THE IMPACT OF ASEI MOVEMENT ON STUDENTS’ ACHIEVEMENT IN SECONDARY SCHOOL BIOLOGY IN NAKURU COUNTY, KENYA

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DECLARATION

This is my original work and has not been submitted for a degree in any other university

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ABSTRACT

The purpose of the study was to assess the extent to which the ASEI movement and lecture method of instruction had an impact on students’ biology achievement in Nakuru County. The objectives of the study were threefold: the first objective was to find out the attitude of students towards the teaching/learning of biology. The second one was to find out the type of teaching/learning methods/approaches used by teachers of biology in teaching the subject; to find out the extent to which the principle of ASEI movement influences students’ achievement in Biology. The study reviewed literature related to the study and was justified by supporting agencies like the Japanese International Cooperation Agency (JICA) and the Strengthening of Mathematics and Science in Secondary Education (SMASSE) projects. The study employed Ex-Post-Facto research design where both the “treatment” and “control” groups exist, but are not assigned or manipulated by the researcher. Secondly, there is no manipulation of conditions under which the study is being conducted. The ASEI movement was the independent variable while students’ achievement in biology was the dependent variable. The pilot study was carried out on ten students in two identical schools which were not included in the study. The face and content validity of the instruments were determined by subject experts in biology while reliability was done by use of the test-retest method. Seven secondary schools out of the 75 public schools in Nakuru County were purposively sampled using the criteria of each school’s status (day or boarding), gender (boys, girls or mixed) and location (urban or rural). From the sampled schools, an equal number of four students was selected from form three and form four classes. Two teachers of biology, one head of department (Science) and one head teacher were selected from each school that was sampled. Data were collected using lesson observation schedule and questionnaires. Data were analysed using the Chi-Square statistic ($\chi^2$) with the help of the Statistical Package for Social Sciences (SPSS version 17). Descriptive statistics such as percentages and means were presented using tables, charts and graphs. The study established that the ASEI movement changed the attitude of students and teachers towards biology education. Findings showed that there was a high positive relationship between attitude and student achievement in biology. The study also found that those teachers who had attended in-service training developed skills in areas of improvisation and small scale experiments which encouraged student-centred participatory learning in the classroom. The study concluded that curriculum developers and planners should find it beneficial to incorporate the ASEI movement during the implementation of school curricula. Apart from adding to existing knowledge, the findings of this study would be expected to add to the existing knowledge in the teaching of biology. The study recommended that student-centred learning be introduced and used in teaching other science subjects. The use of ASEI movement in our schools should be encouraged and all serving teachers should continue attending in-service courses to entrench the strategies advocated by the ASEI movement towards improving learner achievement in biology.
ABBREVIATIONS AND ACRONYMS

ADEA  Association for the Development of Education in Africa
ASEI  Activity, Student-Centred, Experiments, Improvisation
INSET  In-Service Training
JICA  Japanese International Cooperation Agency
KCSE  Kenya Certificate of Secondary Education
KNEC  Kenya National Examinations Council
MOEST  Ministry of Education, Science and Technology
NEPAD  New Partnership of Africa’s Development
PDSI  Plan, Do, See, Improve
SMASSE  Strengthening of Mathematics and Science in Secondary Education
SSP  School Science Project
WECSA  Western, Eastern, Central and South Africa

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CHAPTER ONE

INTRODUCTION

1.1 Background Information

Despite biology being considered the easiest and the most popular of the science subjects, students’ achievement at the Kenya Certificate of Secondary Education (KCSE) has generally remained below average, which poses a great challenge to all stakeholders in education, including teachers of biology, who put in so much effort in teaching (KNEC, 2005). According to the KNEC (2005), there has been a general decline in achievement in biology since 1998, despite an increase in candidature. Table 1.1 shows learners’ achievement in biology in the KCSE examinations between 2001 and 2005.

<table>
<thead>
<tr>
<th>Year</th>
<th>Candidature Number</th>
<th>Maximum Score</th>
<th>Mean Score (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>176,954</td>
<td>160</td>
<td>43.99</td>
</tr>
<tr>
<td>2002</td>
<td>177,251</td>
<td>160</td>
<td>36.24</td>
</tr>
<tr>
<td>2003</td>
<td>184,438</td>
<td>160</td>
<td>41.11</td>
</tr>
<tr>
<td>2004</td>
<td>200,797</td>
<td>160</td>
<td>49.07</td>
</tr>
<tr>
<td>2005</td>
<td>234,975</td>
<td>160</td>
<td>41.59</td>
</tr>
</tbody>
</table>

Source: KNEC, 2002; 2003; 2004; 2005

It can be observed from the table that although the candidature has been increasing since the year 2001, the mean score remains below average. Several factors
have been cited as the causative agents for the poor achievement which include poorly equipped laboratories, the relative inexperience and inappropriate training of the cadre of biology teachers, the negative attitude brought about by the low scores attained in tests and subject factors such as very wide subject area and the use of theoretical concepts in teaching the subject (KNEC, 2005).

All over the world, educationists have been struggling to develop methods/approaches that can optimise the implementation of the teaching/learning strategies. However, there are various challenges brought about by the rapid changes in the teaching approaches that enhance the learning of sciences because of the new curricula in different countries all over the world. Traditionally, biology has been taught as a body of established knowledge in form of passive-receptive experience which emphasises on lecture method i.e. chalk and talk or the expository approach, with the teacher giving factual information with little or no learner participation or practical activities (Teacher-Centred Teaching Strategy). This method is out-dated because it does not offer training for the attainment of scientific skills and the content is quickly forgotten by students. The empiricist approach where biological knowledge is acquired through observation, recording, data analysis and drawing conclusions by the students consumes a lot of time and is not suitable to cover the wide biology syllabus (SMASSE, 1999).

The Nuffield School Science Project (SSP) which began in 1960 introduced pupil-centred approaches such as inquiry/discovery and the constructivist approaches which stressed upon the teacher involving the learners in activities that help in the development of scientific skills such as making observations, analysis and presenting
results (SMASSE, 1998). According to Namuddu (1989), the use of discovery approach was demonstrated during teachers’ In-Service Training (INSET) courses but the new knowledge was not transferred to the classrooms due to the following factors; the importance of instruction and didactic approaches in giving facts and demonstrating skills due to the wide syllabuses, few instructional resources, large class sizes, and the nature and influence of public examinations. Curriculum developers and those conducting INSET assumed that classroom teachers saw the need or importance of changing the teaching/learning approach and therefore the courses presented did not refer to a change in the teachers’ attitudes and perceptions. The Ministry of Education in Kenya did little to monitor the implementation of the new curriculum and discover its interactions with the teachers (Namuddu, 1989).

The achievements of the Strengthening of Mathematics and Science in Secondary Education (SMASSE) project in Japan and the Philipines attracted the interest of development bodies such as the Association for the Development of Education in Africa (ADEA) and the New Partnership of Africa’s Development (NEPAD) where the latter signed a letter of understanding with SMASSE, Western, Central and South Africa (WECSA) to jointly develop activities in relation to Strengthening of Mathematics and Science in Secondary Education in Africa (SMASSE, 1999).

The SMASSE Project is a joint venture that is sponsored by the government of Japan, represented by the Japanese International Cooperation Agency (JICA) and the government of Kenya represented by the Ministry of Education Science and Technology (MOEST). The first phase of the project was started in Kenya in July 1998 and piloted in
nine Districts and in October 2000, an additional six Districts were brought on board through in-country training programme, after mid-term evaluation of the project. By July 2003, the second phase of the project was launched to cover the whole country (SMASSE, 1999).

SMASSE Project activities are aimed at realising the project’s overall goal of enhancing the capability of young Kenyans in mathematics and science. The main outputs of the project were the establishment of an INSET system at the Kenya Science Teachers’ College and in pilot Districts whose purpose was to strengthen the quality of mathematics and science education (Physics, Chemistry, Biology) in secondary schools in Kenya through In-Service Training of serving teachers. A cascade system is used to guarantee INSET system institutionalisation and human capacity by being organised at the national level where District trainers are trained by national trainers and at District level where District trainers carry out INSET activities training mathematics and science teachers at District INSET centres. After training, teachers implement acquired skills in their classrooms (SMASSE, 1999).

The INSET for the course is based upon the needs of the teachers which are revealed through baseline studies whose findings are key in the development of INSET curriculum, workshop and sensitisation programmes. Baseline studies conducted by the SMASSE Project Monitoring and Evaluation taskforce in Kenya in 1998 established that educationists isolated certain major areas as the causative factors for the negative attitude towards mathematics and science education. These factors include: pedagogy, methodology, subject, distribution and utilisation of resources, development of teaching
and learning resources and those factors that involve administration and management (SMASSE, 2005).

According to SMASSE (1999), baseline studies indicated that negative/neutral attitude is one of the main contributing factors of poor achievement in mathematics and science. In the first cycle of the INSET, emphasis is laid on attaining a positive change of attitude among the two key stakeholders i.e. teachers and learners. In addition, biology covers areas in the subject that are centred on theoretical pedagogical issues to tackle the attitude problem. In the second cycle of the INSET, the approach is practical/activity oriented which is done through providing hands-on experience. This is designed to provide teachers with opportunities of ‘doing’ instead of being ‘told’ therefore, translating theory into practice through actual achievement of suitable experiments and practical work. The guiding principle is Activity, Student-centred, Experimentation and Improvisation (ASEI) movement which is important components in the teaching method that SMASSE Project aims to disseminate to the teacher through INSET training using the Plan, Do, See, Improve (PDSI) approach that is used to implement the ASEI movement. The ASEI/PDSI principles give the teacher an experience on how to design/select and carry out suitable classroom teaching/learning activities. The third cycle of the INSET focuses on classroom implementation of the principle of ASEI/PDSI whereby activities are designed to transform the concept of ASEI from theory into practice, in what is known as ‘Actualisation of ASEI’. The fourth cycle of the INSET is impact transfer whose main focus is to prepare the teachers on how to organise and conduct future INSETS in their Districts.
The expected outcomes of the first three cycles of the INSETs are that the activities covered were assist in:

i) Bringing positive attitude towards mathematics and science among participants i.e. teachers and their students.

ii) Enhancing the teacher’s ability to plan and implement ASEI lessons in the school and to translate theoretical pedagogical issues into actual practice in the classroom.

iii) Enabling the teachers to develop skills in the areas of improvisation and scaling down and simplification of experiments.

In December 2000, the SMASSE Project Monitoring and Evaluation taskforce conducted a mid-term evaluation to assess the impact of the INSET, which was done by use of a number of instruments for obtaining data to evaluate the quality of teaching/learning such as lesson observation instrument, an ASEI/PDSI checklist, free description of lesson by the teacher and quality of participation questionnaire which is given to students after a lesson. Results of the Monitoring and Evaluation taskforce showed that the effectiveness of the project was mostly achieved with a positive impact, very high relevance and high sustainability level. Evaluation carried out in October 2002 in the pilot Districts showed that through INSET, the aspects of activity, experiment and improvisation had improved considerably but the improvement in students through questioning and discussion i.e. student-centredness was not significant (SMASSE, 2005).
The results of the taskforce also showed a marked improvement in KCSE performance in almost all schools where teachers had attended INSETs. Baseline studies done in the pilot Districts in 2002 using 274 students and 51 biology teachers as respondents showed that most students found biology to be very interesting and a positive attitude had been created by the INSETs. However, no research has been conducted to examine the effect of ASEI/PDSI movement on learners’ achievement in biology.

1.2 Statement of the Problem

The Kenya National Examinations Council reports of 2001 to 2005 shows a decline in achievement in science and some of the factors that led to poor achievement in biology included lack of exposure to practical work, negative attitude, lack of skills in making observations, recording, drawing, subject content factors and poor coverage of the syllabus. In order to stop the decline in achievement in science, there was need for intervention in methods of instruction employed in the teaching of biology in secondary schools. This study therefore sought to find out if student-centred teaching methods, as introduced by the ASEI movement, used by teachers of biology had any impact on students’ achievement.

1.3 Purpose of the Study

The main purpose for this study was to find out the extent to which the ASEI movement involving student-centred learning had impacted on student achievement in biology in Nakuru County.
1.4 Objectives of the Study

The objectives of the study were to:

1. To find out the contribution of students’ attitude towards the learning of biology and students’ performance.

2. To investigate the effect of the type of teaching/learning methods used by teachers of biology in teaching the subject and students’ performance in biology.

3. To assess the extent to which the principle of ASEI movement influences students’ achievement in biology

1.5 Hypotheses

The following null hypotheses were tested;

\( H_{01} \): There is no significant association between ASEI teaching methods and students’ performance in biology.

\( H_{02} \): There is no relationship between students’ attitude towards biology and their performance in biology

1.6 Research Assumptions

The following assumptions were made in the proposed study:

i) There is a strong desire by the students to perform well in biology.

ii) All teachers of biology in the selected schools have attended the four cycles of INSET on the principle of ASEI movement/PDSI approach.

iii) The principle of ASEI movement/PDSI approach has had an influence on the teaching / learning of biology.
1.7 Limitations of the Study

The study had the following limitations:

i) The time allocated for this research was not enough to carry out extensive
research in most schools in the larger Nakuru County. The researcher was,
therefore, confined to those schools that are within easy reach for quick access to
data.

ii) There was limited access to some of the participants such as Head Teachers. To
overcome this, the questionnaires were left with the respondents to be collected
later after a period of two weeks.

1.8 Delimitations of the Study

The proposed study confined itself to:

a) The study limited itself to selected public secondary schools in Nakuru County
only. To have a more conclusive study, all schools, including private schools
should have been studied. However, this was not possible because of time and
financial constraints.

b) The study could only involve the form three and form four students in selected
public secondary schools that were in session at the time of the study while
excluding those who were not available.

c) Teachers of biology, heads of science department and head teachers who had been
teaching for more than five years in selected secondary schools and had also
attended the four cycles of the SMASSE INSET.
d) Although several factors had affected students’ achievement in biology, such as socio-cultural factors, school type and characteristics, school resources etc, the study only focused on the teaching / learning approach based on the principle of ASEI movement/PDSI approach.

1.9 Significance of the Study

This study was supposed to assess the impact of the ASEI movement, compared with the lecture method, on the teaching / learning of biology and the achievement level of students. This was expected to have both theoretical and practical implications in the future of biology education in that the study was expected to contribute to the advancement of the teaching / learning approaches that would lead to better achievement in the subject and the knowledge of some of the factors that affect student achievement. The research was to provide a feedback to the sponsors of the SMASSE Project i.e. JICA and the Ministry of Education, Science and Technology which would assist in promoting the project. The study was also expected to assist in filling in gaps and form a basis for other studies.

1.10 Theoretical Framework

The theoretical framework was based upon the “Classical Operant Conditioning” developed by B. F. Skinner (1904-1990) who argues that “The organism is in the process of “operating” on the environment in which it lives (Orodho, 2009). During this “operating,” the organism encounters a special kind of stimulus, called a reinforcing stimulus (reinforcer). This special stimulus has the effect of increasing the operant / behaviour occurring just before the reinforcer. This is operant conditioning where the
behaviour is followed by a consequence, and the nature of the consequence modifies the organism’s tendency to repeat the behaviour in the future.” A behaviour followed by a reinforcing stimulus results in an increased probability of that behaviour occurring in the future. Thus, a reward induces positive motivation and subsequent high achievement. On the contrary, a behaviour that is no longer followed by the reinforcing stimulus results in a decreased probability of that behaviour occurring in the future (Orodho, 2005; Boeree, 2006). In this study, the reinforcing stimulus was the new teaching strategy introduced in schools through the ASEI movement, which replaced the traditional chalk and talk strategy (Lecture Method). During learning experiences in class, this stimulus were expected to condition students of biology towards the positive changes (consequences) expected in their achievement in KCSE Biology examinations.

1.11 The Conceptual Framework

The conceptual framework which borrows from B. F. Skinner Classical Operant Conditioning shows the possible relationship between ASEI/PDSI teaching method (Independent Variable) and resultant changes in students’ achievement in Biology (Dependent Variable). The introduction of the SMASSE project in secondary schools in kenya introduced the ASEI/PDSI teaching method to replace the traditional teaching method. This new approach was inculcated in teachers through school holiday INSET in-service training. Students who have been taught under the new approach are expected to exhibit change in their achievement in KCSE biology.
Figure 1.1:
The Conceptual Framework showing the relationship between ASEI movements’ Teaching Strategy and expected change in students’ achievement in Biology.

The relationships between the independent and dependent variables are illustrated in Figure 1.1.
a). Independent Variable

The independent variable comprised the ASEI movement / PDSI approach whereby: the ASEI movement involved instructional procedures that stressed upon learning that is Activity-Based, Student-Centred, Experimental and based on Improvisation. In this study, the ASEI movement was considered to be the experimental treatment or new mode of instruction. The instructional process was broken down as follows;

Activity-Based teaching / learning involves students in hands-on / mind-on activities which should arouse and sustain their interests.

Student-Centred teaching / learning starts with planning, which involves preparing small steps whereby the teacher guides the students to learn step by step by themselves, through questioning, discussion, and confirming their understanding at each step. The teacher should solicit students’ opinions/ideas on the content being taught and also correct students’ misconceptions.

Experimental work, as opposed to theoretical learning, whereby the teacher should plan for many simple, small-scale experiments and also ensure the appropriateness of class demonstrations and teaching aids.

Improvisation of the teaching / learning resources as and when necessary. The teacher should develop skills and ensure the economy of improvised materials. The aim of the ASEI movement is to cause a shift from ineffective classroom practices to effective classroom practice after INSET. The ASEI movement is implemented based upon the PDSI approach which refers to Plan, Do, See and Improve.
Plan where the teacher should prepare small steps so that students can follow the logical flow of the lesson. At various stages, students should be asked prepared questions and the teacher should also prepare to answer the questions from the students, addressing any difficulties and misconceptions.

Do - The teacher should confirm students’ understanding on the concepts at each step and ask them questions to help them think. The teacher should create a friendly atmosphere to enable students to ask questions. The curiosity and interest of the students should be aroused during the lesson and at each step. The teacher should make a clear learning point to focus the students on it.

See - Ask questions to confirm students’ understanding of the concepts at each step.

Improve – If necessary, smaller steps should be built so that the students can learn on their own.

Didactic Teaching Strategies: Another independent variable was the Didactic Teaching Strategies which are commonly used in secondary schools in Kenya. The mode of instruction involves use of the traditional chalk and talk strategy (Lecture Method), where the teacher seeks to create interest, influence and stimulate his students and gets them involved in learning by use of the verbal message (Mukwa & Otieno-Jowi, 1988).

In this study, Didactic Teaching Strategies were considered to be the control treatment or traditional mode of instruction.

b). Dependent Variable

The expected outcomes from the SMASSE INSET are the effects it would have on both the teacher and the student. At the end of the four cycles of the INSET, the effect on the
teacher will be a change from negative/neutral to positive in teaching of biology. The INSET will enhance the teacher’s ability to plan and implement the ASEI lessons, small-scale experiments and develop the ability to bridge between practical work concepts, guide class discussions and improvise as and when necessary. The resulting changes in the student were to be student-centred learning that would highly motivate and create interest in learning biology, thereby, leading to a positive attitude and consequent excellent achievement in biology.

1.12 Operational Definition of central terms

*Achivement:* A person’s success attained through effort and skill which can be assessed by means of a testing device. In this study, this was represented by scores attained in the KCSE biology examinations. The score in biology comprised learners’ achievement in all questions administered in the biology examination at the national level.

*Biology:* The science of the physical life of animals and plants (Hornby, 1979). In this study, the term was adopted and used as defined. The term ‘biology’ was therefore, used holistically, incorporating all branches of the subject as is taken in secondary schools.

*Ex-Post Facto Research Design:* in this design, both the “treatment” and “control” groups exist, but are not assigned or manipulated by the researcher. Secondly, there is no manipulation of conditions under which the study is being conducted. The researcher observes conditions in their natural settings, extracts information and analyses the findings.
**Purposive Sampling:** This is a form of sampling where the investigator uses their expert judgment to select units that are representative of the population. Subjects are chosen according to a certain specified criteria.

**Student-Centred Teaching Strategy:** An approach in which the teacher plays the role of a facilitator in helping the student to understand the required knowledge and skills in small steps thus ensuring the acquisition of knowledge through discovery and experimentation. Students are therefore, actively involved in the learning activities. This study adopted the ASEI Movement’s teaching strategy to refer to the Student-Centred Teaching Strategy.

**Teacher-Centred Teaching Strategy:** A unidirectional teaching approach commonly used by the teacher to disseminate information and skills to learners’ i.e. from teacher-to-student. The instructor mainly uses the lecture method of instruction. This approach encourages the dissemination of information from the teacher to the learners without considering the learners active participation. This term was used as described.
CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In any education system, examination aims at testing by questioning to find out the level of knowledge, skill or qualification of a student who has been undergoing a prescribed course of study. Examinations assess the candidate’s achievement to ascertain how much they know about a certain subject and the ability to apply knowledge to some practical tasks. They also test recognition, the ability to recall, to synthesise the contents of the subject studied, analysis and organisation (SMASSE, 2002).

Examinations also test the effectiveness of teaching and the preparation of the teacher indirectly, using the results of the students as the indicator of the teacher’s efficiency i.e. the teaching methods and devices. Less prepared and inexperienced teachers are major barriers to science teaching. According to Bogonko (1992), teaching strategies, teaching materials and exposure to practical activities greatly affect the student achievement in examinations, especially in the science subjects.

2.2 Teaching Strategies Used in Biology

Development in science education has seen various pedagogical strategies being used in the teaching of biology, such as the didactic approach i.e. lecture, chalk and talk which is characterised by verbal and / or textbook instruction as the main sources of facts and information, with emphasis in giving and getting the right answers. According to Dowdeswell (1981), the didactic approach is largely teacher oriented and consists of handing out information pre-packaged with little or no class involvement. This method
was used by many biology teachers because of the influence by the methodology used during their initial training and the pressure of national examinations with the need to cover the wide syllabus in time for revision. This method is outmoded and does not assist the learner in understanding and acquiring scientific skills. However, there are many occasions when the lecture method can be used in teaching biology, for example, to summarise information in a concise and comprehensible form as a prelude to further inquiry. Towards the late 1950s, science education in Britain was undergoing dramatic change with the Nuffield School Science Project (SSP) which encouraged students to carry out experiments to bring about better understanding of scientific concepts (SMASSE, 1999).

In support of the SSP, a Chinese proverb was quoted “I hear and I forget, I see, I remember, I do and I understand”. Although the SSP programme listed among other characteristics, experiment and practical enquiry i.e. creating concepts at first-hand in the laboratory to answer original thought, many learners still faced problems in understanding science, hence the slogan “I do and am even more confused” (Solomon, 1980).

The first two decades after independence in Kenya led to curriculum reforms that played a central role in strategies that improved the quality of science education. Major innovations such as the School Science Project were introduced but failed to respond to the problems faced due to the low quality curriculum material, inappropriate instructional approaches and its irrelevant content to the Kenyan child. Other approaches that have been used in the teaching of biology include the expository approach which is
characterised by the predominance of teacher talk with little or no involvement of students in practical activities (Teacher-centred approach) and the empiricist approach where biological knowledge is acquired through observation, recording, data analysis and drawing of conclusions by students and at the turn of the 20th century, advocates of the heuristic approach believed that learners should be involved in observation, recording, data analysis and drawing conclusions (Eshiwani, 1993).

According to Namuddu (1989), many countries in Africa had developed new science and mathematics curricula at all levels of learning which were predicated by the discovery approach to learning as opposed to older curricula, using more didactic approaches to learning. In the beginning of 1970s, the Kenya government called for a revision of the curriculum so as to emphasize on practical skills in science subjects. The report of the National Committee on Educational Objectives and Policies (1976) recommended that, in order to improve the teaching of science, more laboratories should be built to promote the spirit of inquiry and innovations by encouraging the use of discovery methods.

Otiende et al (1992) identified reasons that led to the failure of the formal education system to meet the requirements of an expanding economy in the early 1970s. They included poor quality teaching, inadequately equipped science laboratories and classes, and poorly prepared students. The Kenya National Examinations Council (KNEC) reports which analyze, in details, the candidates’ achievement at Kenya Certificate of Secondary Education (KCSE), with an aim of providing a feedback, has annually produced statistics to guide all stakeholders in the achievement. According to
the KNEC report (2005), although the achievement in biology had slightly improved over the years, the highest mean score obtained was in 1998 but it did not reach the normal 50 per cent level expected. Over the years, the annual reports have constantly appealed to biology teachers to expose their students to a variety of practical work, field trips, observation, drawing skills and the correct use of apparatus in the laboratory.

2.3 **Strengthening of Mathematics and Science in Secondary Education (SMASSE) Project**

Recent studies in science education show that the teaching of biology should be learner-centred with the teacher’s role being that of a facilitator, guide, counsellor, motivator, innovator and researcher. There must be student-centred activities involving a lot of improvisation in the experiments which help to demystify biology and also assist in changing the attitude of the learner towards the subject (SMASSE, 1999).

The achievements of the SMASSE Project in Japan and Philippines have attracted the interest of development bodies such as the Association for the Development of Education in Africa (ADEA) and the New Partnership for Africa Development (NEPAD), where the latter signed a letter of understanding with SMASSE, Western, Central and South Africa to jointly develop activities in relation to Strengthening of Mathematics and Science in Secondary Education in Africa. SMASSE – WECSA conducts third country training programmes in Nairobi, Kenya with participants drawn from member countries such as Kenya, Lesotho, Rwanda, Senegal, Niger, Zambia, Uganda, Zimbabwe, Malawi, Tanzania, Mozambique and Nigeria (JICA, 2007).
According to SMASSE (1999), The SMASSE Project in Kenya is a joint venture between the Government of the Republic of Kenya and the Government of Japan, sponsored and represented by the Japanese International Cooperation Agency (JICA) through the Ministry of Education, Science and Technology, and was started in July 1998. The first phase of the project was piloted in nine districts namely; Kisii, Gucha, Kakamega, Butere-Mumias, Lugari, Kajiado, Makueni, Murang’a and Maragua. In October 2000, an additional six Districts were brought on board i.e. Kiambu, Baringo, Kilifi, Taita Taveta, Garissa and Meru south through in-country training programme and after mid-term evaluation of the programme. The second phase of the project was launched to cover the whole country in July 2003.

According to SMASSE (1999), baseline studies done in 1998 by the Monitoring and Evaluation task force isolated major areas such as pedagogical methodology, subject content factors, distribution and utilization of resources, development of teaching / learning materials and administrative/management as the causative factors that led to the negative attitude towards the teaching/learning of mathematics and science in secondary schools. The SMASSE Project activities are aimed at enhancing the capability of young Kenyans in mathematics and science and its main output was the establishment of an In-Service Training system at Kenya Science Teachers’ College and in pilot Districts. The purpose of INSET is to strengthen the quality of mathematics and science education, and is based on the needs of teachers which continuously update teachers’ skills and abilities due to curriculum change, change in teaching approaches/methodology, the teacher’s professional development, technological advancement and emerging issues.
The SMASSE INSET is made up of four cycles whose guiding principle is the Activity, Student-centred, Experimentation and Improvisation (ASEI) movement which is implemented on the basis of Plan, Do, See, Improve (PDSI) approach. The themes of the four cycles are as follows:

i) Cycle one - Attitude change and the introduction of ASEI/PDSI to the teaching of mathematics and science.

ii) Cycle two - Hands-on activities.

iii) Cycle three - Actualisation of ASEI/PDSI and enhancing classroom practice.

iv) Cycle four – impact transfer whose main focus is to prepare participants on how to organise and conduct future District INSETs (SMASSE, 1999).

Other teaching approaches that are emphasised for teaching biology during the SMASSE Project include project work which enables learners to engage in scientific investigation in areas of their own interest, fieldwork excursions to provide students with first-hand evidence of scientific phenomena and how they impact on every day life, and modern methods of teaching such as simulation, games, skits and puzzles which may be very effective in teaching biology if well-understood and used (SMASSE, 2002).

In the year 2000, the SMASSE Project Monitoring and Evaluation task force developed a number of instruments for obtaining data for evaluating the quality of teaching/learning in the pilot Districts (Kisii, Gucha, Kakamega, Butere-Mumias, Lugari, Kajiado, Makeni, Murang’a and Maragua). The instruments included lesson observation guide, an ASEI/PDSI checklist, free description of lesson by the teacher and quality of participation questionnaire for students. This enabled them to assess the impact of the
INSETs. After the baseline studies, it was noted that the principle of ASEI movement/PDSI approach was very compatible with Kenya’s educational aspirations because there was a need to move from knowledge-based to activity-based teaching, teacher-centred to learner-centred learning, lecture method to experiment and research based strategies and finally, from full-scale to small-scale experiments and improvisation. The students were involved in learning through “hands-on”, “minds-on”, “eyes-on” and “mouths-on” activities and developed their own knowledge (SMASSE, 2002).

2.4 The Impact of ASEI Movement’s teaching Strategy

In Malawi, Zambia, Rwanda and Zimbabwe, the SMASSE Project Impact Survey was carried out to establish the impact of ASEI movement’s instructional strategies used by teachers and students in the classroom after teachers had been exposed to the INSET. The results were as follows:

a) Net impact on teachers

After undergoing the INSET training on the ASEI movement/PDSI approach, teachers were found to plan better and more consistently using the ASEI lesson planning strategies. By creating a student-friendly classroom environment, more attention was given to students’ needs by asking questions and allowing them to also ask questions. It was noted that teachers were more confident and open to teamwork and prone to using new innovative methods of teaching. Improvisation and small-scale experiments allowed teachers to face the challenges arising from lack of resources and the handling of larger classes better.

b) Net impact on students
Student-centred learning allowed the students to be actively involved in the classroom and showed greater interest and responsiveness. Classroom lesson attendance became more regular and punctual. Students’ relationships with teachers improved and classroom assignments were done more neatly and promptly. Group discussions and peer teaching aroused students’ curiosity, which also helped to establish teamwork among students. Students’ attitude towards learning became positive and their results showed a great improvement. This effect on teachers and students was not observed in three Districts that had not undergone INSET (Nui & Wahome, 2006).

According to SMASSE (2006), The Ministry of Education, Science and Technology formed a Monitoring and Evaluation Taskforce to conduct evaluation of the SMASSE Project to find out its effectiveness, extent of achievement, efficiency, sustainability and relevance of the INSET in the pilot Districts. The results of the evaluation showed that the INSET was very effective, fairly efficient with an unexpected positive impact. The project showed improved results in pilot Districts. It was also noted that the project proved to be relevant and had a high sustainability in the country. In-service Training in Nakuru County was started in 2004 and ended in 2007. Therefore, there is need to assess the impact of the INSET on teachers and students and consequently its effect on achievement in biology (Nui & Wahome, 2006).
c) **Expected reforms**

Apart from the positive impact noted above on teachers and students in Districts where teachers have attended INSET, other outcomes expected include positive attitude for teachers and students towards teaching/learning of biology with the teachers practising more effective teaching methodology. Teachers are expected to have a better mastery of the subject content using the ASEI lesson planning. Improvisation and small scale experiments will enable teachers to develop effective teaching/learning materials. Generally, the SMASSE Project is expected to bring about better administration and management in schools (Nui & Wahome, 2006).

### 2.5 Summary

The government of Kenya has often responded to demands for changes in the secondary school curriculum. This has been evidenced by the creation of many education commissions. However, this has yielded negligible positive results as is reflected by national examination results from KNEC annually. Bogonko (1992) posits that teaching strategies, teaching materials and exposure to practical activities greatly affect the student achievement in examinations, especially in the science subjects. Despite the use of various pedagogical strategies applied in teaching biology, the little development being experienced in science education as a result of applying the didactic approach towards learning, little progress has been registered. Major changes are yet to be experienced so long as our main perspective to learning remains teacher-centred. A more learner-centred approach needs to be embraced where the heuristic approach is upheld. Learners should be actively involved in the learning process in observation, recording, data analysis and
drawing conclusions. Many countries in Africa have developed new science and mathematics curricula at all levels of learning which were predicated by the discovery approach to learning as opposed to older curricula, using more didactic approaches to learning (Namuddu, 1989).

Studies in science education show that the teaching of biology should be learner-centred with the teacher’s role being that of a facilitator, guide, counsellor, motivator, innovator and researcher. Student-centred activities involving a lot of improvisation in experiments help to demystify biology and also assist in changing the attitude of the learner towards the subject. SMASSE Project activities were aimed at enhancing the capability of young Kenyans in mathematics and science and its main output was the establishment of an In-Service Training system at Kenya Science Teachers’ College and in pilot Districts. INSETs strengthen the quality of mathematics and science education, and is based on the needs of teachers by continuously updating teachers’ skills and abilities due to curriculum change, change in teaching approaches/methodology, the teacher’s professional development, technological advancement and emerging issues (SMASSE, 1999). Results from Malawi, Zambia, Rwanda and Zimbabwe and other parts of the world indicate that, after undergoing the INSET training on the ASEI movement/PDSI Approach, teachers were found to plan better and more consistently using the ASEI lesson planning strategies.

Student-centred learning allowed the students to be actively involved in the classroom and showed greater interest and responsiveness. Classroom lesson attendance became more regular and punctual. Students’ relationships with teachers improved and
classroom assignments were done more neatly and promptly. Group discussions and peer teaching aroused students’ curiosity, which also helped to establish teamwork among students. Students’ attitude towards learning became positive and their results showed a great improvement. Other expected outcomes include the development of a positive attitude for teachers and students towards teaching/learning of biology with the teachers practising more effective teaching methodology. Teachers are expected to have a better mastery of the subject content using the ASEI lesson planning. This study therefore, aims at affirming the role played by SMASSE Project in improving learner achievement after school teachers have embraced the suggested heuristic approach that the project emphasises. This is expected to fill the pedagogical and learning / teaching gaps that have been overlooked by the various previous studies and commissions of education.
CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research design used in the study, objectives of the study and the variables under observation. It also identifies the location and target population of the study, sampling procedure and sample size that were used. It describes the piloting of the instruments, the instrumentation of data collection tools, data collection procedure and data analysis techniques employed in this study.

3.2 Research Design and Location of the study

The study used the descriptive *Ex-post-facto* Research Design. According to Borg and Gall (2003), such a design looks back to relate the measured dependent variable to independent variable after a “natural” event has taken place. The design was chosen because it assisted to establish whether there was a correlation between the principle of ASEI movement / PDSI approach, compared with Traditional didactic teacher-centred teaching strategies and student achievement in biology. The design also assisted in measuring the strength and directions of the relationship between the variables being studied. The location of the study was in Nakuru County because no studies have been carried out to find out the impact of the principle of ASEI movement / PDSI approach on biology education despite the fact that teachers of Biology have undergone all the four cycles of the SMASSE Project INSET.
3.3 **Target Population of the Study**

The study was conducted in Nakuru County where the researcher selected seven boarding/day schools, out of a total of 75 public secondary schools. The target population comprised students taking biology as a subject. The researcher used only teachers who had taught for more than five years and have also undergone the four cycles of the SMASSE INSET. As schools administrators who were in a position to influence learners’ behavior, Headteachers and heads of science department had also attended SMASSE INSET.

3.4 **Sampling Technique**

A purposive sampling technique was used to select sample schools using the schools’ boarding or day status as criteria, gender and location whether the school is urban or rural. The main criterion was the selection of only schools that had participated in the SMASSE Project by the year 2005. This would ensure a sound comparison of these schools’ performance in Biology at KCSE. This method of sampling was found to be reliable for the study and was representative of the target population which was sampled as follows:

i) Secondary school students (boys and girls) in the senior classes were taken intact. Forms 3 and 4 students in selected public secondary schools that taught biology because they would have been exposed to more biology lessons after the introduction of the principle of ASEI movement / PDSI Approach teaching method in Nakuru County.
ii) Teachers of biology in selected public secondary schools that had been serving for more than five years and had also undergone the four cycles of the SMASSE INSET.

iii) Head teachers and Heads of science departments in selected public secondary schools who were all administrators involved in instructional supervision and are interested in the achievement of students in biology in their schools.

3.5 **Sample Size and Structure**

The study sampled seven selected public secondary schools from which the Head Teacher, the Head of science departments, two teachers of biology and an equal number of four students taking biology in either form three and/or form four were used as respondents from each school, giving a total sample size of 95 respondents for the proposed study.

**Table 3.1: The Target Population and sample selected**

<table>
<thead>
<tr>
<th>Students</th>
<th>Teachers, HTs &amp; HoDs</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Respondent</strong></td>
<td><strong>Sample</strong></td>
<td><strong>Respondent</strong></td>
</tr>
<tr>
<td>Boys</td>
<td>40 (42.1%)</td>
<td>Male</td>
</tr>
<tr>
<td>Girls</td>
<td>27 (28.4%)</td>
<td>Female</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>67 (70.5%)</strong></td>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

Table 3.1 shows that 40 boys and 27 girls were sampled to yield a sample size of 67 respondents from the student population, while 11 male and 17 female teachers were
sampled to yield a sample size of 28 respondents from the teaching staff. This sampling yielded an overall sample of size 95, which was then used in the study.

3.6 Research Instruments

The researcher collected data using questionnaires among all the respondents. These questionnaires had two sections, section A and B. Section (A) contained demographic questions which addressed the subject’s background information. Section (B) of the questionnaire contained structured questions accompanied by an appropriate list of options from which the respondents selected answers that suited them best and contingency questions which were a mixture of open-ended and close-ended questions. All questionnaires also contained unstructured open-ended question where respondents expressed their views.

For classroom observation, the researcher used lesson observation guides which consisted of achievement indicators aimed at assessing different aspects of a lesson and rated on a 5-point Likert rating scale weighted from 5-1 in a descending order, and an ASEI /PDSI checklist which enabled the researcher to assess the lesson in line with the ASEI /PDSI principle. Data were also collected by discussing and analysing the trend in achievement in the KCSE results for biology in Nakuru County four years before and four after the introduction of the ASEI Movement through SMASSE INSETs in Nakuru County. Questionnaires were used because they were able to collect a large amount of information in a very short time, allow for anonymity and have standardized questions. They were also very economical.
3.7 Pilot study

According to Orodho 2008, piloting is the most important stage in questionnaire design. Piloting is done to ensure that measurements are of acceptable reliability and validity. This is done with a small representative sample identical to, but did not include the group that was surveyed.

3.7.1 Validity

Validity is concerned with the degree to which an empirical measure or several measures of a concept accurately represents that particular concept (Orodho, 2009). For the purpose of this study, the validity of the questionnaires was determined by comparing results and comments from a sample comprising ten students from one public secondary school. The findings were used to assist in compiling questions in the final questionnaire.

3.7.2 Reliability

Reliability concerns the degree to which a particular measuring procedure gives equivalent results over a number of repeated trials (Orodho, 2009). This study used the Test-Retest method to ensure reliability. The Retesting procedure involved administering questionnaires to an identical sample of ten students who were not included in the sample population. The same questions were administered to the same respondents after a period of two weeks under the similar conditions and these were again scored. The score obtained in the first and second tests were correlated using Pearson’s Correlation Coefficient, $r$, whose formula is shown below;

$$r = \frac{\sum xy}{(\sum x^2)(\sum y^2)}$$

Where $x = (X - \bar{X})$ and $y = (Y - \bar{Y})$.
The formula was used to establish the extent to which the questionnaires were consistent in eliciting the same responses every time the instrument was administered. After the correlation coefficient was obtained, moderations were done on the questions to remove ambiguity and confusion. New items were added to the questionnaire to provide more appropriate information.

3.8 Data Collection Procedure

The following procedure was used in data collection; the researcher made a familiarization tour to the District Education office to inform him/her about the research to be undertaken and also to collect data on achievement in the KCSE Biology in Nakuru County for the sampled schools. The researcher visited each of the selected schools on a familiarisation trip to make an appointment and to brief the Head Teachers, heads of science departments and teachers of biology on the type and use of the study. Arrangements were made for administering of students questionnaires and for classroom observation of biology lessons.

Questionnaires for Head Teachers, heads of science departments and teachers of biology were left in the schools to be collected after two weeks. The researcher personally administered the questionnaires to students taking biology as a subject in the selected secondary schools, who were given a specific time to answer the questions and then the questionnaires were collected immediately. The researcher also observed and evaluated biology lessons in the schools using the lesson observation guide and the ASEI/PDSI checklist.
3.9 Data Analysis Plan

Data from questionnaires were analysed using descriptive statistics (percentages, means) and inferential statistics (The Chi-Square statistic) with the aid of the Statistical Package for Social Sciences (SPSS) version 17. To assess the extent to which the two variables were associated by a single summarizing measure, the Chi-Square statistic ($\chi^2$) was used.

A displays of a summary of the analysis of Data is shown below in table 3.2.

Table 3.2: Summary Table of the Analysis of Data

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Independent Variable</th>
<th>Dependent Variable</th>
<th>Statistic Used</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ho$_1$:</strong> There is no significant association between ASEI teaching methods and students’ performance in biology.</td>
<td>ASEI Movement Teaching Strategy</td>
<td>Achievement</td>
<td>$\chi^2$</td>
</tr>
<tr>
<td><strong>Ho$_2$:</strong> There is no relationship between students’ attitude towards biology and their performance in biology</td>
<td>ASEI/ Movement Teaching Strategy</td>
<td>Attitude</td>
<td>$\chi^2$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Differences in percentages</td>
</tr>
</tbody>
</table>
CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND DISCUSSION

4.1 Introduction

This chapter presents the data analysis, results and discussion of findings of the study on the impact of the ASEI movement on students’ achievement in secondary school biology in Nakuru County. Data were analysed using descriptive statistics which included percentages, frequencies and means. The findings were presented in the form of charts, graphs and tables and their implications discussed. Data were further analysed with the aid of the Statistical Package for Social Sciences (SPSS version 17) and then used in making interpretations, conclusions and recommendations. The Chi-Square statistic ($\chi^2$) was used to test the hypotheses of the study. A discussion of the main findings followed each hypothesis.

The following null hypotheses were tested:

- $H_0_1$: There is no significant association between ASEI teaching methods and students’ performance in biology.

- $H_0_2$: There is no relationship between students’ attitude towards biology and their performance in biology
4.2 BIODATA

4.2.1 Responses on students’ attitude towards the learning of biology and students’ performance

![Type of School by Percentage](image)

<table>
<thead>
<tr>
<th>Type of School</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed Boarding</td>
<td>29%</td>
</tr>
<tr>
<td>Boarding</td>
<td>14%</td>
</tr>
<tr>
<td>Day</td>
<td>57%</td>
</tr>
</tbody>
</table>

Figure 4.1: Head Teachers’ Responses on Types of Schools

The study covered a variety of schools which was composed of mixed schools 4 (57.1%), boarding schools 1 (14.3%) and day schools which were 2 (28.6%). The type of school was significant due to the fact that many parents tend to prefer taking their children to boarding schools instead of day schools owing to their better historical achievement in national examinations and high levels of discipline, unlike the ones exhibited in day schools and their numerous external interferences.
Table 4.1: Head Teachers’ Responses on SMASSE INSET attendance

<table>
<thead>
<tr>
<th>SMASSE INSET Attendance</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>1</td>
<td>14.30</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>85.70</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Table generated by SPSS

The results in table 4.1 indicate that a large majority 6(85.7%) of Headteachers had not undergone SMASSE training like their teachers. Only a small minority 1(14.3%) had attended the INSETs. This might explain the ignorance among Headteachers on the significance of the SMASSE Project, which could work negatively towards its progress. It poses the question whether these Headteachers are fully committed to the success of the program.

Responses from Headteachers on Biology teachers’ SMASSE INSET attendance revealed that all 7(100%) attended the INSETs Data from the questionnaire for Headteachers shows that among the teachers who had attended SMASSE INSETs, four schools dispatched two teachers each, who went through three cycles of training. One school sent three teachers for training who went through three cycles of training while the remaining two schools sent four teachers each, who went through all the cycles of INSETs.
Table 4.2: Responses from students on the school’s boarding status

<table>
<thead>
<tr>
<th>School’s boarding status</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
<td>6</td>
<td>98.5</td>
</tr>
<tr>
<td>Boarding</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: Table generated by SPSS

Table 4.2 shows that 6 schools in the study were day schools. Only one school had boarding facilities.

Figure 4.2: Responses from students on their approval of biology
The outcome in figure 4.2 indicates that 55.5% approve of biology very much, 34.3% approved biology much, 9.0% approve it a little while 1.5% do not approve of the subject at all. Since 98.5% of the respondents approved of biology, this was indicative that a positive attitude towards biology may lead to improved achievement, thus supporting the alternative hypothesis. We therefore, in evidence of the result above, reject the null hypothesis.

4.2.2 Responses on the effect of the type of teaching/learning methods used by teachers of biology in teaching the subject and students’ performance in biology

Table 4.3: Percentage of Laboratories Available in Schools

<table>
<thead>
<tr>
<th>Number of Laboratories</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Laboratory</td>
<td>1</td>
<td>14.30</td>
</tr>
<tr>
<td>2 Laboratories</td>
<td>5</td>
<td>85.70</td>
</tr>
<tr>
<td>Many Laboratories</td>
<td>1</td>
<td>14.30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Table generated by SPSS

Table 4.3 shows that only 1(14.3%) of schools had only one science laboratory, which poses a challenge when all science classes have to utilize the single laboratory. A similar percentage indicated their having many laboratories to cater for each science lesson separately. This was very convenient for the teaching of individual science subjects. However, most of the schools 5(71.4%) had at least two laboratories each. There were no schools without a laboratory.
Table 4.4:
Heads of Science department’s responses on their SMASSE INSET attendance

<table>
<thead>
<tr>
<th>HoDsm SMASSE INSET Attendance</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>7</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Table generated by SPSS

Data from the questionnaire for heads of science departments show that among the HoDs who had attended SMASSE INSETs, four schools dispatched one HoD each, who went through four cycles of training. Two schools sent one HoD each for training who went through two cycles of training while the remaining one school sent one HoD, who went through three cycles of INSETs.

Table 4.5:
Heads of science department’s responses on monitoring biology teachers in their classrooms

<table>
<thead>
<tr>
<th>HoDs monitoring of teachers in class</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>3</td>
<td>42.90</td>
</tr>
<tr>
<td>Yes</td>
<td>4</td>
<td>57.10</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Table generated by SPSS

The results in table 4.5 indicate that over half of the Heads of Science department (57.1%) monitored teachers during their lessons while 42.9% did not.
Table 4.6: Biology teachers’ responses on SMASSE INSET attendance

<table>
<thead>
<tr>
<th>SMASSE INSET Attendance</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>14</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Table generated by SPSS

Data from the questionnaire for biology teachers show that all teachers of biology had undergone training. Among those who had attended SMASSE INSETs, two went through six cycles of training, one went through five cycles, 7 went through four cycles, two went through three cycles, while two other teachers went through six cycles of training.

4.2.3 Responses on the extent to which the principle of ASEI movement influences students’ achievement in biology

Table 4.7: Instructional approaches used in biology classes

<table>
<thead>
<tr>
<th>Instructional Approach</th>
<th>Frequency</th>
<th>Responses by HoD(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture method</td>
<td>2</td>
<td>28.60</td>
</tr>
<tr>
<td>Teacher - centred Learning</td>
<td>2</td>
<td>28.60</td>
</tr>
<tr>
<td>Group discussions</td>
<td>3</td>
<td>42.90</td>
</tr>
<tr>
<td>Student - centred Learning</td>
<td>1</td>
<td>14.30</td>
</tr>
<tr>
<td>Small scale experiments</td>
<td>2</td>
<td>28.60</td>
</tr>
<tr>
<td>Teacher demonstrations</td>
<td>2</td>
<td>28.60</td>
</tr>
<tr>
<td>Questioning method</td>
<td>2</td>
<td>28.60</td>
</tr>
</tbody>
</table>

Source: Table generated by SPSS
Table 4.7 shows that the following instructional approaches were used. A majority of the teachers (42.9%) involved their students in group discussions. 14.3% used student-centred learning techniques while 28.6% used either lecture method or teacher-centred learning or teacher demonstrations or questioning method or small-scale experiments. Observations made above indicate that a minority (less than 30%) of teachers employed the recommended methods of instructions and instead used the lecture method, while 42.9% used group discussions. A greater majority of heads of departments were lacking in responses.

Table 4.8:

**Responses by heads of science departments on improvement in classroom environment**

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Frequency</th>
<th>Responses by HoDs (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proper utilization of teaching/learning resources</td>
<td>6</td>
<td>85.70</td>
</tr>
<tr>
<td>More teaching aids in the classroom</td>
<td>5</td>
<td>71.40</td>
</tr>
<tr>
<td>Increased interaction between teachers and students and between students themselves</td>
<td>5</td>
<td>28.60</td>
</tr>
<tr>
<td>Good rapport between teacher/learners</td>
<td>6</td>
<td>85.70</td>
</tr>
<tr>
<td>Motivation of learners</td>
<td>2</td>
<td>28.60</td>
</tr>
<tr>
<td>Positive attitude towards biology</td>
<td>5</td>
<td>71.40</td>
</tr>
<tr>
<td>Improvisation during experiments</td>
<td>6</td>
<td>85.70</td>
</tr>
</tbody>
</table>

Source: Table generated by SPSS
When heads of science departments were required to tick indicators that were observed in the biology classes, 85.7% of respondents indicated that there was proper utilization of teaching/learning resources, improvisation during experiments and also good rapport between teacher/learners. Seventy one point four percent of the respondents indicated the use of more teaching aids in the classroom, a positive attitude towards biology and also increased interaction between teachers and students and between students themselves in biology classes. However, only a small percentage of respondents (28.6%) observed some motivation of learners in the biology classes.

### Table 4.9: Responses from students on their achievement in biology

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>8</td>
<td>11.9</td>
</tr>
<tr>
<td>Good</td>
<td>26</td>
<td>38.8</td>
</tr>
<tr>
<td>Fairly Good</td>
<td>7</td>
<td>10.4</td>
</tr>
<tr>
<td>Average</td>
<td>23</td>
<td>34.3</td>
</tr>
<tr>
<td>Below Average</td>
<td>3</td>
<td>4.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>67</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

Source: Table generated by SPSS
Figure 4.3: Responses from students on their achievement in biology

Table 4.9 and figure 4.3 indicate that responses from 11.9% of students on their achievement in biology described their performance as excellent. Thirty eight point eight percent described their performance as good. Responses from 10.4% of respondents described their performance as fairly good, 34.3% said their performance was average while 4.5% said their performance as being below average. Since 64% of the respondents scored average and above average in biology, this was indicative that a positive attitude towards biology may lead to improved achievement, thus supporting the alternative hypothesis. We therefore, in evidence of the result above, reject the null hypothesis and retain the alternative hypothesis. Students who achieved high scores in biology supported their excellence with remarks that they were good in the subject and always score high marks. Other respondents said biology was their favourite subject.
Respondent who experienced difficulties in biology claimed that they did not understand the biological terms, some concepts are hard. Others said that biology practicals are never done, and thus blaming their performance on their teachers.

Many respondents credited their good performance on their parents who encouraged them with claims of the available career opportunities in the subject. Other respondents credited encouragement upon renowned scientist Ben Carson as their mentor. A majority of respondents got encouragement from their biology teachers, the fact that biology is a compulsory subject in their school, that the subject is good and interesting, that human anatomy intrigues them. Other respondents said that future career prospects, peer influence and competition were the driving forces and hence motivation.

4.3 Chi-square analysis on the contribution of students’ attitude towards the learning of biology and students’ performance

Table 4.10:
Chi-square analysis of responses from headteachers on Positive change in students’ attitude and their rating of achievement in biology

<table>
<thead>
<tr>
<th>Variables</th>
<th>$\alpha$</th>
<th>df</th>
<th>$\chi^2_{\text{Calc}}$</th>
<th>$\chi^2_{\text{Crit}}$</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTs’ response on change in student attitude</td>
<td>0.05</td>
<td>1</td>
<td>1.286</td>
<td>3.5</td>
<td>NS</td>
</tr>
<tr>
<td>Students’ rating of their achievement in Biology</td>
<td>0.05</td>
<td>4</td>
<td>32.030</td>
<td>13.4</td>
<td>Sig</td>
</tr>
</tbody>
</table>

NB: ‘Sig’ implies ‘Significant findings’ and NS implies ‘Not Significant’
A comparison between the critical value and the calculated chi-square statistic for respondents at the 5% level of significance in table 4.10 indicated that the calculated value was lower than the critical value (Positive change in student attitude: 3.5 > 1.286). There was therefore no sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “Ho2: There is no relationship between students’ attitude towards biology and their performance in biology” was retained.

On the other hand, a comparison of students’ ratings of their achievement in biology indicated that the calculated value was higher than the critical value (Rating achievement in Biology: 13.4 < 32.030). There was sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “‘Ho2: There is no relationship between students’ attitude towards biology and their performance in biology” was rejected.
4.4 Chi-square analysis on the effect of the type of teaching/learning methods used by teachers of biology in teaching the subject and students’ performance in biology

Table 4.11:

Chi-square analysis of responses on the effect of the type of teaching/learning methods used by teachers of biology in teaching the subject and students’ performance in biology

<table>
<thead>
<tr>
<th>Variables</th>
<th>α</th>
<th>df</th>
<th>$\chi^2_{Calc}$</th>
<th>$\chi^2_{Crit}$</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rating on laboratory and equipment</td>
<td>0.05</td>
<td>2</td>
<td>17.286</td>
<td>4.7</td>
<td>Sig</td>
</tr>
<tr>
<td>Rating on laboratory assistants</td>
<td>0.05</td>
<td>1</td>
<td>4.000</td>
<td>4.7</td>
<td>NS</td>
</tr>
<tr>
<td>Rating on Biology textbooks</td>
<td>0.05</td>
<td>2</td>
<td>7.000</td>
<td>4.7</td>
<td>Sig</td>
</tr>
<tr>
<td>Rating on Preservation of specimen</td>
<td>0.05</td>
<td>2</td>
<td>7.000</td>
<td>4.7</td>
<td>Sig</td>
</tr>
<tr>
<td>Rating on Preparation of slides</td>
<td>0.05</td>
<td>3</td>
<td>5.429</td>
<td>3.5</td>
<td>Sig</td>
</tr>
<tr>
<td>Rating on Preparation of charts</td>
<td>0.05</td>
<td>2</td>
<td>2.714</td>
<td>4.7</td>
<td>NS</td>
</tr>
<tr>
<td>Rating on Botanical garden</td>
<td>0.05</td>
<td>2</td>
<td>5.286</td>
<td>4.7</td>
<td>Sig</td>
</tr>
<tr>
<td>Rating on Fish pond</td>
<td>0.05</td>
<td>2</td>
<td>1.000</td>
<td>4.7</td>
<td>NS</td>
</tr>
<tr>
<td>Responses on Class demonstrations</td>
<td>0.05</td>
<td>3</td>
<td>6.000</td>
<td>2.8</td>
<td>Sig</td>
</tr>
<tr>
<td>Responses on Group discussions</td>
<td>0.05</td>
<td>3</td>
<td>3.714</td>
<td>3.5</td>
<td>Sig</td>
</tr>
<tr>
<td>Rating on Lecture method</td>
<td>0.05</td>
<td>3</td>
<td>3.143</td>
<td>3.5</td>
<td>NS</td>
</tr>
<tr>
<td>Rating on Student-centred teaching</td>
<td>0.05</td>
<td>3</td>
<td>3.143</td>
<td>3.5</td>
<td>NS</td>
</tr>
<tr>
<td>Rating on Activity-based teaching</td>
<td>0.05</td>
<td>3</td>
<td>6.000</td>
<td>3.5</td>
<td>Sig</td>
</tr>
<tr>
<td>Rating on Experimental activities</td>
<td>0.05</td>
<td>4</td>
<td>24.567</td>
<td>13.4</td>
<td>Sig</td>
</tr>
<tr>
<td>Rating on Group discussions</td>
<td>0.05</td>
<td>4</td>
<td>35.463</td>
<td>13.4</td>
<td>Sig</td>
</tr>
<tr>
<td>Observation of teacher demonstrations</td>
<td>0.05</td>
<td>4</td>
<td>73.224</td>
<td>13.4</td>
<td>Sig</td>
</tr>
<tr>
<td>Frequency of field trips</td>
<td>0.05</td>
<td>4</td>
<td>16.149</td>
<td>22.3</td>
<td>NS</td>
</tr>
<tr>
<td>Carry out ecological studies</td>
<td>0.05</td>
<td>4</td>
<td>49.045</td>
<td>13.4</td>
<td>Sig</td>
</tr>
<tr>
<td>Responses on doing project work</td>
<td>0.05</td>
<td>4</td>
<td>39.522</td>
<td>22.3</td>
<td>Sig</td>
</tr>
<tr>
<td>Responses on peer teaching</td>
<td>0.05</td>
<td>4</td>
<td>10.239</td>
<td>13.4</td>
<td>NS</td>
</tr>
</tbody>
</table>

Source: Results Generated by SPSS

NB: ‘Sig’ implies ‘Significant findings’ and NS implies ‘Not Significant’
Table 4.11 shows a Chi-square analysis at the 5% level of significance conducted at varying degrees of freedom. The rating by teachers of biology on laboratory and equipment indicated that the calculated value was higher than the critical value (Biology on laboratory and equipment: $4.7 < 17.286$). There was therefore sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “$H_0_1$: There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.

A Chi-square analysis of rating by teachers of biology on laboratory assistants in the table above indicated that the calculated value was lower than the critical value (Laboratory assistants: $4.7 > 4.0000$). There was therefore no sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “$H_0_1$: There is no significant association between ASEI teaching methods and students’ performance in biology” was retained.

An analysis of the rating by teachers of biology on biology textbooks indicated that the calculated value was higher than the critical value (Biology textbooks: $4.7 < 7.000$). There was therefore sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “$H_0_1$: There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.

A Chi-square analysis of rating by teachers of biology on preservation of specimen indicated that the calculated value was higher than the critical value (Preservation of specimen: $4.7 < 7.000$). There was therefore sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “$H_0_1$: There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.
The analysis of rating by teachers of biology on preparation of slides indicated that the calculated value was higher than the critical value (Preparation of slides: 3.5 < 5.429). There was therefore sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “$Ho_1$: There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.

An analysis of rating by teachers of biology on preparation of charts indicated that the calculated value was lower than the critical value (Preparation of charts: 4.7 > 2.714). There was therefore no sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “$Ho_1$: There is no significant association between ASEI teaching methods and students’ performance in biology” was retained.

A Chi-square analysis of rating by teachers of biology on the botanical garden was conducted at a 5% level of significance and 2 degrees of freedom. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was higher than the critical value (Botanical garden: 4.7 < 5.286). There was therefore sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “$Ho_1$: There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.

The Chi-square analysis of rating by teachers of biology on the fish pond conducted at the 5% level of significance at 2 degrees of freedom indicated a critical value of 4.7. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was lower than the critical value (Fish pond: 4.7 > 1.000). There was therefore no sufficient evidence to reject the null
hypothesis. Therefore, the null hypothesis that “\(\text{Ho}_1\): There is no significant association between ASEI teaching methods and students’ performance in biology” was retained.

An analysis of rating by teachers of biology on class demonstrations was conducted at the 5% level of significance and 3 degrees of freedom indicated a critical value of 2.8. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was higher than the critical value (Class demonstrations: 2.8 < 6.000). There was therefore sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “\(\text{Ho}_1\): There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.

The analysis of rating by teachers of biology on the organization of group discussions was conducted at the 5% level of significance at 3 degrees of freedom indicating a critical value of 3.5. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was higher than the critical value (Organization of group discussions: 3.5 < 3.714). There was therefore sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “\(\text{Ho}_1\): There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.

A Chi-square analysis of rating by teachers of biology on lecture method at the 5% level of significance at 3 degrees of freedom indicated a critical value of 3.5. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was lower than the critical value (Lecture method: 3.5 > 3.143).
There was therefore no sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “\( Ho_1 \): There is no significant association between ASEI teaching methods and students’ performance in biology” was retained.

The Chi-square analysis of rating by teachers of biology on student-centred teaching at the 5% level of significance at 3 degrees of freedom indicated a critical value of 3.5. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was lower than the critical value (Student-centred teaching: 3.5 > 3.143). There was therefore no sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “\( Ho_1 \): There is no significant association between ASEI teaching methods and students’ performance in biology” was retained.

A Chi-square analysis of rating by teachers of biology on activity-based teaching at the 5% level of significance at 3 degrees of freedom indicated a critical value of 3.5. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was lower than the critical value (Activity-based teaching: 3.5 < 6.000). There was therefore sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “\( Ho_1 \): There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.

An analysis of responses from students on duration of conducting individual learning activities in biology experiments at the 5% level of significance at 4 degrees of freedom
indicated a critical value of 13.4. A comparison between the critical value with the calculated chi-square statistic for respondents indicated that the calculated value was higher than the critical value (Individual experimental activities: \(13.4 < 24.567\)). There was sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “\(H_0_1\): There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.

A Chi-square analysis of responses from students on how often they held group discussions at the 5% level of significance at 4 degrees of freedom indicated a critical value of 13.4. A comparison between the critical value with the calculated chi-square statistic for respondents indicated that the calculated value was higher than the critical value (Group discussions: \(13.4 < 35.463\)). There was sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “\(H_0_1\): There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected in favour of the alternative hypothesis.

The Chi-square analysis of responses from students on how often they observed teacher demonstrations at the 5% level of significance at 4 degrees of freedom indicated a critical value of 13.4. A comparison between the critical value with the calculated chi-square statistic for respondents indicated that the calculated value was higher than the critical value (Observed teacher demonstrations: \(13.4 < 73.224\)). There was sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “\(H_0_1\): There is no
significant association between ASEI teaching methods and students’ performance in biology” was rejected.

A Chi-square analysis of responses from students on the frequency of field trips at the 5% level of significance at 4 degrees of freedom indicated a critical value of 22.3. A comparison between the critical value with the calculated chi-square statistic for respondents indicated that the calculated value was lower than the critical value (Frequency of field trips: 22.3 > 16.149). There was no sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “\(Ho_1\): There is no significant association between ASEI teaching methods and students’ performance in biology” was retained.

An analysis of responses from students on how often they carry out ecological studies was conducted at the 5% level of significance at 4 degrees of freedom indicated a critical value of 13.4. A comparison between the critical value with the calculated chi-square statistic for respondents indicated that the calculated value was higher than the critical value (Carry out ecological studies: 13.4 < 49.045). There was sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “\(Ho_1\): There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected in favour of the alternative hypothesis.

A Chi-square analysis of responses from students on how often they do project work was conducted at the 5% level of significance at 4 degrees of freedom indicated a critical value of 22.3. A comparison between the critical value with the calculated chi-square statistic for respondents indicated that the calculated value was higher than the critical
value (Do project work: 22.3 < 39.522). There was sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “Ho₁: There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.

An analysis of responses from students on how often they peer teaching was conducted at the 5% level of significance at 4 degrees of freedom indicated a critical value of 13.4. A comparison between the critical value with the calculated chi-square statistic for respondents indicated that the calculated value was lower than the critical value (Do peer teaching: 13.4 > 10.239). There was no sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “Ho₁: There is no significant association between ASEI teaching methods and students’ performance in biology” was retained.

4.5 Chi-square analysis on the extent to which the principle of ASEI movement influences students’ achievement in biology

A Chi-square analysis of rating by teachers of biology on Time to plan lessons was conducted at the 5% level of significance at 2 degrees of freedom indicated a critical value of 4.7. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was higher than the critical value (Time to plan lessons: 4.7 < 7.000). There was therefore sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “Ho₁: There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.
An analysis of rating by teachers of biology on ASEI lesson planning was conducted at the 5% level of significance at 3 degrees of freedom indicated a critical value of 3.5. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was higher than the critical value (ASEI lesson planning: 3.5 < 4.857). There was therefore sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “$Ho_1$: There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.

A Chi-square analysis of rating by teachers of biology on carrying out small scale experiments was conducted at the 5% level of significance at 3 degrees of freedom indicated a critical value of 3.5. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was lower than the critical value (Small scale experiments: 3.5 > 3.143). There was therefore no sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “$Ho_1$: There is no significant association between ASEI teaching methods and students’ performance in biology” was retained.

An analysis of rating by teachers of biology on students’ project work was conducted at the 5% level of significance at 1 degree of freedom indicated a critical value of 7.0. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was higher than the critical value (Students’ project work: 7.0 < 10.286). There was therefore sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “$Ho_1$: There is no significant
association between ASEI teaching methods and students’ performance in biology” was rejected.

A Chi-square analysis of rating by teachers of biology on improvisation in experiments was conducted at the 5% level of significance at 3 degrees of freedom indicated a critical value of 3.5. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was lower than the critical value (Improvisation in experiments: 3.5 > 0.286). There was therefore no sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “Ho1: There is no significant association between ASEI teaching methods and students’ performance in biology” was retained.

The Chi-square analysis of rating by teachers of biology on the use of teaching aids, models and charts was conducted at the 5% level of significance at 3 degrees of freedom indicated a critical value of 3.5. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was higher than the critical value (Use of teaching aids, models and charts: 3.5 < 6.000). There was therefore sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “Ho1: There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.

A Chi-square analysis of rating by teachers of biology on the organization of trips and ecological studies was conducted at the 5% level of significance at 1 degree of freedom indicated a critical value of 7.0. A comparison between the critical value and the
calculated chi-square statistic for respondents indicated that the calculated value was higher than the critical value (Organization of trips and ecological studies: 7.0 < 10.286). There was therefore sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “\( \text{Ho}_1: \) There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.

An analysis of rating by teachers of biology on the use of students’ ideas and suggestions for teaching was conducted at the 5% level of significance at 3 degrees of freedom indicated a critical value of 2.8. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was lower than the critical value (Use of students’ ideas and suggestions for teaching: 2.8 > 2.429). There was therefore no sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “\( \text{Ho}_1: \) There is no significant association between ASEI teaching methods and students’ performance in biology” was retained.

A Chi-square analysis of rating by teachers of biology on teacher demonstration was conducted at the 5% level of significance at 3 degrees of freedom indicated a critical value of 3.5. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was lower than the critical value (Teacher demonstration: 7.0 > 0.286). There was therefore no sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “\( \text{Ho}_1: \) There is no significant association between ASEI teaching methods and students’ performance in biology” was retained.
The rating by teachers of biology on guided group discussions were analysed at the 5% level of significance and 3 degrees of freedom indicating a critical value of 3.5. A comparison between the critical value and the calculated chi-square statistic for respondents indicated that the calculated value was lower than the critical value (Guided group discussions: 3.5 > 4.857). There was therefore no sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “Ho1: There is no significant association between ASEI teaching methods and students’ performance in biology” was retained.

An analysis of responses from students on the use of locally available materials was conducted at the 5% level of significance and 4 degrees of freedom indicated a critical value of 13.4. A comparison between the critical value with the calculated chi-square statistic for respondents indicated that the calculated value was higher than the critical value (Use of locally available materials: 13.4 < 17.403). There was sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that “Ho1: There is no significant association between ASEI teaching methods and students’ performance in biology” was rejected.
### 4.5.1 Evaluation of Aspects of the Lesson using ASEI/PDSI Check List

**Table 4.12: Results on evaluation of lessons using the ASEI/PDSI checklists**

<table>
<thead>
<tr>
<th>PLAN</th>
<th>ASPECTS OF THE LESSON</th>
<th>RATING SCALE IN PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0-Not at all</td>
</tr>
<tr>
<td>Plan</td>
<td>The work plan was appropriate and realistic in the light of the lesson content and student’s abilities, skills and interest</td>
<td>14.3</td>
</tr>
<tr>
<td>Do</td>
<td>Introduction</td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>Introduction was clear, stimulating and linked them to the new topic</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Development</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>The lesson encouraged active participation of students as much as possible in the main teaching</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>See</td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>Teacher supervised classwork and was attentive to the needs students</td>
<td>28.6</td>
</tr>
<tr>
<td></td>
<td>Improve</td>
<td></td>
</tr>
<tr>
<td>IM</td>
<td>Teacher gave further guidance to students on lesson activity(ies)</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>ASEI</td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>The lesson was activity focused and student centred</td>
<td>14.3</td>
</tr>
<tr>
<td>Experiment</td>
<td>The experiment helped to achieve the objectives of the lesson and Improvisation was practised during the lesson</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Results from table 4.12 on the evaluation of lesson aspects using ASEI/PDSI checklist indicated that 42.8% of teachers did a great deal of planning, taking into account students’ backgrounds and had realistic and appropriate work plans. A large number of teachers (71.4%) were well-prepared with adequate materials. However, 42.8% of teachers were adequately prepared, while not a single teacher was found unprepared. In the introduction of the lesson, a majority of the teachers (71.4%) linked the lessons to previous students’ interest and curiosity a great deal. Only a few teachers (14.3%) introduced their lessons fairly. With regard to learner participation in class, students’ own prediction, observations and student-centred learning was not observed in 42.8% of the lessons, while 28.6% of teachers did not involve students in the development of the lessons.

In the conclusion of the lessons, it was observed that 28.6% of the teachers involved students in drawing conclusions and a large number of the lessons observed, 42.8% had lesson summaries, follow-up activities and also related the lesson’s contents to real life experiences in the society. However, 28.6% of lesson summaries did not allow students to draw conclusions. A few lessons (14.3%), the teachers did not relate the lessons to the society and there were no questions and answers techniques to check accuracy, correctness, depth and appropriateness of the lesson’s content.

The researcher observed that 28.6% of the classes were well-managed with individual student differences being taken into account and the effective use of the teaching/learning materials and media. However, another 28.6% of the classes were not well-managed at all. In most of the classes under observation, 42.8% of the classes
registered some improvement when the teacher adjusted the conduct of the lessons and gave further guidance to the students. However, a few lessons (14.3%) had a great deal of improvement. In most of the lessons observed (57.1%), practical work was conducted and appropriate tasks for discussion were given. Generally, more student-centred activities and learner participation in the learning process was observed. However, the researcher felt that more improvement should have been made in the planning of the lessons.

Table 4.13: Evaluation of aspects of the lesson using ASEI/PDSI check list

<table>
<thead>
<tr>
<th>ASPECTS OF THE LESSON</th>
<th>RATING SCALE IN PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-Poor</td>
</tr>
<tr>
<td>Teaching procedure</td>
<td></td>
</tr>
<tr>
<td>Clarity/feasibility of lesson objectives</td>
<td>14.3</td>
</tr>
<tr>
<td>Appropriateness of the lesson</td>
<td></td>
</tr>
<tr>
<td>Teacher relevant in content and language was Geared to level of learners</td>
<td>14.3</td>
</tr>
<tr>
<td>Achievement of set objectives</td>
<td></td>
</tr>
<tr>
<td>Fundamental techniques/Methodology</td>
<td>14.2</td>
</tr>
<tr>
<td>Management &amp; Distribution of time</td>
<td>28.6</td>
</tr>
<tr>
<td>Class control</td>
<td></td>
</tr>
<tr>
<td>Use of students opinions/ideas</td>
<td>28.6</td>
</tr>
<tr>
<td>Evaluation of the lesson by the teacher</td>
<td>14.3</td>
</tr>
</tbody>
</table>
Results from table 4.13 on the analysis of aspects of the lesson using lesson observation lists indicate that the growing majority of teachers (71.4%) were very good in clarity and feasibility of lesson objectives, appropriateness of the lesson in terms of introduction and content. However, a few teachers (14.3%) were rated between fair to satisfactory in the teaching procedures. In the majority of the lessons observed (57.1%), there was very good emphasis on the main concepts being taught and the language used by the teachers was very appropriate to the level of learners. However, a few lessons (14.3%) did not have appropriate language and difficult terms were not explained. Instructions given to learners were not clear.

In most of the lessons observed (71.4%), teachers recapitulated the main points and referred to the main concepts in the summary of the lesson. In some lessons (28.6%), lesson summaries were found to be satisfactory and even good. In the achievement of set objectives, some lessons (42.8%) were very good as observed in classroom activities, teachers/students’ questions and the level of enthusiasm. In a few lessons observed (14.3%), the achievement of lesson objectives was poor in that teachers did not ask questions and students’ answers were not adequate. In 28.6% of lessons, teachers were very good in involving students through questioning, discussions and hands-on/minds-on activities. Most of the lessons under observation were satisfactory and recording 42.8% of student involvement, while a smaller number of lessons (28.6%) did not involve learners in discussions and activities.

A majority of lessons under observation (57.1%) had very good teaching aids and improvised materials with appropriate demonstrations. In 42.8% of the lessons, materials
and demonstrations were not appropriate for use in teaching. Twenty eight point six percent of the teachers did not appear to enjoy the teaching and hence were not sensitive to problems and needs of learners. Majority of teachers (71.4%) were either good or very good with regard to their appropriateness of their expressions and general attitude when teaching.

The distribution of time in the planning and execution of lessons was satisfactory among 28.6% of the teachers, while a similar proportion was good. Only 14.3% of the teachers had very good distribution of their time in lesson management. Some 28.6% of teachers engaged all the learners in relevant activities and handled disruptive behaviour appropriately. A majority (57.1%) of teachers did not care about learners who were not engaged in relevant classroom activities. Forty two point eight percent of the teachers did not solicit and relate students’ ideas to the content being taught while a few teachers (14.3%) actively used students’ opinions and ideas. There was no or little evaluation of the lessons taught and no indication of measures to be taken to improve the lessons in future planning in 28.6% of the lessons. Only 14.3% of teachers had lesson evaluation incorporated in their plans and also included measures to be taken to improve future planning.

Generally, the results indicated that the teaching procedures used in class sessions under observation were very good, while fundamental techniques/methodology used were satisfactory but could be improved upon with further training of teachers in student-centred activities. In the management of lessons, more teachers need to distribute the time
appropriately in the work plan and execution of their lessons. Some teachers need to solicit students’ ideas and opinions to arouse their curiosity and interest.

4.6 Discussion of the Results

4.6.1 Discussion of ASEI teaching methods and its Influence on Students’ performance in Biology

Data gathered with the help of questionnaires for headteachers, heads of science departments, biology teachers and students were analyzed using Chi-square ($\chi^2$), and a comparison of critical values with calculated values was made. The comparison between critical values with the calculated chi-square statistics from all respondents indicated that in 61.76% of the cases rejected the hypothesis “$H_0$: ASEI Movement’s teaching strategy has no influence on students’ achievement in Biology” while 38.24% retained the hypothesis, thereby suggesting that the majority were in favour of the alternative hypothesis. It therefore follows that ASEI movement’s teaching strategy has an influence on students’ achievement in biology.

This study, therefore, produced sufficient evidence to suggest that schools’ achievement in biology was relatively lower prior to the SMASSE Project and the introduction of the ASEI movement with its inherent student-centred learning strategy. The study showed that biology results greatly improved after the SMASSE Project and implementation of the new strategy. The outcome of this study supports similar studies conducted by SMASSE Project Monitoring and Evaluation Taskforce on the pilot
Districts of Murang’a, Maragua, Kisii, Gucha, Butere-Mumias and Kakamega. The studies showed marked improvement in KCSE results in all the Districts where teachers who had attended SMASSE INSETs were teaching. However, the studies noted that it may have been too early to attribute the improvement in KCSE performance to the ASEI movement’s teaching strategy since there were a number of other factors that affected performance (SMASSE, 2002).

The SMASSE Project impact survey also carried out studies in Malawi, Zambia and Zimbabwe. These studies showed that after undergoing INSET training on the ASEI movement, teachers were found to plan better and more consistently, which made them more confident in using new innovative methods of teaching. The impact of the student-centred learning showed that learners were more actively involved in the class, with improved teamwork, positive attitude and great improvement in performance (Nui & Wahome, 2006).

Data from the Questionnaire for biology teachers showed that all teachers of biology had undergone training by attending SMASSE INSETs. They were adequately armed with necessary skills. This study established that teachers tended to be more enthusiastic when teaching in appreciation of the new learning strategy (ASEI movement/PDSI approach) which offered proactive variants from traditional modes of instruction – mainly chalk and talk or lecture method that hindered active learner participation while encouraging passive listening. This was further enhanced by the fact that most of the schools (71.4%) had at least two laboratories each. There were no schools without a laboratory, an impetus towards practical learning. Most of the schools
(71.4%) had fairly adequately equipped science laboratories. This implied that a majority of schools are well-equipped to handle science subjects leading to better outcomes in national examinations. On planning and organizing of biology lessons, many respondents reported using ASEI lesson planning once a week 42.9%, 35.7% used it once a term, 14.2% used it in 2 to 3 days a week, while 7.1% used it once a month. Thirty five point seven percent of the respondents give class demonstrations during biology lessons 2 to 3 days a week or once a month. Fourteen point three percent give class demonstrations once in two weeks while 7.1% use it once a month or once a term. This suggested that schools had embraced the new teaching/learning strategy.

Group discussions were used by 21.4% of the respondents, 2 to 3 days a week, 42.9% of the respondents used group discussions once a week, 28.6% of respondents used discussions once a term while 7.1% used the method once a month. The table also shows that 21.4% of the respondents carry out small scale experiments 2 to 3 days a week, 35.7% and another 35.7% either used the approach once a week or once a term respectively. The remaining 7.1% of the respondents utilized the method once a month.

It was interesting to note that, a majority of the heads of science departments (57.1%) were females and most of biology teachers (64.3%) were females too, with male teachers forming a small proportion of the respondents. A majority of the teachers (42.9%) involved their students in group discussions, while 14.3% used student-centred learning. This reflected the extent to which the ASEI movement/PDSI approach had been assimilated in schools. A majority of Headteachers pointed out that results had improved
with time, which conclusively sums up the influence of the ASEI movement/PDSI approach towards teaching biology in secondary schools.

4.6.2 Discussion of the Relationship between students’ attitude towards biology and their performance in Biology

The comparison between critical values with the calculated chi-square statistics from respondents indicated that 66.67% of the cases rejected the hypothesis “\( \text{Ho}_2: \) There is no relationship between teaching strategy and attitude among Biology students” while 33.33% retained the hypothesis, thereby suggesting that the majority were in favour of the alternative hypothesis. It therefore follows that there is a relationship between teaching strategy and attitude among Biology students.

Students who achieved high scores in biology supported their excellence with remarks that they were good in the subject and always scored high marks. Other respondents said biology was their favourite subject. This reflected a positive change of attitude towards the subject. The study also established that the attitude of the students towards the learning of biology improved significantly when they were subjected to practical hands-on learning tasks. Many students developed greater interest in the subject with better terminal results. The response registered by teachers among learners led to a positive change in the attitude of teachers of biology towards the teaching of biology as a subject.

Responses from Headteachers on a positive change in student attitude revealed that a majority (71.4%) felt that there was much change in learner attitude towards biology. This was a good indicator of the effect of SMASSE on the teaching of biology in
schools. Twenty eight point six percent of the respondents felt that there was little positive change in learner attitude towards biology. All the respondents (100%) felt that there was very much, a little more confidence and efficiency in teachers. The same percentage of respondents (100%) felt there was an increased demand for facilities by teachers of biology in their schools. There was better interaction among students and teachers during learning sessions. This was evidenced by the fact that, when heads of science departments were required to tick indicators that were observed in the biology classes, 85.7 % of respondents indicated that there was proper utilization of teaching/learning resources, improvisation during experiments and also good rapport between teacher/learners. Seventy one point four percent of the respondents indicated the use of more teaching aids in the classroom, a positive attitude towards biology and also increased interaction between teachers and students and between students themselves in biology classes.

The most preferred methods of instruction were Guided group discussions (26.9%), and Activity-based teaching (23.1%), which were picked upon more times than any other method. Teachers felt that these methods enhanced students’ understanding and that learners were able to recall what they had been taught when they participated. Concepts were better understood because learners’ attention span was lengthened. Other respondents felt that learners became more creative and hence productive. Learners tend to concentrate and hence enjoy the lesson. Teacher demonstrations were preferred by 19.2% of the respondents. Respondents who preferred student–centred teaching (15.4%) stated that learners tend to be actively involved; they are directly involved and retain
what they are taught for a longer period. Other respondents stated that student’s research and reading ahead of the teacher led to better understanding. Lecture method was chosen by 15.4% of the respondents. The changes in learning strategy greatly encouraged a change in attitude towards biology.
CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction
The major purpose of this study was to find out the impact of the ASEI movement on students’ achievement in biology at secondary school level in Nakuru County. Data were collected using questionnaires and lesson observation/ASEIPDSI checklists. This chapter presents a summary of findings, conclusions and recommendations for further research.

5.2 Summary
On the basis of results presented in the discussion, it can be established that:

i) There is a high positive relationship between ASEI movement’s teaching strategy and students’ achievement in biology.

ii) Schools’ achievement in biology in Nakuru County was relatively lower prior to the introduction of the SMASSE INSETs introduction of the ASEI movement i.e. student-centred learning strategy.

iii) There is a positive relationship between attitude and students’ achievement in biology

iv) The attitude of students towards learning of biology improved significantly when they were subjected to student-centred learning.
v) There was a positive change in teachers' attitude towards biology teaching as indicated by better interaction and good rapport among students and teachers during learning sessions.

vi) Teachers who had undergone training in ASEI movement carried out more lesson planning, class demonstrations, group discussions, small-scale experiments and student-centred teaching.

vii) The preferred methods of instruction were Guided group discussions and Activity-based teaching which allowed students to be more actively involved in learning.

5.3 Conclusions

These conclusions are based on the objectives of the study and are generalised upon students' achievement in biology at secondary school level in Nakuru County.

i) There is a positive attitude in teacher and students towards the teaching/learning of biology.

ii) The main types of teaching/learning methods that are used by teachers of biology when teaching the subject were Guided discussions and Activity-based teaching.

iii) The ASEI movement teaching strategy which employs student-centred learning strategy was used by most teachers of biology.
iv) Analysis of the achievement of students in biology at KCSE showed a great improvement in most of the schools after the introduction of the ASEI movement in Nakuru County.

5.4 Implications of the Study

The study has clearly established that the introduction of SMASSE INSETs in Nakuru County will:

i) Strengthen the quality of biology education in secondary schools through regular in-servicing of serving teachers.

ii) Change the attitude of students and teachers towards biology education since this is a major causative factor influencing achievement in the subject.

iii) Teachers attending regular SMASSE INSETS will be able to develop skills in areas of improvisation and carry out small-scale experiments. They will also encourage student-centred participatory learning in the classroom.

iv) Student-centred learning is very interesting and motivating to learners, therefore creates a positive attitude that improves achievement in biology.

v) Curriculum developers and planners will find it beneficial to incorporate the ASEI movement during the implementation of the school curricula in all subjects to enhance learning, therefore improving the standards of education in the country.
5.5 Recommendations

The ASEI movement emphasises on the use of student-centred learning with active student participation. The method allows biology teaching/learning to move from outdated traditional teaching methods where the subject was taught as a passive-receptive experience (Teacher-centred learning). Student-centred learning is practical/activity oriented, providing hands-on experiences to students which enhances the learning environment. Therefore the researcher recommends that:

i) Student-centred learning emphasised in the ASEI movement be introduced and used in all other subjects taught in secondary schools to improve KCSE performance.

ii) Student-centred learning can also be introduced in primary schools to make learning more interesting.

iii) Students-centred learning and regular INSETs in ASEI movement should be made compulsory to all teachers

iv) SMASSE INSETs should be sustained and serving teachers should continue attending regularly.

5.6 Suggestions for Further Research

The results of this study show that the ASEI movement which emphasises student-centred learning has greatly improved learner achievement in secondary school biology in the Kenya Certificate of Secondary Education examination in Nakuru County. However, similar research should be replicated in all other Districts in Kenya to find out
the impact of student-centred learning in biology to exhaustively conclude this study. It is also important to consider similar studies involving other factors that affect achievement in biology e.g socio-cultural factors, school type/characteristics and resource availability in schools.
REFERENCES


APPENDICES
APPENDIX ONE
COVER LETTER

Dear Respondent,

RE: MED RESEARCH PROJECT

I am a post graduate at Kenyatta pursuing a course in Master of Education (Administration) degree.

You have been carefully selected to take part in the research project for academic purpose.

Please complete the attached questionnaire as accurately as possible. The information given will be treated with strict confidence.

Thanking you in advance for your co-operation.

Yours faithfully,

NAOMI K. ONAMU.

NAOMI K. ONAMU, P.O. BOX 14751, NAKURU.
APPENDIX TWO

QUESTIONNAIRE FOR THE HEAD TEACHER

Please note that the information you will give is for academic purpose only and will be kept strictly confidential.

School Code ----------------

Please fill in or Tick (√) your response in the box against the answer you have given.

SECTION ONE

1. Boys ☐ Girls ☐ Mixed ☐
2. Is your school a day or boarding school?
   Day ☐ Boarding ☐ Mixed (Day/Boarding) ☐

SECTION TWO

3. Have you attended SMASSE INSET as an administrator?
   Yes ☐ No ☐
4. a) Have the teachers of biology in your school attended SMASSE INSET?
   Yes ☐ No ☐
   b) I your answer in question 4a) above is yes, how many teachers of biology have attended and for how many cycles?

5. a) The School has:
   i. No laboratory ☐
   ii. One laboratory for all Science subjects ☐
   iii. Two laboratories ☐
   iv. Separate laboratories for each science subject. ☐
   b) The laboratory facilities are:
   Adequate ☐ Fairly adequate ☐ Inadequate ☐

6. Using the rating
A – Very much      B – Much      C – Little      D – Very little      E – None

Fill your response in the blank space, from what you have observed about the biology classes in your school.

- Positive change in student attitude
  
- More confidence and efficiency in teachers
  
- Increased requisition demands for facilities by biology teachers
  
- Teachers giving students more practicals
  
- Field trips and ecological studies

7. a) Briefly describe the students’ achievement in Biology at KCSE in the last four years.

__________________________________________________________________________________________

__________________________________________________________________________________________

__________________________________________________________________________________________

Thank you for your cooperation
APPENDIX THREE

QUESTIONNAIRE FOR THE HEADS OF SCIENCE DEPARTMENTS

Please note that the information you will give is for academic purpose only and will be kept strictly confidential.

School Code______________

Please fill in or tick (✓) in your response in the box where indicated.

SECTION ONE

1. Sex
   Male [ ]    Female [ ]

2. State your professional qualification
   Diploma [ ]    B.Ed [ ]
   B.Sc [ ]    M.Ed/M.Sc/MA [ ]

3. How long have you been a Head of Department?
   A – Less than 1 year [ ]    B – 1 to 5 years [ ]
   C – 6 to 10 years [ ]    D – Above 10 years [ ]

SECTION TWO

4. a) Have you attended the SMASSE INSET ?
   Yes [ ]    No [ ]
   b) If your answer in question 4a) above is yes, please state how many cycles you have attended---------------------------------------------------------------

5. At what level did you attend the SMASSE INSET?
   Participant [ ]    Trainer [ ]

6. a) Have all the teachers of biology attended the SMASSE INSET?
   b) If your answer in 6a) above is No, briefly explain why:
7. a) Do you observe the biology teachers in the classroom?

Yes ☐ No ☐

b) If the answer above is YES, which of the teaching/learning approaches are used often?

(Tick (√) your answer)

i) Lecture method 

ii) Teacher-centred learning 

iii) Group discussion

iv) Student-centred learning 

v) Small-scale experiment 

vi) Teacher demonstration 

vii) Questioning method

8. The following are verifiable indicators on improved classroom environment. Tick those that you have observed in the biology classes.

i) Proper utilization of teaching/learning resources

ii) More teaching aids in the classroom

iii) Increased interaction between teachers and students and between students themselves

iv) Good rapport between teacher/learners

v) Motivation of learners

vi) Positive attitude towards biology

vii) Improvisation during experiments
Thank you for your cooperation.

APPENDIX FOUR

QUESTIONNAIRE FOR BIOLOGY TEACHER

Please note that the information you will give is for academic purpose only and will be kept strictly confidential.

School Code___________

Please tick (✓) your response in the box where indicated.

SECTION ONE

1. Sex
   Male □ □
   Female □ □

2. State your professional qualification
   Diploma □ □
   B.Ed □ □
   B.Sc/BA □ □
   M.Ed/M.Sc/MA □ □

SECTION TWO

3. For how long have you been teaching?
   A – 1 to 5 years □ □
   B – 6 to 10 years □ □
   C – 11 to 15 years □ □
   D – Above 15 years □ □

4. a) Have you attended the SMASSE INSET?
   Yes □ □
   No □ □

   b) If your answer in question 4a) above is yes, please state how many cycles you have attended.

5. How adequately do you rate the following teaching/learning resources in your school rating?
   A – Very adequate □ □
   B – Adequate □ □
   C – Not Adequate □ □
   D – Not present □ □
Fill in the blank space

i) Biology laboratory and equipment _____________________________

ii) Laboratory assistants________________________________________

iii) Textbook (biology)_________________________________________

iv) Time to plan lessons________________________________________

v) Preserved specimen__________________________________________

vi) Prepared slides--------------------------------------------------------------------

vii) Prepared charts-------------------------------------------------------------------

viii) Botanical garden---------------------------------------------------------------

ix) Fish pond-----------------------------------------------------------------------

6. In planning and organising biology lessons, how often do you perform the following activities;

   Rating:  A – 2 to 3 days a week       B – Once a week       C – Once in 2 weeks
            D – Once in a month   E – Once in a term

   Fill in the blank space

a) ASEI lesson planning___________________________________________

b) Give class demonstration_____________________________________

c) Organise group discussions_____________________________________

d) Carry out small scale experiments_________________________________

e) Engage students in project work------------------------------------

f) Improvise in experiments_______________________________________

g) Use teaching aids models and charts-------------------------------

h) Organize field trip/ecological studies-------------------------------

i) Use students’ ideas and suggestions for teaching-------------------
7. a) Which of the following teaching strategies / approaches do you adapt while teaching biology to your students?

Rating:  A – Very frequently   B – Frequently   C – Occasionally  
                  D – Rarely  E – Never

i) Lecture Method________________________________________________

ii) Teacher demonstration-__________________________________________

iii) Guided group discussions________________________________________

iv) Student-centred teaching_________________________________________

v) Activity based teaching__________________________________________

b) In order of preference, which of the above mentioned methods do you find the most effective in teaching biology and why?

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

8. a) Describe your student’s achievement in biology at KCSE since 2004 by grading using the following scale

1- Excellent  2 - Very Good  3 – Good  4 – Average  5 - Poor

--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------

b) What do you think is the main cause of the trend in achievement in the subject that you have described above?

Thank you for your cooperation

(Source Orodho, 2003)
APPENDIX FIVE

QUESTIONNAIRE FOR STUDENTS

Please fill in or tick (√) in the box against the answer that you have given

School Code _______________________

SECTION ONE

1 Which is your class/form?
   Form 3  □  Form 4  □

2 Sex  Male  □  Female  □

3 School status:  Boys  □  Girls  □  Mixed  □

4 Boarding status:  Boarding  □  Day  □  Mixed  □

SECTION TWO

5 a) How do you like the biology subject?
   Very Much  □  Much  □
   A little  □  Not at all  □

   b) Give a reason for your answer in 3a) above.

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

6 a) How many times do you perform the following learning activities in Biology?

   Rating-  A – Daily  B – 2 to 3 days in a week  C – After two weeks
   D – Once a term  E – Once in a year

   Using the code A to E above, fill in the blank space.

   i) Individual experiments__________________________________________
   ii) Use locally available materials__________________________________

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iii) Group discussions
iv) Observe teacher demonstration
v) Go for field trips
vi) Carry out ecological studies
vii) Do project work
viii) Do peer teaching

b) Which of the above mentioned learning activities do you enjoy most and why?

7 a) How do you rate your achievement in biology?
   Excellent  Good  Fairly good  
   Average  Below average

b) Give a reason(s) for your answer in 5(a) above

8 Who encourages you to study Biology and why?

Thank you for your cooperation

(Source: Orodho 2003)
APPENDIX SIX

ASEI/PDSI Checklist

ASEI: Activity focused, Student centred learning, Experiments, Improvisation

PDSI: Plan, Do, See, Improve

<table>
<thead>
<tr>
<th>Plan</th>
<th>Description</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>The work plan took into account the students’ backgrounds such as learning difficulties, their needs/interest/misconceptions, growth of experimental skills and previous experience in relation to the topic</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>P2</td>
<td>The work plan was appropriate and realistic in the light of the lesson content and students’ abilities/skills/interest</td>
<td></td>
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<tr>
<td>P3</td>
<td>The teacher prepared appropriate and adequate materials for the students’ use</td>
<td></td>
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<tr>
<td></td>
<td><strong>Do(Teach) Introduction</strong></td>
<td></td>
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<tr>
<td>D1</td>
<td>Introduction incorporated previous knowledge/skills/everyday experience and linked them to the new topic</td>
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<tr>
<td>D2</td>
<td>Introduction was clear on what the teacher wanted the students to learn</td>
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<tr>
<td>D3</td>
<td>Introduction was stimulating enough to arouse the interest and curiosity of the students</td>
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<td></td>
<td><strong>Development</strong></td>
<td></td>
<td></td>
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<td>D4</td>
<td>Lesson encouraged students to express their prior experiences and explain their ideas related to the content</td>
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<tr>
<td>D5</td>
<td>Lesson encouraged students to give their own hypothesis/predictions and helped to discuss how they differed from those held by others and to verify them through experiments, facts, etc.</td>
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<tr>
<td>D6</td>
<td>Lesson encouraged students to give their own observations/results in the experiment and to discuss how they differed from those of others</td>
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<tr>
<td>D7</td>
<td>Lesson facilitated process skills such as observing, measuring, identifying variables planning experiments, etc</td>
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<tr>
<td>D8</td>
<td>Teacher dealt with students’ questions, misconceptions and reinforced learning at each step</td>
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<td><strong>D9</strong></td>
<td>The lesson encouraged active participation of students as much as possible in the main teaching steps</td>
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<tr>
<td><strong>Conclusion</strong></td>
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<td><strong>D10</strong></td>
<td>Lesson encouraged students to draw conclusions</td>
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<td><strong>D11</strong></td>
<td>Teacher summarised the lesson and gave follow-up activities</td>
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<td><strong>D12</strong></td>
<td>The lesson assisted to view the content in relation to what they come across in the society</td>
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<td><strong>D13</strong></td>
<td>Teacher checked the accuracy, correctness, depth and appropriateness of the content through question and answer techniques</td>
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<tr>
<td><strong>Class management</strong></td>
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<td><strong>D14</strong></td>
<td>Teacher organised and conducted lesson talking into account the individual differences in student capability</td>
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<tr>
<td><strong>Instructional materials/media</strong></td>
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<td><strong>D15</strong></td>
<td>Teacher made effective use of the teaching /learning materials and media</td>
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<tr>
<td><strong>See(Evaluate)</strong></td>
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<tr>
<td><strong>S1</strong></td>
<td>Teacher supervised class-work</td>
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<td><strong>S2</strong></td>
<td>Teacher was attentive to needs of students-low ability and high academic ability</td>
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<td><strong>S3</strong></td>
<td>Teacher kept eye contact with students to monitor their feelings</td>
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<td><strong>S4</strong></td>
<td>Teacher invited questions from students</td>
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<td><strong>S5</strong></td>
<td>Teacher asked questions to check quality of understanding</td>
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<tr>
<td><strong>Improve</strong></td>
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<tr>
<td><strong>IM1</strong></td>
<td>Teacher rephrased questions or instructional statements as necessary</td>
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<td><strong>IM2</strong></td>
<td>Teacher interjected rightly and called to attention inattentive students</td>
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<td><strong>IM3</strong></td>
<td>Teacher gave further guidance to students on lesson activity(ies)</td>
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<td><strong>IM4</strong></td>
<td>Teacher made appropriate adjustment in the conduct of lesson</td>
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<tr>
<td><strong>ASEI</strong></td>
<td>(0-not at all, 1-a little, 2-fairly adequately, 3-adequately, 4-a great deal)</td>
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<tr>
<td><strong>Activity</strong></td>
<td>The lesson was activity focused: Reasons: a) Practical work was conducted b) Appropriate tasks for discussion were given</td>
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<tr>
<td><strong>Student involvement</strong></td>
<td>The lesson was student-centred: Evidence: a) Students were effectively encouraged to give their prior experiences and explain their ideas related to the content. b) Students were effectively encouraged to give their own hypotheses/predictions and helped to discuss how they differed from those held by others and to verify them through experiments, facts, etc.</td>
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99
c) Students were effectively encouraged to give their own observations/results in the experiment and to discuss how they differed from those of others
d) Students were effectively encouraged to evaluate the lesson.

Experiment effectiveness

The experiment(s) helped to achieve the objective(s) of the lesson
Evidence:
a) Students were able to solve related problems
b) Students were able to make deductions from the practical work
c) Students were able to verify hypotheses/predictions.

Improvisation

Improvisation was practised during the lesson:
Evidence:
a) Modified/simplified experiment(s), small scale experiments were done
b) Utilisation of available materials in the students’ immediate environment
c) Teacher produced and or utilised improvised materials
d) Students were able to use improvised materials effectively
e) Students’ participation was enhanced/increased

(Source: SMASSE, 2006)
APPENDIX SEVEN

LESSON OBSERVATION LIST

School Code---------------------------------------------------------------

Subject---------------------------------------------------------------

Topic/Subtopic---------------------------------------------------------------

Class---------------- Number of students-----------------

Date----------------------------

Please indicate your assessment of the following aspects of the lesson by placing a tick in the appropriate box on the rating scale

**Rating scale: 0-poor, 1-fair, 2-satisfactory, 3-good, 4-very good**

<table>
<thead>
<tr>
<th>1. Teaching procedure</th>
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</thead>
<tbody>
<tr>
<td>1. Clarity/feasibility of lesson objectives</td>
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<tr>
<td>• Stated in simple and clear language</td>
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<td>• Stated in terms of what learners are expected to achieve</td>
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<td>• Achievable within stipulated time</td>
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<td>2. Appropriateness of lesson in terms of:</td>
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<tr>
<td>i) Introduction</td>
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<td>• Help learners to focus on content of lesson</td>
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<td>• Simulating</td>
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<td>• Makes reference to previous lessons, everyday experience</td>
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<td>ii) Content</td>
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<tr>
<td>• Related to learners’ previous experience</td>
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<td>• Geared to level of learners</td>
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<td>• Stimulus variation (use of a variety of techniques) apparent in handling of content</td>
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<td>• Teacher well-versed in content</td>
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<td>iii) Gender</td>
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<td>• Examples free of gender bias</td>
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<td>• Questions distributed evenly</td>
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<td>• Motivational cues free of gender bias</td>
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<td>iv) Language</td>
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<td>• Voice well projected</td>
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<td>• Language appropriate to level of learners</td>
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<td>• Teacher defines and explains difficult terms</td>
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<td>• Friendly in terms of communication with learners</td>
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<td>• Instructions given clearly and unambiguously</td>
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3. Emphasis on main concept
• Explanation and elaboration on main concept
• Use of appropriate examples to illustrate main concept
4. Lesson consolidation/summary
   - Recapitulation of main points
   - Reference to main concepts
   - Sufficient time for learners to ask questions seek clarification

5. Achievement of set objectives is apparent in:
   - Activities
   - Teachers questions
   - Students’ question
   - Students answers
   - Level of enthusiasm

II. Fundamental Technique/Methodology

1. Student involvement through questioning and discussion
   - Did the teacher ask questions?
   - Did students ask questions?
   - Were the learners involved in discussions?

2. Students involvement in hands-on/minds-on activities
   - Were learners meaningfully engaged in learning activities?
   - Were the activities planned to arouse and sustain interest?

3. Appropriateness of demonstrations, teaching aids and improvised materials
   - Materials, demonstrations, appropriate for the purpose
   - Evidence of improvisation and economy in use of materials

4. Appropriateness of teacher’s attitude and expression
   - Did the teacher appear to be enjoying the teaching?
   - Was the teacher sympathetic to the needs and problems of the learners?
   - Did the teacher exercise patience with the learners?

III. Management

1. Distribution of time
   - Was the time appropriately distributed?
   - In the work plan?
   - In the execution of the lesson?

2. Class control
   - Did the teacher ensure all learners were engaged in relevant learning activities?
   - Did the teacher handle disruptive behaviour appropriately?

3. Use of students’ opinions/ideas
   - Did the teacher actively solicit students’ ideas on content being taught?
   - Did the teacher relate students’ ideas to the content being taught?
   - Did the teacher discuss and correct students’ misconceptions?

4. Evaluation of the lesson by the teacher
   - Was evaluation incorporated in the plan?
   - Did the teacher actually evaluate the lesson?
   - Did the teacher indicate measures to be taken to improve future planning/execution?

Additional comments

(Source: SMASSE, 2006)