ aids using locally available, low or no cost materials to assist students understand the concept of science. This can easily make the learner centered activities function. However, other less significant hindrances to improvisation include lack of motivation from the administration from 2(50%) of the teachers,
lack of materials for proper improvisation and inefficiency of improvisation prominent with female teachers 2(100%).

4.4.3.4: Planning for Lessons

The hindrance to planning for lessons is revealed in table 4.12

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Time consuming to plan</td>
<td>1</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Tedious</td>
<td>1</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Laziness to write a lesson plan</td>
<td>1</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Too many lessons</td>
<td>2</td>
<td>50</td>
<td>2</td>
<td>50</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>Format too detailed</td>
<td>2</td>
<td>50</td>
<td>2</td>
<td>50</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>Handling two science</td>
<td>1</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Teacher claim to be experienced</td>
<td>2</td>
<td>50</td>
<td>1</td>
<td>25</td>
<td>3</td>
<td>75</td>
</tr>
</tbody>
</table>

The table 4.12 reveals that 4(100%) of the teacher do not plan for their lesson because of having too many lessons and also due to the highly detailed format of the ASEI lesson plan. Seventy five
percent of the teacher’s claims that they have enough experience hence do not plan on paper. This is in agreement with Nui and Wahome (2006) whose report from SMASSE project impact assessment survey (2004) indicates that students were actively in the learning process though none of the teachers had a written work plan but judging from the flow of the lesson, it was evident that teachers knew what they intended to do.

4.4.3.5 Inclusion of “hands-on” activities that would enhance participation and learning.

The hindrances to inclusion of “hand-on” activities are revealed in table 4.13

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
</tr>
<tr>
<td>Inadequate physical facilities</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Large class of students</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Improper planning</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Shortage of time</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>Inability of students to work alone</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>Lack of motivation among teachers</td>
<td>1</td>
<td>25</td>
</tr>
</tbody>
</table>
Lack of lab technician 2 50 1 25 3 75
Pressure to cover the syllabi 2 50 2 50 4 100

Table 4.13 unravels that 4(100%) of the teachers do not include “hand-on” activities in their lessons because of the learners’ inability to work alone and the pressure to cover the syllabus to improve the mean score which also stands at 4(100%). The other key hindrances are lack of laboratory technicians which stands at 3(75%) same as shortage of time standing at 3(75%). Other hindrances include large number of students, inadequate physical facilities and lack of motivation of the teachers.

4.4.3.6 Observation by other teachers

The hindrances to being observed by another biology teacher while in class is revealed in table 4.14

Table 4.14: Hindrances to being observed by another teacher (N= 4)

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
</tr>
<tr>
<td>Intimidation</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Looking down upon young tchrs</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Being the only Biology tchr in class</td>
<td>2</td>
<td>50</td>
</tr>
</tbody>
</table>
Table 4 reveals that teachers do not like being observed in class because of being the only biology teacher in the school which is a response from all 4(100%) of the teachers. Secondly, fear of criticism ranks second at 3(75%). Other reasons include intimidation, lack of confidence, lack of mastery of the content and resistance to change.

### 4.4.3.7 Feedback From Students

The hindrances for asking feedback from students are unraveled in table 4.15

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not wanting challenge from students</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>Idea Alien</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>Lack of self confidence</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4.14: Hindrances to asking for feedback from students (N=4)
Table 4.15 reveals that 4(100%) of the teachers do not like students evaluating them because of lack of self confidence. Seventy five percent felt that the idea of lesson study is alien and some learners may fake their expression towards their teacher. Other responses includes 3 (75%) of teachers not wanting challenge from students, time limit and bad teacher-learner relationship.

### 4.4.4 Recommendations for enhancing the implementation of ASEI/ PDSI approach

Teachers were requested for recommendations to the District Planning Committee that would assist in ensuring smooth implementation of ASEI/PDSI and the responses are revealed in table 4.16.

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freq</td>
<td>%</td>
<td>Freq</td>
</tr>
<tr>
<td>Sensitize head tchrs on ASEI/PDSI</td>
<td>2 50</td>
<td>2 50</td>
</tr>
</tbody>
</table>

Table 4.16: Recommendation to the District Planning Committee (N=4)
Select competent District Trainers | 1 | 25 | 1 | 25 | 2 | 50
Select committed trainers | 0 | 0 | 1 | 25 | 1 | 25
Equip SMASSE centres | 0 | 0 | 1 | 25 | 1 | 25
Aid in supply of materials | 1 | 25 | 0 | 0 | 1 | 25
Organize friendly INSET centres | 2 | 50 | 2 | 50 | 4 | 100
Motivate teachers financially | 2 | 50 | 2 | 50 | 4 | 100
Shorten time for INSETS | 2 | 50 | 1 | 25 | 3 | 75
Follow up of activities by DQASO | 1 | 25 | 0 | 0 | 1 | 25

All the respondents 4(100%) recommended for three key issues to the District planning committee. These include; first, sensitizing the heads of institutions, secondly, organizing INSET centres which have conducive environment for teachers and motivating teachers with better allowances, thirdly, the District Planning Committee was also recommended to shorten time for INSET as they occur during the holidays. Fourth, the DPC was advised to select competent district trainers who are committed. Other minor recommendations included supply of equipments and materials as well as follow up of SMASSE activities in school by District Quality Assurance & Standards Officers.

4.4.5 Conclusion,
The implementation of the ASEI/PDSI concept has not been 100% perfect. The findings revealed that 4(100%) of teachers embrace demonstrations and exercises during biology practical lessons although none 0(0%) of the teachers use the discovery methods. Over 3 (75%) of the teacher have very many lessons of over twenty lessons per week. Group activities were also used in teaching biology as revealed by 4(100%) of the respondents same case with peer teaching. Inadequate time and heavy teacher’s workload were ranked as the major hindrances to a learner focused approach by 2(50%) of the respondents. Improvisation of resource/ equipment was due to inadequate time as revealed by 3(75%) of the respondents, unqualified lab technicians revealed by 3(75%) of the respondents and too much workload revealed by 3(75%) of the respondents. Teachers do not plan their lessons because of lack of time for they 4(100%) have too many lessons and the ASEI lessons plan is too detailed. A hundred percent of the respondents do not give activities due to inability of the learners to work alone. The observation by other teachers as one teaches was hindered by the fact that 4 (100%) of the teachers were the only teacher in their schools. Teachers did not like feedback from students due to lack of confidence revealed by 4(100%) of the respondents and fear of challenge from learners revealed by 3(75%) of the respondents. All the respondents 4(100%) recommended to the DPC to have better allowances, better INSET centres and sensitizing heads of schools about SMASSE principles.

4.4.6 Recommendations

The District Planning Committee should enforce SMASSE INSET be mandatory for all science teachers since implementation was partial in class. Science teachers can be exempted from too many schools duties to have time for planning. Teachers should be given incentives for adopting the ASEI/PDSI Concept or SMASSE certificates used to form basis for promotion. Schools with lab
technicians should in co-operate them in SMASSE, INSET to familiarize them with SMASSE principles. Headteachers to be sensitized on SMASSE principles. The DPC should avail all resources needed for SMASSE in the SMASSE centres. Teachers and administrators should embrace teamwork to effect the lesson study in the classrooms.

4.5 Students’ Attitude Towards Biology

The third objective of the study was to identify students’ attitude towards Biology.

4.5.1 Best Science Subject

The responses on the best science subject are revealed in table 4.17.

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
</tr>
<tr>
<td>Biology</td>
<td>44</td>
<td>36</td>
</tr>
<tr>
<td>Chemistry</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Physics</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>None</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>40</td>
</tr>
</tbody>
</table>
The table 4.7 reveals that 101(82%) of the respondents rated Biology as their best Science subject. This is due to the fact that their attitude towards Biology is highly positive. This is in agreement with Muriuki (2004) who describes attitudes as a way of thinking or feeling about something or somebody usually reflected a person’s behaviours. According to Njuguna (1991) students attitude towards biology and the biology instructional programs can only be expressed as personal views or feelings which differ from one pupil to another and this is in agreement with the findings since some respondents 11(9%) expressed Chemistry as their best Science subject, 6(5%) expressed Physics to be their best Science subject while still 5(4%) did not have any best Science subject an indicator of negative attitude. The SMASSE project (2004) emphasizes the learner centred since the approach focuses on the needs, interest and experiences of the learners hence learners select subjects of their interests indicating a correlation.

4.5.2 Interests Towards Biology Lessons

Considering the attitude of learners towards Biology, the respondents were required to declare their interest to biology lessons and the responses were revealed in table 4:18

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
<td>Freq</td>
<td>%</td>
</tr>
<tr>
<td>Yes</td>
<td>46</td>
<td>38</td>
<td>70</td>
<td>57</td>
</tr>
</tbody>
</table>
To support positive attitude towards Biology, interest must be within the person. Table 4.18 reveals that 116(94%) of the students respondents said they have interest in biology lessons. However, a small proportion of 7(6%) indicated they have no interest towards biology probably the same group that did not rate biology as their best science subject. SMASSE project (2004) emphasizes learner’s interests as a guiding factor to subject selection indicating a correlation.

**4.5.3 Questions from the Teacher to Students**

The positive attitude to learners can be cultivated by the teacher hence there was need to investigate whether the Biology teacher invites questions from the learners. Table 4.19 reveals the findings.

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
</tr>
<tr>
<td>Yes</td>
<td>48</td>
<td>39</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>40</td>
</tr>
</tbody>
</table>
Table 4.19 reveals that the biology teacher to 121(98%) of the respondents invites questions from students. However 2(2%) of the respondents reveal that their teacher does not invite questions from students. The teacher is supposed to inculcate positive attitude to his/ her learners toward her subject as well as demystifying sciences which is in agreement with Mbeere south (2006) in actualization.

4.5.3 Answering Teacher’s Questions

Questions and answer is one of the methods used in teaching biology. Table 4.20 reveals whether students answer teacher’s questions.

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
</tr>
<tr>
<td>Always</td>
<td>21</td>
<td>17</td>
</tr>
<tr>
<td>Rarely</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>Not at all</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>40</td>
</tr>
</tbody>
</table>

Table 4.20: Answering Teacher’s Questions  (N=123)
Table 4.20 reveals that most of the students i.e. 70(57 %) rarely answer teachers’ questions while 49(40%) of the respondents would always answer the teachers’ questions. However a small percentage 4(3%) never answer teacher questions a proof that some students have no interest in the subject at all.

### 4.5.6 Questions from the Students to the Teachers

In trying to justify their interests in Biology, the student respondents were required to answer the question: Do you ask questions to the teacher? Their responses are revealed in table 4.21

| Responses | Males | | | Females | | | Total | |
|-----------|------|------|------|---------------|------|------|--------|
|           | Freq | %    | Freq | %    | Total | %    |
| Yes       | 34   | 28   | 59   | 48   | 93    | 76   |
| Yes       | 15   | 12   | 15   | 12   | 30    | 24   |
| Total     | 49   | 40   | 74   | 60   | 123   | 100  |

Table 4.21 reveals that 93(76%) of the respondents ask questions to the teachers so as to seek clarification on areas not understood. This is in agreement with Arunga (2007) that the ASEI/PDSI approach corrects misconceptions in Biology. Thirty (24%) of the respondents do not ask questions to the teacher.
4.5.7 Frequency of Seeking Clarification

In seeking clarification on areas not understood, table 4.22 reveal the findings.

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
<td>Freq</td>
</tr>
<tr>
<td>Always</td>
<td>17</td>
<td>14</td>
<td>24</td>
</tr>
<tr>
<td>Rarely</td>
<td>25</td>
<td>20</td>
<td>48</td>
</tr>
<tr>
<td>Not at all</td>
<td>7</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>40</td>
<td>74</td>
</tr>
</tbody>
</table>

Table 4.22 reveals that 73(59%) of the respondents rarely participates in seeking clarification in areas not understood. This is in total disagreement with Arunga (2007) who postulates that the adoption of ASEI/PDSI approach in teaching demystifies Science and corrects misconceptions in Biology. However 41(33%) always seeks clarification in areas not understood. This is in agreement with Arunga (2007) quite a high number 9(7%) never participate in seeking clarification in areas not understood. This does not favour conducive learning.

4.5.7 Average Performance in Biology Exams

Performance of the respondent which is the result of evaluation is revealed in table 4.23.
Table 4.23: Performance in biology exams  
(N= 123)

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
<td>Freq</td>
</tr>
<tr>
<td>70% and above</td>
<td>12</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>51- 69%</td>
<td>30</td>
<td>24</td>
<td>17</td>
</tr>
<tr>
<td>41-50%</td>
<td>4</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>Below 40 %</td>
<td>3</td>
<td>3</td>
<td>28</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>49</strong></td>
<td><strong>40</strong></td>
<td><strong>74</strong></td>
</tr>
</tbody>
</table>

Table 4.23 reveals that 30(24%) of the respondents scored 70% and above on average in Biology exams. Forty seven (39%) scored between 50-69% in exams while 31(25%) scored less than 40%. This percentage was higher than for those who scored between 41-50% who were 25(22%). According to Olembo et al (1992) who concur with Mugiri and Omulando, evaluation is a basic tool for improving the quality of in- service education which is also applicable to improved performance. Mwangi (2004) Poor performance in science and mathematics is due to negative attitude (Mwangi, 2004). This is in agreement with the findings that 31(25%) students’ respondents scored less than 40%. Negative attitude was one of the key baseline findings of 1998 survey which makes the poor performance revealed be in agreement with it.


4.5.8 Conclusion-

The students’ attitude towards Biology influences their class performance differently.

Biology was rated by 101(82%) of the respondents as their best science subject. This is attributed to positive attitude by the respondents. Most of the respondents 116 (94%) revealed that they have interest towards biology lessons. Interest is normally tied to a positive attitude towards something. However 7(6%) have negative attitude towards biology. The biology teachers inculcate the positive attitude to the learners since a very high percentage i.e. 121(98%) revealed that teachers invite questions from the learners.

Most of the students 70(57%) rarely answer teachers’ questions while 4(3%) will never answer teachers’ questions. This is a challenge to learning of biology. Ninety three (76%) of the respondents participate in seeking clarification to areas not understood. However 30 (24%) never seek clarification which poses a great challenge of learning by SMASS project approach which emphasizes the learner-centered approach. On the frequency of seeking clarification to issues 73(59%) rarely participate while 9(7%) will never seek clarification. This shows there is positive attitude towards Biology. The attitude of the learner determines their performance positive attitude contributed to 30(24%) of the respondents doing very well in biology by scoring over 70% while 47(39%) scores 51-69%. Negative attitude contributed to 31(25%) scoring less than 40%.

4.5.9 Recommendation

The biology teacher should recognize any attempts by the learner to answer questions whether correctly or wrongly in order to boast their confidence and Morale. The teacher should allow students to communicate their interest freely so as to see them articulate scientific concepts
competently. The teacher should encourage learners to develop intrinsic motivation in them by explaining to them why they should perform well in biology. The students can also be motivated by award of rewards both verbal and material. The career teacher should expose learners to all careers that require them to develop positive attitude towards Biology. To make biology lessons interesting various pedagogies should be used by the teachers so as to promote the interest of the learner towards biology. Where conventional materials are lacking teachers should improvise to raise the interest and curiously of the learner. Learners should be given questions that promote their interest and understanding.

4.6 Physical Facilities and Resources

The fourth objective of the study was to find out the availability and reliability of the resources and physical facilities present in the school that aid in the teaching and learning of Biology.

4.6.1 Library

The availability and reliability of the physical facilities as revealed by the researcher’s observation guideline is unraveled in table 4.24

<table>
<thead>
<tr>
<th>Table 4.24: Library Availability &amp; Reliability (N=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responses</td>
</tr>
<tr>
<td>Library Availability &amp; Reliability</td>
</tr>
<tr>
<td>Freq</td>
</tr>
</tbody>
</table>
Table 4.24 reveals that 3(75%) of the sampled schools did not have a library while only 1(25%) had a library that lacked Biology resources for borrowing. Though it was conveniently opened, this posed a challenge to teaching and learning Biology as there were no references for further reading by both teachers and students.

4.6.2 Laboratory

The findings on the availability and reliability of the laboratory in the sampled school are revealed in table 4.25.
Table 4.25: Laboratory Availability and Reliability  
(N=4)

<table>
<thead>
<tr>
<th>Responses</th>
<th>Laboratory availability &amp; reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
</tr>
<tr>
<td>Available</td>
<td>4</td>
</tr>
<tr>
<td>Not available</td>
<td>0</td>
</tr>
<tr>
<td>Well equipped</td>
<td>2</td>
</tr>
<tr>
<td>Not well equipped</td>
<td>2</td>
</tr>
<tr>
<td>Qualified lab technician</td>
<td>2</td>
</tr>
<tr>
<td>Unqualified lab technician</td>
<td>2</td>
</tr>
<tr>
<td>Number of available labs: 1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Biology lab present</td>
<td>1</td>
</tr>
<tr>
<td>Biology lab absent</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 4.25 reveals that all the sampled schools 4(100%) had laboratories in their schools. However only 2(50%) had well equipped laboratories while the other 2(50%) had poorly equipped laboratories which is a challenge to teaching Biology. Two (50%) of the sampled schools had
qualified lab technicians while 2(50%) had unqualified lab technicians. There was only 1(25%) of the sampled schools with three laboratories while one (25%) of the schools had a Biology laboratory alone. Three (75%) of the school had only one laboratory. The 4(100%) availability of physical facilities in the sampled schools is in agreement with Amanuel (2009) that laboratories are necessary in a school as instructional facilities for effective science programmes where development of scientific skills and attitudes are greatly facilitated. Lack of Biology resources in the library is a total disagreement with Femsa (2003) whose findings revealed that teachers and students should make use of available materials to improvise learning resources not available in their schools. The unequipped laboratories revealed by 2(50%) is in disagreement with Beynon (1997) whose findings reveals that facilities & resources well chosen contribute to proper pedagogical approaches of teaching where more student centred activities are dominant in a Biology class. The study findings are in agreement with the Ministry of Education (1973) that whenever it is possible science double lesson be taught in the lab as the laboratories were found to be available in 4(100%) of the schools.

The availability of the laboratories 4(100%) and library 1(25%) is also in agreement with Shiundu and Omulando (1992) that there should be resource centres in an education set up to foster learning. The availability of physical facilities i.e. the laboratory in 4(100%) of the school is also in agreement with Murithi et al (2004) who views resources and facilities as a conducive environment in which to carry out effective teaching.

4.6.3 Resources / Materials Available in the Laboratories

A resource used in Biology laboratories supports effective and meaningful learning of Biology. The table 4.26 reveals the availability and frequency of use of materials in the laboratory
Table 4.26: Availability and Frequency of Use of Biology Materials in the Laboratory

<table>
<thead>
<tr>
<th>No Materials</th>
<th>Adequate</th>
<th>Inadequate</th>
<th>Not There</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F %</td>
<td>F %</td>
<td>F %</td>
<td>F %</td>
<td>F %</td>
<td>F %</td>
</tr>
<tr>
<td>1. Common reagents</td>
<td>3 75</td>
<td>1 25</td>
<td>0 25</td>
<td>0 1</td>
<td>0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>2. Preserved specimen</td>
<td>2 50</td>
<td>2 50</td>
<td>0 0</td>
<td>2 50</td>
<td>0 0</td>
<td>2 50</td>
</tr>
<tr>
<td>3. Models</td>
<td>2 50</td>
<td>1 25</td>
<td>1 25</td>
<td>1 25</td>
<td>1 25</td>
<td>2 50</td>
</tr>
<tr>
<td>4. Charts</td>
<td>1 25</td>
<td>3 75</td>
<td>0 0</td>
<td>3 75</td>
<td>0 0</td>
<td>1 25</td>
</tr>
<tr>
<td>5. Diagrams</td>
<td>1 25</td>
<td>2 50</td>
<td>1 25</td>
<td>4 100</td>
<td>0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>6. Dissecting kit</td>
<td>0 1 25</td>
<td>3 75</td>
<td>0 0</td>
<td>2 50</td>
<td>2 50</td>
<td>0 0</td>
</tr>
<tr>
<td>7. Microscopes</td>
<td>50 1 25</td>
<td>1 25</td>
<td>1 25</td>
<td>3 75</td>
<td>1 25</td>
<td>0 0</td>
</tr>
<tr>
<td>8. Pictograms</td>
<td>0 0</td>
<td>0 0</td>
<td>4 100</td>
<td>0 10</td>
<td>0 0</td>
<td>4 100</td>
</tr>
<tr>
<td>9. Photographs</td>
<td>0 1 25</td>
<td>3 75</td>
<td>0 0</td>
<td>1 25</td>
<td>3 75</td>
<td>0 0</td>
</tr>
<tr>
<td>10. Herbarium</td>
<td>0 0</td>
<td>0 0</td>
<td>4 100</td>
<td>0 0</td>
<td>0 0</td>
<td>4 100</td>
</tr>
<tr>
<td>11. Vivarium</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>12. Botanical garden</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>25</td>
<td>3</td>
<td>75</td>
</tr>
</tbody>
</table>

Key: frequency of use

1 = Frequently

2 = Rarely

3 = Not used
Table 4.26 reveals that the key Biology resources available in the laboratory were common reagents as revealed by 3 (75%) of school, preserved specimen 2 (50%), models 2 (50%), charts 1 (25%), diagrams 1 (25%) and microscopes 2 (50%). Four (100%) of the schools revealed that diagrams are the most frequency sued 4 (100%) resources followed by charts 3 (75%) and preserved specimen 2 (50%). The Biology resources which are not there in the laboratories include pictograms as revealed by 4 (100%) of the school Herbarum and vivarum both also revealed by 4 (100%) of the school. The same resources were also not used in all the schools, 4 (100%) since they were not available. The frequency of use of the resources depends on their availability and if there are no resources for teaching Biology then these poses a major challenge.

The availability of resources as per this study is in agreement with Shiundu and Omulando (1992) that resources are necessary for improved conditions of learning. The resources used in the sampled schools were used by the teacher to make teaching more effective and meaningful to the learner. This is in agreement with Murithi et al (2004) who define a resource as any source of information or support that the teacher uses to make teaching more effective and meaningful to the learner. Using Biology resources as indicated in the study is as also in agreement with Babu (2005) who recognizes the need for science teachers to make full use of available learning equipments and resources so as to make students understand the concept. Not using some resources like herbarium 4 (100%), vivarum 4 (100%), botanical gardens 4 (100%) and pictograms 4 (100%), as revealed by this study is in total disagreement with Femsa (2003) who notes that its important that teachers and students make use of available materials to improvise learning resources not available in their schools. The findings of the failure to use these resources in biology lesson is in disagreement with Beynon (1997) who reveals that well chosen resources contribute to proper pedagogical approaches of teaching
where more students centred activities are dominant in a Biology class hence a major challenge to learning/teaching biology.

4. 6.4 Conclusions

The availability and reliability of both physical facilities and resources present in the school have a great bearing in the teaching & learning of biology. The findings of the study revealed that 3(75%) of the sampled schools lacked a library, only 1(25%) of the schools had a library that lacked Biology resources for borrowing and librarian is there. Hours for opening are however convenient. All the sampled schools 4(100%) have laboratories. However, only 2(50%) of the school have well equipped laboratory and 2(50%) have unequipped laboratory which poses a challenge to the teaching and learning of biology by SMASSE project approach. Two (50%) of the sampled schools have qualified lab technicians while 2(50%) have unqualified lab technicians which is a challenge to the teaching and learning of Biology.

Most of the sampled school, 3(75%) have only one laboratory hence they do not have a specific lab for Biology alone. The key resources used in Biology in the sampled schools that aid in learning include common reagents used in 3(75%) of the schools, preserved specimen in 2(50%) of the schools, models 2(50%), charts 1(25%) diagrams, 1(25%), and diagrams 1(25%). Diagrams are the most frequently used as revealed in 4(100%) of the school followed by charts 3(75%) then by preserved specimen 2(50%). So many important resources are missing in schools. They include pictograms in all 4(100%) of the schools Herbarum, vivarum and botanical gardens all missing in 4(100%) of the schools. The missing resources are not used in all the 4(100%) of the sampled school since they are unavailable. The frequency of use of the resources is reflected in their availability.
4.6.4   Recommendations

Schools in the District can apply for bursary funds to construct physical facilities like libraries and laboratories as well as equip them. The school can also solicit for funds from well wishers, NGOs, alumni and from sponsors so as to construct the libraries & laboratories.

The lab technicians should be incorporated into SMASSE INSET programmes to learn more on material improvisation. More INSET to be organized for teachers to keep themselves a breast with the current curriculum and pedagogical issues. Improvising is a key factor in ASEI hence teachers should be more innovative and creative. The Free Secondary Education Funds should be used to acquire the basic resources and facilities. The Biology teachers should combine several facilities and resources to make teaching & learning of Biology more interesting and thus motivating the students.

4.7   Interest in “Hand- on Activities

The fifth objective of this study was to determine the interest of the learners towards performing Biology Practicals in the laboratory by themselves.

4.7.1   Biology Practicals

The students gave their responses on the question; Do you perform Biology practical on your own? Their responses are given in table 4.27
Table 4.27: Performance of Biology Practical  
(N= 123)

<table>
<thead>
<tr>
<th>Responses</th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
<td>Freq</td>
<td>%</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Yes</td>
<td>41</td>
<td>33</td>
<td>50</td>
<td>41</td>
<td>91</td>
<td>74</td>
</tr>
<tr>
<td>No</td>
<td>8</td>
<td>7</td>
<td>24</td>
<td>19</td>
<td>32</td>
<td>26</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>40</td>
<td>74</td>
<td>60</td>
<td>123</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4.27 reveals that 91 (74%) of the student respondents perform Biology practical on their own. This shows they have high interest in “hands-on” activities. This is in agreement with SMASSE project (2004) that recommends “hand-on” activities to make learning learner-centred as the ASEI concept is being implemented. However, a large fraction of (26%) does not engage in “hand-on” activities. This could be due to lack of interest in practical work, negative attitude or lack of confidence in the learners which is a major challenge to learning of Biology.

According to the MoE (1976) the experimental approach is considered to the teaching of Sciences to encourage careful observation, recording and verifying scientific facts which correlates highly to the study findings that most students 91(74%) perform practical on their own. This is also in agreement
with Mugo et al (2005) that practical work approach to teaching learning of science enables learners to get more interested in the subject matter by seeing or by performing for themselves. Some of the responses given by the 32 (26%) of the respondents for not performing Practicals on their own are revealed in table 2.28.

<table>
<thead>
<tr>
<th>Response</th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Unavailability of resources</td>
<td>2</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Lack of time</td>
<td>2</td>
<td>6</td>
<td>3</td>
<td>9</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Don’t know Practical</td>
<td>2</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Lack of motivation</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>13</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Not given a chance</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>13</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Practicals are too easy</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Lack of self confidence</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 4.28: Reasons for not performing practical on their own (N= 32)
Among the key reasons for not performing practical were lack of time 5(16%) lack of motivation 4(13%) not given a chance 4(13%). Other reasons were lack of self confidence 2(6%), unavailable resources 2(6%) and learners do not know Practicals 3(9%).

### 4.7.2 Participation in Biology Practical Group Work

The students’ participation in Biology practical group work is revealed in table 4.29.

<table>
<thead>
<tr>
<th>Response</th>
<th>Males</th>
<th></th>
<th></th>
<th>Females</th>
<th></th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
<td></td>
<td>Freq</td>
<td>%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>22</td>
<td>18</td>
<td></td>
<td>35</td>
<td>28</td>
<td></td>
<td>57</td>
<td>46</td>
</tr>
<tr>
<td>Rarely</td>
<td>21</td>
<td>17</td>
<td></td>
<td>35</td>
<td>28</td>
<td></td>
<td>56</td>
<td>46</td>
</tr>
<tr>
<td>Not at all</td>
<td>6</td>
<td>5</td>
<td></td>
<td>4</td>
<td>4</td>
<td></td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>49</td>
<td>40</td>
<td></td>
<td>74</td>
<td>60</td>
<td></td>
<td>123</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4.29 reveals that 57(46%) of the respondents always participate in Biology group work during Biology Practicals. Fifty six (46%) rarely participate in biology group work. A group of 10(8%) do not participate at all. Effandi et el (2007) notes that the teachers think that students lack skills to work in groups. The findings do not correlate with effendis opinion as the highest percentage of 56(46%) is in agreement with Effandi (2007).
4.7.3 **Voluntary Clean Up.**

The frequency by which students volunteer to clean up the working area after the practical work is revealed in table 4.30.

**Table 4.30: Voluntary Clean Up**

<table>
<thead>
<tr>
<th>Response</th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
<td>freq</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum participation</td>
<td>16</td>
<td>13</td>
<td>19</td>
<td>19</td>
<td>39</td>
<td>32</td>
</tr>
<tr>
<td>Above average</td>
<td>10</td>
<td>8</td>
<td>25</td>
<td>20</td>
<td>35</td>
<td>28</td>
</tr>
<tr>
<td>Minimal participation</td>
<td>18</td>
<td>15</td>
<td>18</td>
<td>15</td>
<td>36</td>
<td>29</td>
</tr>
<tr>
<td>No participation</td>
<td>5</td>
<td>4</td>
<td>8</td>
<td>6</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>49</td>
<td>40</td>
<td>74</td>
<td>60</td>
<td>123</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4.30 reveals that the students who participates maximumly were 39(32%), above average participation were 35(28%) Minimum participation were 36(29%) while those who did not participate in volunteering to clean up the working area after the practical work were 13(11%) may be due to laziness. “Hands- on” activities are the key redagogy of teaching (SMASSE project, 2005). The findings on participation are in agreement with this requirement.
4.7.4 Teacher Appreciation to Learners’ Contribution

The teacher’s appreciation of learner’s contributions in Biology practical is revealed in table 4.31.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th></th>
<th></th>
<th>Females</th>
<th></th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td>Freq</td>
<td>%</td>
<td>Freq</td>
<td>%</td>
<td>Freq</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A great deal</td>
<td>10</td>
<td>8</td>
<td>16</td>
<td>13</td>
<td>26</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequately</td>
<td>11</td>
<td>9</td>
<td>20</td>
<td>16</td>
<td>31</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairly</td>
<td>22</td>
<td>18</td>
<td>34</td>
<td>28</td>
<td>56</td>
<td>46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A little</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>49</strong></td>
<td><strong>40</strong></td>
<td><strong>74</strong></td>
<td><strong>60</strong></td>
<td><strong>123</strong></td>
<td><strong>100</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.31 reveals that most of the learners’ contribution 56(46%) were fairly appreciated by the teacher. Twenty six (21%) of the learners’ contributions were appreciated a great deal while 31(25%) are adequately appreciated. However 5(4%) of the learners’ participation was a little appreciated while another 5(4%) is not appreciated at all may be because they did not participate in the practical class.
4.7.4 Conclusion

The interest of the learners to perform biology practical in the laboratory manually by themselves varied greatly from one individual to another. Most of the students respondents 91(74%) performed Biology practical on their own. However, a large number of 32(26%) of these respondents did not perform Biology practical on their own may not be due to lack of confidence, lack of interest or negative attitude posing a great challenge to teaching of Biology by SMASSE project approach. Among the key reasons for not performing biology practical among the thirty two respondents include; First, lack of time revealed by 5(16%) of the respondents, secondly, lack of motivation revealed 4(13%) of the respondents. Third, not being given a chance by the teacher by 4(13%) of the respondents. Fourth, lack of self confidence by 2(6%) and lastly learners lack resources by 2(6%). Most of the students 57(46%) participated in Biology group work. A group of 56 (46%) participated rarely while 10(8%) did not participate at all posing a major challenge to learning of Biology. Some students 39(32%) voluntarily cleaned up the working area maximumly. Others 35(29%) were above average in voluntary cleans up, 36(29%) participated maximally while 13(11%) did not participate at all may be due to laziness which is a challenge to learning of Biology. The teachers appreciate fairly to 56(46%) of the learners’ contribution, 26(21%) were appreciated a grate deal, 31(25%) were appreciated adequately, 5(4%) a little appreciation and another 5(4%) were not appreciated at all.

4.7.8 Recommendations

The teacher should motivate learners differently for example by verbal statement, shaking their hands appreciating their responses, encouraging them, congratulating them and rewarding them so that they can feel motivated to perform the Biology Practicals alone, be able to participate in
Biology practical group work and be able to voluntarily clean up the working areas. The teacher should allow learners to perform the Practicals individually.

CHAPTER FIVE

SUMMARY, CONCLUSIONS & RECOMMENDATIONS

5.1 Introduction

This chapter deals with summary of findings, conclusions and Recommendations organized per objective.

5.2 ASEI/PDSI CONCEPT

The first objective of this study was to find out the extent to which ASEI/ PDSI concept was understood by teacher with reference to teaching Biology.

5.2.1 Summary of findings

The findings on the use of ASEI lessons plan in the Biology class revealed that 2(50%) of the teachers had not embraced the use of the lesson plan. However 2(50%) of the Biology teacher planed their lesson according to the ASEI lesson plan approach. The findings also reveal that all the biology teacher respondents 4(100%) improvised the biology resources where conventional resources are not adequate. Most of the teachers 3(75%) used discussion methodology. One (25%) of the respondent used Practicals while the findings indicated that nobody 0(0%) used the out dated
lecture method which is teacher centred. The concept of plan Do, see, improve was not well understood by teachers as the findings reveal that all the teacher respondents 4(100%) did not teamwork in teaching.

5.2.2 Conclusion

The ASEI PDSI concept is not 100% understood by the Biology teachers since 2(50%) of the teachers do not plan their lessons which is a challenge in teaching Biology by SMASSE project approach. Another challenge emanating from the PDSI concept is that there is no teamwork among the teachers in this region under study.

5.2.3 Recommendations

After this study the researcher made the following recommendations;

First, the District Planning Committee should issue guidelines to make ASEI/ PDSI and SMASSE INSET compulsory to all Biology teachers. Second the district quality assurance & standards officer should take disciplinary action to biology teachers who fail to attend SMASSE INSETS the time they are scheduled to. Third, SMASSE certificates can be recognized finally to motivate the teachers fourth, the principals of schools should ensure there is even distribution of lessons and employ BOG teachers to solve the issue of team teaching and create time for ASEI lesson planning. Lastly teachers in nearby schools can create Biology subject panel and assist one another in lesson study, planning as a team and teaching the improved lessons.

5.3 Implementation of the ASEI/PDSI Concept
The second objective of this study was to find out how the ASEI/PDSI approach to the teaching of biology was being implemented in the classroom setting.

5.3.1 Summary of Findings

All the teacher respondents 4(100%) rely on demonstration and exercises to handle Biology practical lessons. However none 0(0%) of the teachers embrace discovery method of teaching Biology which is a key consideration for SMASSE project approach. Teachers have a very high workload where 3(75%) have over twenty lessons per week. This is a key hindrance to implementation of the ASEI/PDSI concept. Other hindrances to effective implementation of the ASEI/PDSI concept are: One, inadequate time 2(50%) for planning as a team, for creative improvisation and even teachers are unwilling to use their free time. Two, lack of motivation 1(25%) third, lack of funds by 1(25%) and lastly laziness revealed by 2(50%) of the respondents. The hindrances to improvisation includes, first, lack of time claimed by 3(75%) of the teacher. Second, too much workload claimed by 3(75%) of the respondents Third, unqualified lab technicians claimed by 3(75%) respondents. Fourth, lack of motivation from administration, lack of materials and inefficiency of improvisation were revealed by 2 (50%) of the respondents equally.

All the teachers 4(100%) claimed that the hindrance they face in planning for lessons were too many lessons and format of an ASEI lesson plan is too detailed. About 3(75%) of the teachers claimed to be experienced hence no need to plan for lessons on paper, inadequate time revealed by 3(75%) was also a hindrance. Inadequate facilities, large class of students and lack of motivation among teachers were all revealed by 2(50%) of the respondents as hindrance to include “hands-on” activities. The inability of students to work alone and pressure to cover the syllabus were also key
issues raised by all 4(100%) of the teacher respondents. Lack of planning for “hand-on’ activities was a hindrance to 1(25%) of the teachers.

The hindrance to be observed by other teachers were mainly due to having only one teacher by 4(100%) and fear of criticism 3(75%) intimidation by 2(50%) hinders lesson study. Lack of mastery of content was claimed by 1(25%) as another hindrance to lesson observation. The hindrance to have feedback or evaluation from students was due to lack oaf confidence by 4( 100%) respondents, idea is alien and faked expression by learners claimed by 3(75%). Other reasons includes not wanting challenges from students by 3(75%) fear of criticism, time limit and bad teacher- learner relationship all claimed by 2 (50%).

5.3.2 Conclusion

The implementation of ASEI/ PDSI concept has not been 100% because of various challenges as discovered from various channels of implementing the concept. They include: first, failure to use discovery method in Biology practical lessons which is a key requirement for SMASSE project approach so as to make lessons more of learner centred, second, high workloads of the teachers hindered them from implementing the ASEI/ PDSI approach, Third, lack of enough time to prepare the ASEI lessons was also sited as a major challenge. Fourth, there emerged lack of motivation to the teachers as their allowances were negligible and the idea of being accommodated in the dormitories during the INSETS did not augur well with teachers. Five, the large class sizes hindered the teacher-learner contact. Six, pressure to cover the syllabus was also a major hindrance to teaching by SMASSE project approach. Seven, unqualified lab technicians which is also key challenge. Eight, the format of the ASEI, lesson plan was too detailed to embrace by teachers as it entails introduction,
lesson development, conclusion & Evaluation. Nine, lack of funds, materials and inefficient improvisation where necessary posed a great challenge. Ten, the current regime of learners do not want “hand-on’ activities but are engaged more in IT. Lastly teachers do not embrace lesson study mainly because these upcoming schools have only one Biology teacher, lack of confidence in the teacher fear of criticism and some teachers claim they have many years of teaching experience.

5.3.3 Recommendations

The researcher made the following recommendations, first, all Biology teachers should be attending SMASSE INSETS, workshops and seminars to keep themselves abreast with upcoming pedagogies like integration of ICT in lesson plans so as to capture the interest of the learners in IT. Second, due to inadequate time to make the ASEI lessons plans the Science teachers should be exempted from other school duties so that they can have time to prepare for Practicals, as well as improvise materials for experiments. Third, teachers should be given incentives for adopting ASEI/ PDSI concept may be by developing a scheme or evaluating, identifying and rewarding the best implementers of the concept. The SMASSE certificates can also be used as basis for teacher promotions. Fourth, laboratory technicians could also be incorporated in the ASEI/ PDSI principles. In this way they can help biology teachers to plan for experiments and to improvise equipments where necessary. Fifth, all schools heads should be inducted on SMASSE issues so that they can save enough funds for purchase of science resource. The DPC should also avail all resources required for SMASSE training in the District SMASSE centres; there should be frequent classroom observation or lesson study by administrators. If this happens then the teacher in-charge of the lesson should
start giving their strengths followed by other team members and then, the teacher’s gives weakness of the lesson followed by other team members so as to improve on that lesson. Lastly, learners should be motivated to do “hands- on activities.

5.4 Students’ Attitude Towards Biology

The third objective of the study was to indentify student’s attitude towards Biology.

5.4.1 Summary of Findings

The findings on the choice of the best science subject of the learners revealed that 101 (82%) of the student respondents rated Biology as their best science subject, 11(9%) rated Chemistry as the best science subject and 6(5%) rated Physics as their best subject. However 5(4%) did not rate any Science subject as their best. This is an indication of negative attitude. One hundred and sixteen (94%) of the respondents expressed their interest in Biology lessons which means they have a positive attitude towards Biology subject only a small proportion of 7(6%) expressed lack of interest towards Biology probably the same group of students who did not rate biology as their best subject.

According to 121(98%) of the respondents, the biology teachers invites questions from the learners to making a learning environment friendly and also to change the negative attitude towards sciences by students. This also ensures the teacher demystifies Science. However it was evident that some teachers may not be inviting questions from the learners which poses a challenge to learners who
may not have understood a certain concept. When answering teachers questions 49 (40%) of the respondents would always answer them.

A large group of 70(57%) would answer teachers questions in rare occasions while a small fraction of 4(3%) of the respondents would never answer teachers questions a proof of lack of interest in the subject all. When it comes to asking their teachers questions only 93(76%) would ask questions to the teacher so as to seek clarification of areas not understood while 30(24%) of the respondents do not ask questions. In trying to seek how often the students participate in seeking clarification on areas not understood, 73(59%) of the student respondents rarely participated, 41(33%) always sought clarification which 9(7%) always sought clarification on areas not understood. This makes learning difficult. The performance in Biology exams after evaluations revealed that only 30(24%) of the respondents scored 70% and above, 47(39%) scored between 51-69% in exams while 25(22%) scored between 41-50% and 31(25%) revealed that they scored less than 40%. This indicates general poor performance in Biology may be due to the challenges both teachers and learners face as highlighted in chapter 4 of this study.

5.4.2 Conclusions

Students’ attitude towards Biology influences this class performance differently. Those students whose best Science subject was Biology have a positive attitude towards Biology and had interest in the Biology lessons. They also ask questions to their teachers and sought on clarification of ideas where they did not understand. Their teachers also invite questions from the students and finally this group performs better in Biology exams by scoring quality grades. However there exists a challenge to a second group of students who had negative attitude towards Biology as a Science
subject hence do not rate it as their best subject. The same group lacks interest in Biology lessons hence their teachers do not invite questions from them since they demotivate the teacher. The same group does not ask questions to seek clarification to their teacher and they do not answer teachers’ question hence they score poorly in Biology exams.

5.4.3 Recommendations

The researcher recommends guidance and counseling to poor performing students so that he can develop positive attitude to learning of Biology. Second, the teacher should motivate the learners either by verbal statements like very good, well done among others or through material rewards to the achievers. Third, the teacher should create a conducive learning environment so that learners can articulate scientific concepts competently. Fourth, the teacher should embrace ICT in ASEI lesson plans to develop curiosity and interest for the subject. Fifth, improvisation shall be effected where necessary so that students can incorporate scientific theoretical aspects into practice. Sixth, teachers should be able to deal with students who have poor social-economic background to adjust them in class. Seventh, the teacher needs to vary the pedagogy depending on the content being delivered to the learners. Finally, the biology teacher should also encourage peer teaching and group discussions so that students help one another.

5.5 Physical Facilities and Resources

The fourth objective of this study was to find out the availability and reliability of the resources and physical facilities present in the school that aided in the teaching and learning of Biology.
5.5.1 Summary of Findings

The researchers’ findings of this study revealed that 3(75%) of the sampled schools did not have a library which indicates there were no reference materials for use by students to study Biology on their own. Out of the sample school 1(25%) had a library but it lacked Biology resources materials for use although its hours of opening were convenient though it was not a reliable library for research or further reading by both teachers and students. The other physical facility of concern was the laboratory. The researchers findings revealed that all school 4(100%) had laboratories. However on 2(50%) of these laboratories were well equipped while the other 2(50%) had poorly equipped laboratories which is a challenge to effective teaching of Biology Practicals. Concerning the laboratories it was also revealed that 2(50%) school have qualified laboratory technicians while 2(50%) had unqualified lab technicians. There was only 1(25%) of the sampled schools with three laboratories while 1(25%) of the school had a Biology alone laboratory. The study findings also revealed that the key Biology resources and materials were available in the laboratories and they include common reagents available in 3(75%) of the school in the sample, preserved specimen were fond to be available in 2 (50%) models in 2(50%) and charts in 1(25%) of the schools. The diagrams were the most used resource as it is revealed by 4(10%) of the respondents followed by charts used in 3(75%) and preserved specimen in 2(50%) of the school. There were so many Biology resources which are key but they were not available and not reliable to the users. They included: one, pictograms which were not available and not used in all 4(100%) of the sampled schools, two, herbarium 4(100%), three, Vivarium 4(100%) and four, Botanical garden 4(100%). All these unavailable resources are not used at all in the sampled schools.
5.5.2 Conclusions

The availability and reliability of both physical facilities and resources present in the school have a great bearing in the teaching and learning of Biology. When they are available and reliable they aid in the teaching and learning of Biology as they make theoretical work real and easy to understand the theoretical concepts. The availability of libraries allow for further reading by both teachers and learners. The unavailability of libraries suppresses research work by learners & teachers. Laboratories on the other hand, aid in developing scientific skills of the learners. If there are no laboratories the teacher can conduct Practicals in the classroom or even outside the classroom to aid in acquisition of the necessary scientific skills. Where laboratories are present they should be well equipped and have a qualified laboratory technician to aid in learning. Lack of basic resources in the laboratory hinders learning of biology. However it was noted that some of the basic resources were available in the laboratories.

5.5.3 Recommendations

The researcher recommends that school lacking the physical facilities can apply for bursary funds like the Constituency Development Funds, Government Grants, Contributions from well wishers, sponsors parents and school alumni so as to avail these facilities and equip them with the required resources. Another recommendation is for the Biology teacher to combine several facilities and resources which are well chosen to make the teaching/learning of biology more interesting and motivating to students. Teachers are also recommended to improvise resources where conventional ones are lacking. Then another recommendation is to teach Biology Practicals in the classroom or
outside the classrooms where there are no laboratories. Teachers should also attend more workshop & seminars to keep abreast with emerging issues.

5.6 **Interests in “Hand –on” Activities**

The fifth objective of this study was to determine the interest of the learners towards performing Biology practical in the laboratory by themselves.

5.6.1 **Summary of Findings**

From the findings of the students performing Biology Practicals, 91(74%) of the students respondents revealed that they perform Biology Practicals on their own, however a large fraction of 32(26%) do not engage on “hand-on” activities like manually performing the Practicals on their own. Among the reasons given by the thirty two who do not perform Biology Practicals on their own includes: one, lack of time revealed by 5(16%) of the respondents, two, lack of self motivation by 4(13%), three, not given a chance duet large groups, 4(13%) , four, lack of self confidence 2(16%) are unavailability of resources 2(6%) and lastly learners do not know Practicals revealed by 3(9%) of the respondents. On their participation in Biology group work 57(46%) of the respondents always participate 56(46%) rarely participate in biology group work while 10(8%) do not participate at all. The students who voluntarily participate to the working area to clean up maximumly were 39(32%), those whose participation is above average was  35(28%), those with minimum participation were 36(29%) while those who do not do volunteer to clean up working areas at all were 13(11%). On teachers appreciation to learners contributions in biology practical, 56(46%) indicated that their contributions were fairly appreciated by the teacher, 26(21%) revealed that their contributions were appreciated a great deal, 31(25%) revealed that their contributions were adequately appreciated,
5(4%) indicated little appreciation while another 5(4%) revealed no appreciation at all to their participation.

5.6.2 Conclusion

The interest of the learners to perform Biology Practicals in the laboratory manually by themselves varied greatly from one individual to another. Most of those who do not perform Practicals on their own gave the following as the hindrances. One, lack of time to do the work allocated to them by the teachers. Two, lack of self motivation since they lacked intrinsic self motivation hence not interested in manual work. Three, some were not given a chance to participate in Practicals mainly due the high teacher: student’s ratios of over 1: 65. Four. Lack of self confidence and lastly inadequate resources for practical work. Quite a large percentage of 66(54%) either rarely or do not participate in “hand-on” activities. Most of the students seemed not to do voluntary work like cleaning working areas. Some students also feel like the teacher does not appreciate their contributions and may be they then developed a negative attitude towards performing “hand –on” activities.

5.6.3 Recommendations

From these findings researcher recommends that: first teachers should motivate learners and encourage them to participate more on the “hand- on” activities. Second, the teachers should encourage group work participation. Third, all resources should be available for learners to manipulate during the biology lesson at individual level. Fourth, teachers in the study region can organize Biology symposium to foster group work. Lastly the teacher should be available always to supervise the practical lesson, to guide the learners, to correct their misconceptions and also to ensure that every learner participates fully.
5.7 Overall Conclusion

In conclusion all the five objectives of the study were achieved. The first objective was to find out the extent to which ASEI/PDSI concept was understood by teacher with reference to teaching Biology. The study findings revealed that the understanding of the ASEI/PDSI concept is still wanting as its application is not understood by 100% of the teachers. The second objective was to find out how the ASEI/ PDSI approach to the teaching of Biology was being implemented in the classroom setting. The study findings revealed that the implementation of ASEI/PDSI concept is not 100% perfect. The third objective was to indentify student’s attitude towards Biology. The study findings unraveled that attitude of the learners has a great influence to the learners class performance but differently. The fourth objective was to find out the availability and reliability of the resources and physical facilities present in the school that aided in the teaching of Biology. The study findings revealed that the availability and reliability of the resources and physical facilities have a great bearing to the teaching & learning of Biology. The fifth objective was to determine the interest of the learners towards performing Biology practical in the laboratory by themselves and the challenges they face. The research findings revealed that the learners’ interest to perform Biology Practicals in the lab manually by themselves varied greatly from one individual to another.

5.8 Recommendations for Further Research

This study only concentrated on the challenges of teaching and learning Biology by SMASSE project approach among secondary schools in Mbeere south district, Embu County, Kenya. A similar study should be carried out by other interested scholars in the same region to gather adequate and generalizable information on the subject. The researcher would also like to suggest a study on
challenges facing teaching & learning of Science by SMASSE approach in the primary schools in the District.

REFERENCES


Daily Nation (4/3/10) page 4, column 2.


Dear Sir/Madam,

This questionnaire is meant to obtain confidential information for use by the Research on the implementation of ASEI/PDSI approach to the teaching and learning of Biology in our Secondary Schools. It is also meant to obtain information on challenges faced by Biology teachers while implementing the concept. It will also seek your suggestion on how this concept implementation can be enhanced. Kindly answer all the questions to the best of your ability or tick where appropriate.

DATE ........................................

SCHOOL: ........................................

DISTRICT: ........................................

SEX:  MALE { }  FEMALE { }
SECTION ONE: ASEI/ PDSI CONCEPT

Q1). Do you plan your lesson according to the ASEI approach lesson plan?

   Yes {   } No {   }

Q2). Do you improvise resources in the teaching of Biology? Yes {   } No {   }

Q3). How do students learn Biology lessons in class? 1. Discussion 2 Practical

   3. Lecture

Q4). Do you team teach with other SMASSE teachers in your school?

   Yes {   } No {   } If yes do you critic your lessons Yes {   } No {   }

SECTION TWO: ASEI/ PDSI IMPLEMENTATION

Q5). How do you handle the Biology practical lesson?

   1. Demonstration {   } 2. Exercise {   } 3. Discovery {   }

Q6). How many classes do you teach Biology?..............................................................

Q7). What is your weekly workload?...............................................................................

127
Q8). How do you motivate your students in Biology classes?.................................

Q9). State the factors that would make a Biology teacher not to carry out
the following in his/her teaching even after attending the SMASSE INSETS.

(a) Focus on the students and involve them wholly in the learning process
(learner-centered).
................................................................................................................
................................................................................................................
................................................................................................................

(b) Designing of research based approach to experimentation in teaching Biology.
................................................................................................................
................................................................................................................
................................................................................................................

(c) Use improvisation in absence of conventional equipments/apparatus.
................................................................................................................
................................................................................................................
................................................................................................................

(d) Plan for their lessons
................................................................................................................
................................................................................................................
................................................................................................................

(e) Include ‘hands-on’ activities that would enhance student participation and learning.
(f) Allow another teacher to observe you while you teach in class?

........................................................................................................

........................................................................................................

(g) Evaluate your performance by getting feedback from the students.

........................................................................................................

........................................................................................................

Q10). What recommendations would you make to the District Planning Committee concerning the implementation of ASEI/PDSI approach to teaching and learning of Biology in the secondary schools?

........................................................................................................

........................................................................................................

........................................................................................................

........................................................................................................
Appendix 2

STUDENT QUESTIONNAIRE ON ASSESSMENT AND PARTICIPATION IN BIOLOGY CLASSES.
Dear Student,

This questionnaire is meant to obtain information on your participation in classroom activities during teaching and learning. You need not indicate your name on the questionnaire but please answer all the questions. The information you give will be treated with strict confidence.

Tick or fill the blank spaces as may be appropriate.

SECTION ONE

SCHOOL: ...........................................

CLASS...........................................

DATE ...........................................

SEX: MALE { } FEMALE { }

SECTION TWO: ATTITUDE TOWARDS BIOLOGY

Q1). Which is your best science subject?.................................................................

Q2). Are Biology lessons interesting to you? Ye { } No { }

Q3). Does your Biology teacher invite questions from the students? Yes { } No { }
Q4). How much do you participate in seeking clarification on areas not understood?

1. not at all 2. Rarely 3. Always

Q5). Do you ask questions to the teacher? Yes {   } No. {     }

Q6). Do you answer teacher’s Questions?

1. Not at all 2. Rarely 3. Always

Q7). What is your average mark in Biology Exams?

1. Below 40% 2. Between 41 – 50% 3. 51- 60% 4. 70 % and above

SECTION THREE: INTEREST TOWARDS BIOLOGY PRACTICALS

Q8). Do you perform Biology practicals on your own Yes {   } No {   }.

If your answer is No explain why?

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................
Q9). How much does your teacher appreciate your contributions in Biology practical class


Q10). How much do you participate in group work?

1. Not at all  2. Rarely  3. Always

Q11). How often do you volunteer to clean the working area after the Biology Practical activity?

1. No participation  2. Minimal participation  3. Above average
4. Maximum participation.

Appendix 3

RESEARCHER’S OBSERVATION GUIDELINE
SCHOOL …………………………………………

FACILITIES AND RESOURCES

1. LIBRARY

Is it designed like a library or Not/ If not, how is it designed?

...................................................................................................................

...................................................................................................................

Are opening hours convenient and sufficient?

...................................................................................................................

Are there librarians? If not, who is responsible?

...................................................................................................................

Are there enough Biology resources for borrowing?

...................................................................................................................

Which resources are available for use?

...................................................................................................................

2. LABORATORY

Are there laboratories?...........................................................................................................................

How many labs are there in the school? {1}………….{ 2}…………..{3}…………..
Well or not well equipped?

Is there one for Biology alone?

Is there a qualified lab assistant?

What materials are available in this laboratory and how frequently are they used?

<table>
<thead>
<tr>
<th>No.</th>
<th>Material</th>
<th>Availability</th>
<th>Frequency of use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Adequate</td>
<td>Inadequate</td>
</tr>
<tr>
<td>1.</td>
<td>Common Reagents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Preserved specimen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Charts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Diagrams</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Dissecting kits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Microscopes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Pictograms</td>
<td></td>
<td></td>
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<tr>
<td>----</td>
<td>------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>9.</td>
<td>Photographs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Herbarium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Vivarium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Botanical garden</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Frequency of use: 1= frequently    2= Rarely    3= Not used

3. TEACHING METHODS

How do teachers approach the lesson in class and in the lab?

..........................................................................................................

..........................................................................................................

Are specimen for each experiment well presented or collected?...............................

Are improvised materials used?..............................................................................

Do teachers’ lesson look captivating to the learners?..............................................

Are they student centred?.......................................................................................

Do students participate in their Biology classes?.....................................................

Appendix 4

Research Authorization
Appendix 5

Working time Schedule
## Appendix 6

### BUDGET

<table>
<thead>
<tr>
<th>NO</th>
<th>ACTIVITY</th>
<th>COST (KSH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Proposal typing 45 pages @ 25/=</td>
<td>1,125</td>
</tr>
<tr>
<td>2.</td>
<td>Concept paper typing</td>
<td>1,000</td>
</tr>
<tr>
<td>3.</td>
<td>Binding of proposal</td>
<td>50</td>
</tr>
<tr>
<td>4.</td>
<td>Literature Review</td>
<td>1,600</td>
</tr>
<tr>
<td></td>
<td>- Lunches</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Travelling</td>
<td>4,000</td>
</tr>
<tr>
<td></td>
<td>Research instruments - Typing 10 pgs</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Data collection - Travelling</td>
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</tr>
<tr>
<td></td>
<td>Data analysis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Report writing</td>
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</tr>
<tr>
<td></td>
<td>Report binding</td>
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</tr>
<tr>
<td></td>
<td>Contingency costs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTAL COST</td>
<td></td>
</tr>
</tbody>
</table>
The principal,

----------  Sec school,

Dear sir/madam,

Re: Data collection

I wish to request for permission to collect data from your school on ---------------- at 9 a.m concerning the Challenges facing the teachers and learners in the teaching and learning of Biology by SMASSE project. The information will be used to assist in better delivery of SMASSE project.

Thank you.

Yours faithfully,

Zipporah Njiru
Appendix 8

SKETCH MAP OF LOCALE

RIVER SAGANA