EVALUATION OF SMASSE TRAINING ON TEACHERS' SOURCING AND USAGE OF INSTRUCTIONAL MATERIALS FOR TEACHING CHEMISTRY IN BUNGOMA EAST DISTRICT, KENYA

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E55/CE/12567/2009

A research thesis submitted for the degree of Master of Education in the School of Education of Kenyatta University

JANUARY 2014
DEDICATION

To my parents Shem and Grace Nangabo. I am forever indebted to them for their unyielding determination to lay my basic academic foundation in countless ways.
ACKNOWLEDGEMENTS

This study was successful because of the assistance and cooperation received from very many people. Some actively took part in it, while others unconsciously energized my determination to concentrate on it with a deserving level of enthusiasm. Regardless of the kind of support accorded to me, I wish to recognize some individuals whose contribution was so remarkable.

Firstly my supervisors Dr. Nicholas W. Twoli and Dr. Ndichu Gitau, who credibly directed me from the very onset, always setting aside their precious time to critically read several versions of my work, and out of which, they generously offered their rich scholarly advice, guidance and suggestions. Their sentiments became significant guideposts which shaped many of the ideas reflected in this research study.

Secondly, I remain thankful to my wife Jackline for her compulsive and strongly blended personality. Her demeanor was godsend; it supplied me with the inspiration to stoically imagine and plan and design and carry out this study with a deservingly high degree of austerity. I also wish to thank my young children; Jabez, Dorothy and Justin, for missing me without registering any form of complain during the entire period I spent on this research instead of them. Their coolness and calmness made me happy and focused up to the very end.

Thirdly, I express my appreciation to the D. E. O's office, Bungoma East District for its twofold assistance; availing the analyzed K.C.S.E results for chemistry and an authority letter for validating my collection of data from selected schools. Moreover the Chemistry teachers, they willingly shared their teaching experiences with me. Lastly, I do confess the unconditional support which I received from my brothers Linus and Wilfred. Besides, to everyone who was involved in this momentous achievement, I say thank you very much.
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ABBREVIATIONS AND ACRONYMS

ASEI — Activity, Student-centered, Experiments, Improvisation

CEMASTEA — Centre for Mathematics, Science and Technology Education in Africa

C.D.F aided schools — newly established secondary schools that heavily rely on assistance from the Constituency Development Fund kitty.

D.E.O — District Education Officer

HOTS — High order thinking skills

INSET — In-Service Training

JICA — Japan International Cooperation Agency

K.L.B. — Kenya Literature Bureau

K.I.E. — Kenya Institute of Education

K. C. S.E. — Kenya Certificate of Secondary Examination

KNEC — Kenya National Examinations Council

LCT — Learner-centered Teaching

MOEST — Ministry of Education Science and Technology

PDSI — Plan, Do, See, Improvise

SMASSE — Strengthening of Mathematics and Science in Secondary Education

SPSS — Statistical Package for Social Sciences

TLP — Teaching and learning process

T.S.C — Teachers Service Commission
ABSTRACT

SMASSE training was designed for serving secondary school teachers of Mathematics and Science subjects, it was meant to bring about a pedagogic paradigm shift in teaching through an introduction of ASEI / PDSI instructional approach. It was projected that such an approach would improve the performance of students in K.C.S.E examinations. This study was executed to investigate abilities of Chemistry teachers to source and integrate instructional materials in their regular teaching as influenced by SMASSE project training. The study was guided by four objectives; to determine availability of instructional materials in schools, to establish modes of acquiring teaching resources, to ascertain the degree of learner participation in lessons and to assess the role of SMASSE training on teachers’ modes of instruction. The researcher applied a descriptive survey design to a sample size of; 18 secondary schools, 25 Chemistry lessons, 42 Chemistry teachers and all heads of science department within sampled schools. The raw data was analyzed using a computer software, SPSS. Results were presented in form of descriptive statistics using percentages, frequency tables, and histograms. Findings showed that; (a) Chemistry teachers declined to acknowledge having been influenced by SMASSE training in their regular teaching, (b) most schools had laboratories which are inadequately stocked with necessary facilities and equipment, (c) schools were predominantly acquiring instructional materials through purchasing, (d) expository teaching strategies were still prevalent in Chemistry lessons and (e) learner participation in classrooms was limited to students’ responses to their teacher’s questions. Additionally, newly established schools were found to be severely disadvantaged in terms of having qualified teachers and requisite facilities for teaching Chemistry. Consequently, the following recommendations were made; (1) goals of SMASSE training should be changed from lesson improvement to focus more on teacher improvement since teachers are charged with overseeing classroom learning activities, (2) SMASSE national trainers should conflate all emergent issues which arise in various INSET centers across the country into an annual publication, and then avail its copy to schools as a stand by guide for Chemistry teachers, (3) the MOEST should set basic minimum requirements for all laboratories in schools, (4) the MOEST should conduct impromptu visits to schools to ensure that Chemistry teachers are totally adhering to proper teaching methodologies that satisfactorily address the practical aspects of Chemistry, (5) The MOEST should develop modalities to start awarding students’ manipulative skills in chemistry practical paper during national examinations and (6) the MOEST should develop and supply audio-visual instructional resources for topics/experiments whose facilities have continued to remain scarce in schools. Empirically, the core aims of the SMASSE training are not yet fully integrated in classrooms by Chemistry teachers.
CHAPTER ONE
INTRODUCTION

This study focused on the instructional resources for Chemistry at secondary school level. Chapter one is outlining one by one; the background to the study, statement of the problem, the objectives, the significance, the limitations and the assumptions of the study, the conceptual framework and the operational definition of terms.

1.1 Background to the study

Applications and uses of the knowledge of Chemistry are so immense in our daily life. Chemistry is responsible for the presence of many modern-day materials (Helmestine, Web1; Helmestine, Web 2; McAlphine, Web 5 and Royal society of Chemistry, Web 4). Some of the applications whose existence is rooted in the primary knowledge of Chemistry are:

- the field of medicine; that is developing medicines, testing new of medical treatments, diagnosis and curing of many diseases.
- the production of building materials for example; cement, paints, tiles metals, among others.
- the household products for instance utensils, carpets, seats, and so forth.
- industrially manufactured products like; soaps, detergents, fertilizers, cooking fats, automotive tyres, bleaches, disinfectants, light bulbs, synthetic products and others.
- the nuclear development-for generation of electricity.
- Water purification
- the functioning of electronic gadgets, like radios, televisions and mobile phones.
Many of these applications are realized through the co-opting of skills from other science subjects. This indicates that Chemistry has a unique ability of creating significant connections and overlaps with theories derived from other science subjects. This unique linkage portrays Chemistry as a central science subject whose inclusion in the syllabus is very necessary (Web 4).

Chemistry is officially introduced to learners as a subject, at the secondary school level. It has been noted in the preliminary pages of the Chemistry syllabus that “its knowledge is necessary in the understanding of the composition, properties and behaviour changes of matter that form the environment around us”. From the very onset, Chemistry is presented as a practical subject requiring the presence of apparatus, chemicals and equipment (K.I.E., 2008).

There are ten general objectives intended to be achieved by learners upon completion of their secondary school Chemistry syllabus. These objectives are supposed to be practicable amongst the learners of Chemistry. For purposes of their critical evaluation, these objectives are reproduced hereunder.

By the end of the course, the learner should be able to:

1. select and handle appropriate apparatus for use in experimental work
2. make accurate measurements, observations and draw logical conclusions from experiments
3. observe and appreciate the need for safety precautions during experimental investigations
4. understand and appreciate the use of chemical symbols and formulae in writing equations
5. use appropriate chemical terms in describing physical and chemical processes
6. identify patterns in the physical and chemical behaviour of substances
7. apply the knowledge acquired to promote positive environmental and health practices
8. use the knowledge and skills acquired to solve problems in everyday life
9. apply principles and skills acquired in technology and industrial development
10. acquire adequate knowledge in chemistry for further education and for training.
These course objectives are good since they focus on producing knowledgeable professionals, but there is need to specify an appropriate time for implementing each objective and to point out how each objective can be implemented.

These objectives can be classified depending on their ideal placement for implementation. Objectives 1 to 6 (category I) can be realized while the learner is schooling. Objective 7 and 8 (category II) can be accomplished partly inside and outside the schooling calendar. Objectives 9 and 10 (category III) can exclusively be implemented outside the schooling calendar by learners who pursued further studies in Chemistry. It is noteworthy that the success of implementing category I objectives overrides all the other categories, since they are just but subsets of category I. The successful implementation of category I objectives depends on the availability and proper usage of instructional materials in the teaching and learning of Chemistry. This aspect of obtaining and subsequent proper usage of instructional materials was the crux of SMASSE training.

The paradigm of teaching Chemistry is practical work. Its practical aspects exist both in its teaching and in its evaluation. Proper usage of instructional materials is primarily measured with respect to the performance of learners in Chemistry during national examinations after their four year secondary school curriculum. However, the performance of Chemistry at the Kenya Certificate of Secondary Education (K.C.S.E) at the national level has been poor for a very long time. This condition of poor performance of students in Chemistry has been rampant across many districts in the country. For instance, Bungoma East district has had approximately 30,000 candidates who sat for their K.C.S.E examinations for nine years from 2001 up to 2009. This longitudinal analysis of their performance reveals a consistent trend where majority of them
scored very poor grades in Chemistry. Table 1.1 provides the number of students by percentage per given grade, as they scored in Chemistry.

Table 1.1: Number of students who scored a given grade in Chemistry K.C.S.E examinations between 2001 to 2009 within Bungoma East district

<table>
<thead>
<tr>
<th>Grade</th>
<th>Number of Students (%)</th>
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<tr>
<td>A</td>
<td>2.6</td>
</tr>
<tr>
<td>A-</td>
<td>1.6</td>
</tr>
<tr>
<td>B+</td>
<td>2.5</td>
</tr>
<tr>
<td>B</td>
<td>2.8</td>
</tr>
<tr>
<td>B-</td>
<td>3.7</td>
</tr>
<tr>
<td>C+</td>
<td>5.0</td>
</tr>
<tr>
<td>C</td>
<td>5.9</td>
</tr>
<tr>
<td>C-</td>
<td>7.6</td>
</tr>
<tr>
<td>D+</td>
<td>9.4</td>
</tr>
<tr>
<td>D</td>
<td>26.8</td>
</tr>
<tr>
<td>D-</td>
<td>26.8</td>
</tr>
<tr>
<td>E</td>
<td>5.3</td>
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Source: D.E.O’s office Bungoma East

This state of performance, especially in an essential science subject is awful. If these students have been proceeding on to their tertiary level of education, then their Chemistry grades did not make it possible for them to pursue any of the Chemistry related courses, since the entry grade for most Chemistry related courses is C+ and above in chemistry as a selected subject. This scenario, where there is an acute shortage of quality grades in Chemistry, points towards a future where most of the Chemistry related professions are going to be seriously understaffed.
Moreover, the average performance of Chemistry in entire Bungoma East district in national examinations remains unsatisfactory up to date. Table 1.2 has displayed the magnitude of this dismal performance in terms of the overall mean score.

Table 1.2: Average performance of Bungoma East District in Chemistry in K.C.S.E examinations from 2001 to 2009

<table>
<thead>
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<th>YEAR</th>
<th>MEAN SCORE</th>
<th>MEAN GRADE</th>
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<tbody>
<tr>
<td>2001</td>
<td>3.3196</td>
<td>D</td>
</tr>
<tr>
<td>2002</td>
<td>3.4327</td>
<td>D</td>
</tr>
<tr>
<td>2003 (SMASSE started)</td>
<td>4.0702</td>
<td>D+</td>
</tr>
<tr>
<td>2004</td>
<td>4.2903</td>
<td>D+</td>
</tr>
<tr>
<td>2005</td>
<td>4.1994</td>
<td>D+</td>
</tr>
<tr>
<td>2006</td>
<td>4.0163</td>
<td>D+</td>
</tr>
<tr>
<td>2007</td>
<td>3.7832</td>
<td>D+</td>
</tr>
<tr>
<td>2008</td>
<td>3.3795</td>
<td>D</td>
</tr>
<tr>
<td>2009</td>
<td>3.8307</td>
<td>D+</td>
</tr>
</tbody>
</table>

Source: D.E O’s Office, Bungoma East

Table 1.2 indicates that there was no significant change in the performance of Chemistry in K.C.S.E examinations during the pre-SMASSE and SMASSE years. On the basis of Tables 1.1 and 1.2, the Kenya’s vision 2030 is under a serious threat of not being met. The inception of SMASSE project training arose out of concern to improve the performance of students in the Mathematics and the Science subjects, where Chemistry correctly belongs (SMASSE, 2004; Njuguna, 1999 and Wambui & Nyacomba, 2006).
The SMASSE training was concerned with those aspects of teaching that could promote meaningful learning amongst students. These aspects were inclined to empower Chemistry teachers to:

a) Develop appropriate teaching methodology,
b) Advance mobilization and prioritization of resources,
c) Expand utilization of resources,
d) Reform the attitude of both teachers and students towards the subject,
e) Enrich understanding by teachers of students' status and needs,
f) Improve the content mastery of some teachers.

The project was a deliberate effort to better the teacher-students' interaction during teaching and its key concept was “lesson improvement”, that is, to renew Chemistry lessons with good classroom practices where the learners' participation is significant.

From the foregoing discussion, best methods of instruction ought to be employed so as to guarantee learners a good overall score. Similarly, these modes of instruction ought to appreciate that Chemistry is a practical subject both in its teaching and its assessment. Therefore, teachers should endeavour to instruct their students to learn facts beyond mere recall, if these students are to pass Chemistry with good grades. The national wide rolling out of SMASSE project trainings in 2003 was meant to empower the Chemistry teachers with essential skills to develop miscellaneous ways of sourcing and utilising instructional materials in their teaching to guarantee good results to their students.
1.2 Statement of the problem

Introduction of SMASSE project was aimed at equipping Chemistry teachers with right skills to enable them to increase the hands-on activities and the student participation in classrooms. Presence of “hands-on activities and student participation in class” can only be possible where there is adequate supply of instructional materials. Since most schools lacked instructional materials, the SMASSE project trainings were envisioned to encourage Chemistry teachers to source for their instructional materials either through improvisations or by modifying existing ones to play several roles. The architects of SMASSE project were fully aware that “hands-on activities and student participation in class” would improve the performance of Chemistry in the national K. C. S. E examinations.

After the introduction of 8-4-4 system of education in Kenya opened up opportunities for many students at the secondary level to take Chemistry as their subject of choice. The teaching of Chemistry requires the presence and adequate utilization of a well furnished laboratory in each secondary school. The costs of constructing a laboratory and equipping it with necessary facilities are high. These prohibitive costs have made it difficult for most schools to expose their students to standard conditions of learning Chemistry. As a result, most students all over the country have persistently been scoring very poor grades in Chemistry during the national examinations. Several measures have been undertaken in an attempt to turn around this perennial poor performance, and the introduction of SMASSE project was one such remedy measure. At its inception, the teachers’ approach towards teaching Chemistry changed positively and the interest of the students in the subject was well enhanced. However, SMASSE project is now thirteen years old in Kenya, its long presence has not translated into lasting good performance of Chemistry in K.C.S.E examinations.
This study was carried out to evaluate the role SMASSE project annual trainings have played in promoting good classroom practices, namely to enrich lessons with suiting hands-on activities and boost students' participation during the teaching and learning process as envisioned in its primary objectives. Teachers were to acquire some key resources and integrate them in the course of their classroom instruction. Therefore, this study will investigate the ability of Chemistry teachers to source instructional materials and to integrate those sourced instructional resources throughout their teaching as influenced by the SMASSE project training.

1.3. Purpose of the study

The purpose of this study was to find out whether or not schools had adequate instructional materials meant for the teaching of Chemistry, to identify the means which schools were using to acquire instructional resources, to determine whether or not if Chemistry teachers were carrying out any improvisations and if those improvised resources are effective and to find out whether or not Chemistry teachers were using learner centered teaching strategies as advocated for by the SMASSE project in-service trainings (INSETs).

1.4. Objectives of the study

This study was guided by the following overall research objectives:

1. To determine whether instructional materials meant for the teaching of Chemistry were available in schools and to establish if those instructional materials are adequate in terms the teachers' and the students' use. Besides, to ascertain whether teachers were availing instructional materials in their Chemistry lessons as advocated for by SMASSE training
2. To find out the methods which schools were using to acquire the instructional materials meant for teaching Chemistry and to establish whether or not Chemistry teachers were improvising some instructional materials as guided by SMASSE project INSETs. Furthermore, to establish the suitability of improvised instructional materials for Chemistry, with regard to their efficiency during classroom instruction.

3. To find out the practicability of small scale experiments within Chemistry lessons as motivated by SMASSE training, so as to determine teaching strategies being used by Chemistry teachers and to establish the degree of learner-participation in lessons.

4. To investigate whether or not SMASSE project INSETs have influenced the Chemistry teachers' modes of teaching and to establish if teachers were still willing to continue attending the SMASSE trainings.

1.5 Research questions

The main research question was;

How has the SMASSE training of Chemistry teachers influenced the availability, the adequacy and the utilization of instructional materials meant for Chemistry in schools?

Subsidiary questions were;

a. Do schools possess adequate instructional materials for teaching Chemistry?

b. Who are the main agents responsible for sourcing instructional materials in schools?
c. Which instructional materials are commonly being improvised by teachers and their students?

d. Which teaching strategies are teachers of Chemistry employing during their interaction with students in classrooms?

e. Are those improvised instructional materials assisting Chemistry teachers in bringing about desired learning outcomes in students?

1.6 Significance of the study

SMASSE project is an investment in the education sector by the government of Kenya with an intention of improving the performance of Chemistry at secondary school level in national examinations. Hitherto, SMASSE project has been in the national domain since 2003 and it has undergone many phases. These phases have consumed countless government efforts in terms of time, money and other supportive resources. Therefore, this study sought to evaluate the effectiveness of the SMASSE project INSETs in empowering Chemistry teachers to rejuvenate the performance of students in K.C.S.E examinations. Therefore, the findings of this study will furnish the policy makers with an evaluation report of the project and accordingly offer to suggest new realistic ways of perfecting SMASSE project INSETs in order to make it remain relevant in solving the challenges which Chemistry teachers encounter in their everyday interaction with their learners.

1.7 Scope and limitations

1.7.1 Scope of the study

This study concentrated on the Chemistry teachers, their Form three students and the heads of science department for 18 schools that were randomly selected within Bungoma East district. For
further classification; there was 1 national school, 4 county schools, 10 district schools, 2 schools supported by Constituency development fund kitty (C.D.F aided schools) and 1 private school.

1.7.2 Limitations of the study

In spite of Bungoma East district had a total of 50 secondary schools at the moment of this study, the research focused on sampled schools only. Additionally, SMASSE project INSETs included three other subjects Mathematics, Biology and Physics yet this study concentrated on finding out how SMASSE training had affected the sourcing and usage of instructional resources appearing in Chemistry only.

1.8. Assumptions of the study

The basic assumptions in this study were that:

a. The learning atmosphere within Bungoma East district schools is relatively similar.

b. Majority of the practicing teachers of Chemistry are fully knowledgeable about of the existence and purposes of SMASSE project INSETs.

c. All practicing Chemistry teachers have the competence to apply various teaching strategies as the needs of a particular the topic demands.

d. The learners’ entry behavior does not differ significantly in various schools.
1.9 Conceptual framework

This study relied on the ASSURE instructional design model of learning (Smaldino, Lother and Russell, 2012). ASSURE model is a procedural guide for planning and delivering an instruction that integrates instructional media and technology into the teaching process. Such a guide is necessary for teachers since “teaching is unforgivingly complex; it is not simply good or bad, right or wrong, working or failing” (Cochran-Smith, 2003).

Teaching occurs in three phases; the planning, the implementation and reflection. Planning phase involves what a teacher does to prepare for an instruction. This planning is first influenced by the individual teachers’ characteristics and then secondly by the learners’ characteristics. Teachers’ characteristics which this study considered that were teaching experience, SMASSE training and the teacher’s opinions. Learners’ characteristics which a teacher ought to observe are class size, their entry competencies and their combined attitudes. The implementation phase comprises four distinct parts: (1) a teacher stating the objectives for a given instruction, (2) a teacher selecting appropriate instructional materials and media alongside a suitable teaching strategy, (3) a teacher utilizing the selected instructional materials and media as per lesson objectives and (4) a teacher requiring learner participation in the learning process. The reflection phase requires a teacher to evaluate and possibly revise: the media components and the students’ performance in examinations. Figure 1.1 is a diagrammatic representation that is explaining the main factors, concepts, variables and the presumed relationships existing among them.
Figure 1.1: Conceptual framework for the study
1.10. Operational definition of terms

ASEI/PDSI approach

This is an instructional strategy proposed by SMASSE training that advocates for increased student participation in learning sessions characterized by the presence of many small scale experiments being carried out with learners.

Classroom

A place where Chemistry lessons are conducted, it is either a laboratory or a normal classroom

County schools

Type of secondary schools that were previously referred to as provincial schools

Hands on activities

These are organized undertakings carried out by students in class during the teaching and learning process.

Improvisation

This is an attempt to devise alternative teaching resources and use them in situations where conventional instructional materials are not available.

Instructional materials

These are devices, which assist a teacher in transmitting knowledge to students during the teaching and learning process. They are referred to as learning materials if used by a student to bring about learning.

Mobilization of resources

This sensitization drive meant to encourage teachers to acquire instructional materials which are deemed necessary for effective their teaching of complex concepts and theories.

School(s)

Denotes secondary school(s)

Science subjects

These are Chemistry, Biology and physics as taught at secondary school level.
SMASSE project

This is an initiative by the government of Kenya to equip teachers of Mathematics and Science subjects at the secondary school level with good pedagogical skills in order to boost the performance of students in these subjects in K.C.S.E examinations.

SMASSE Trainings

These are two week workshops planned for mathematics and science subjects' teachers once a year and organized by the SMASSE project.

Sourcing

Acquiring instructional resources either through improvisation or by carrying out some modifications on the existing ones so that they are made suitable for other purposes apart from those that they were originally designed for.

Stocked laboratory

A laboratory containing facilities and equipment like; chemicals, glassware, models, slides and general infrastructure, such as running tap water and laboratory gas wirings.

The project

Denotes the SMASSE project

The training

Denotes the SMASSE project training

Usage

Utilization of instructional materials in classrooms to bring about desired learning

8-4-4 system of education

This is a mode of education in Kenya, where a student takes 8 years at primary school level, 4 years at secondary school level and 4 years at university level.
CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

This chapter is dealing with the literature review. The literature review is sequentially focusing on: nature of learning and evaluating Chemistry, types of instructional materials for the teaching of Chemistry, selection of instructional materials in Chemistry, availability of instructional materials for Chemistry, role of instructional materials for Chemistry, acquisition of instructional materials for Chemistry and the concerns of the SMASSE project training.

2.1 Nature of learning and evaluating Chemistry

The nature of learning Chemistry constitutes three conceptual levels. These conceptual levels are the macro, the micro and the symbolic (Biswajit, 2008). Macro level refers to a phenomenon, which can be perceived by use of senses without aid of instruments. The micro level refers to those skills, which are mastered with the aid of the pieces of apparatus, or abstracted by inferences arising from chemical processes. The symbolic level refers to the language of expressing Chemistry ideas using symbols, models and equations. Biswajit (2008) has pointed out that the micro and the symbolic conceptual levels work to interpret the macro level. The linkage of these three conceptual levels makes Chemistry to be a practical subject. Since Chemistry is a practical subject both in its teaching and in its evaluation, any meaningful in-service training of teachers ought to have concentrated on equipping them with skills to enable them prepare their learners well for the examinations. The SMASSE training never explained to teachers the nature of evaluating Chemistry in national examinations.

The Kenya National Examination Council (KNEC) evaluates Chemistry using two theory papers (233/1 and 233/2) and one practical paper (233/3). In this latter case, each learner is provided
with necessary apparatus, chemicals and equipment, and is required to carry out particular 
experiments, as directed by the supplied question paper. The performance of any given student in 
this practical paper influences, to a large extent, the overall final score of that student. For those 
students who have obtained poor grades in Chemistry at K.C.S.E, their weak grades can be 
traced back to their individual scores in the Chemistry practical paper.

There is need to explore the features of the Chemistry practical paper. It contains three questions 
and its marked out of forty marks. These marks are allocated to two broad sets of questions. 
Out of these forty marks, there is some marks earned by a candidate for making correct 
observations and for providing correct inferences which must be arising from correctly reported 
observations. Table 2.1 shows the distribution of the forty marks across these two broad sets of 
question items, as distributed in the previous K.C.S.E Chemistry practical paper.

Table 2.1: Allocation of forty marks by percentage to observational and inferential 
question items of Chemistry 233/3 in K.C.S.E examinations from 2005 to 2011

<table>
<thead>
<tr>
<th>Year</th>
<th>Marks for observations (%)</th>
<th>Marks for valid inferences (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>48</td>
<td>52</td>
</tr>
<tr>
<td>2006</td>
<td>42</td>
<td>58</td>
</tr>
<tr>
<td>2007</td>
<td>46</td>
<td>54</td>
</tr>
<tr>
<td>2008</td>
<td>41</td>
<td>59</td>
</tr>
<tr>
<td>2009</td>
<td>43</td>
<td>57</td>
</tr>
<tr>
<td>2010</td>
<td>45</td>
<td>55</td>
</tr>
<tr>
<td>2011</td>
<td>38</td>
<td>62</td>
</tr>
</tbody>
</table>

Source: K.C.S.E chemistry practicals(233/3)
Table 2.1 indicates that over the years, KNEC has been allocating more marks to the question items characterised by a candidate making correct inferences. For a candidate to score any marks on question items involving “the making of correct inferences”, that candidate is obligated to employ high order thinking skills (HOTS), due to a follow – on effect of an examiner making references to the reported corresponding observations. For any candidate to score any of those marks meant for making valid inferences, the corresponding reported observations must be right, otherwise, wrong observations cannot yield correct inferences.

Therefore, the nature of evaluating Chemistry demands for better learning techniques amongst students. Learning techniques that call for proper usage of instructional resources by way of a teacher stating the purpose of an experiment beforehand, followed by its careful execution to bring about the desired learning outcomes (Biswajit, 2008 and Millar, 2001). The points of view of Biswajit (2008) and Millar (2001) call upon the Chemistry teachers to evaluate a new their modes of administering practical sessions in their pursuit to transmit Chemistry knowledge to their students. Specific suggestions originating from both Biswajit and Millar require that the Chemistry teachers ought to train their learners so that out of the practical sessions they can be able to; make accurate observations, report their findings using acceptable scientific language and to deduce the implications of their findings.

The students who are trained from the very onset to make good use of these basic skills in all their practical sessions are not expected to have problems in interpreting the intended Chemistry principles, supposed to be arising from each learning situation. The ultimate indicator for the existence of “effective practical sessions” within Chemistry is the eventual general performance in the annual K. C. S. E examinations.
There are many ways of promoting maximum learning in people. Tewksbury and Macdonald (2005) have identified appropriate situations for supporting meaningful learning. These situations occur when: (1) a person is actively engaged in participation, with regard to observing, speaking, writing, listening, thinking, drawing, and doing; (2) a person sees potential implications, applications, and benefits of learning knowledge; and lastly, (3) learning new knowledge builds on current understanding (including misconceptions). Edgar Dale in Heidi, (Web16) and Raymond (Web17) attempted to describe various learning experiences using a Cone of Experience model, which theorized that learners retain more information by what they “do” as opposed to what is “heard”, “read” or “observed”. As illustrated in Figure 2.1, a Raymond’s modification of the Edgar Dale’s original Cone of Experience.

![Figure 2.1: Dale’s Cone of experiences; From Raymond, Web 17](image)

This Cone of Experience demonstrates two main aspects of learning that more learning occurs depending on; (1) the type of an activity engaging learners and the degree of learner involvement
and (2) use of human senses, modes of learning that employ the most use of the human senses are the ones that promote the learners' ability to learn and to remember. Teaching methodologies at the bottom of the cone of experience is less of expository and more of heuristic.

A detailed comparison between these two teaching strategies has been explained by Twoli et al (2007) and it is reproduced hereunder. Expository teaching strategies are teacher centered; the teacher controls all activities in the classroom. Learning is characterized by talk and chalk, transfer of information, rote learning and the teacher is an all-knowing expert while students take notes, listens, and ask questions. Examples of the teaching methodologies in this category are; lecturing, dictation of notes and demonstrations. On the other hand, heuristic teaching methodologies are learner centered in nature, characterized by dialogue and inquiry, deep learning and the teachers' role is minimized to being a facilitator. The students are at the center of learning; exploring, reflecting, and questioning. The main teaching methodologies are discussions, practical sessions and projects, all of them aiming at solving problems.

2.2 Types of instructional materials for the teaching Chemistry

The SMASSE training never stated vividly the types of instructional materials which can be used in the teaching of Chemistry. However, its teachings focused on specific experiments within the secondary Chemistry syllabus and the probable materials that teachers could improvise or modify for use in classrooms with their learners. All the same, this study has endeavored to point out two major types of resources successful teaching of Chemistry; the text books and the laboratory equipped with necessary fittings and facilities.
2.2.1 The textbooks

In picking effective textbook for any science subject, one has to focus on two general areas; text structure and layout (Committee on undergraduate science education in America, 1997). The text structure refers to an organization which the author(s) takes, either a proof-first format or a principle-first format. In proof-first organization, a book develops an argument that builds to a conclusion. Specifically, a book presents science in the way it is practiced by experts. On the other hand, in principle-first organization, a book states a concept at the onset and then presents the evidence needed to support it. A principle-first textbook is more effective for long-term retention and understanding by novice readers like secondary school students. The layout and illustrations are important predictors of an effective textbook.

In Kenya, teachers play a minor role in choosing a textbook for their use in classrooms; it is the Ministry of Education Science and Technology (MOEST) which recommends subject a few course books and other additional reference materials. In Chemistry, there are four recommended course books. Perusal of each of the four textbooks reveals the following salient features:

a. They are full of essays discussing scientific principles,

b. Some of the selected topics have side bars enriched with vital facts,

c. Most topics contain well labeled diagrams for experimental set ups,

d. Some topics have been illustrated using black and white photographs,

e. All topics contain many problems and questions at the end,

f. Topics which are mathematical in nature contain worked examples,

g. Topics start with description of important ideas and discoveries in historical perspective,

h. They contain systematic procedures for carrying out various practical activities,
i. After each practical activity, there are questions requiring learners to recall the observations made,

j. These publications come along with a separate copy of a teacher's guidebook.

On the other hand, a comprehensive observation of the additional reference textbooks shows the following features:

a) They are less historical in nature;

b) They contain more facts, stated without justifying their scientific derivations.

c) They are less sophisticated, no experimental procedures.

d) They contain many exercises modeled on past K.C.S.E questions.

e) They contain examination tips on how to handle the K.C.S.E practical paper.

f) They contain tips examination tips on how to prepare for and pass chemistry.

g) Each book contains answers to all the questions tested in exercises.

2.2.2 The laboratory

Availability of a laboratory in a school helps the students to be exposed to vital laboratory experiences which enhance the learning of science subjects. Singer et al (web, 18) has stated some of these vital experiences as: (1) mastery of the subject matter, (2).develop scientific reasoning, (3).understanding the complexity and ambiguity of empirical work, (4). Developing practical skills, (5).understanding the nature of science, (6).cultivating interest in science, and (7).developing teamwork skills. This implies that students who attend schools without laboratories are bound exhibit poor laboratory experiences.

For a laboratory to function maximally as an instructional resource, it has to be equipped with adequate necessary facilities and equipment (Miller, 2000; singer et al, web 18). These facilities
and equipment include substances like chemicals, glassware, models, slides and general laboratory infrastructure such as running tap water and laboratory gas wirings. The adequacy of laboratory facilities denotes enough space for teacher's demonstrations, students' activities and resultant discussions, and presence of a space for safe storage of supplies.

Additionally, there are other instructional materials used for the teaching of Chemistry, however, they play a very minor role. Unlike the laboratory reagents and facilities, these instructional materials are not required both in the teaching and the subsequent evaluation process of chemistry. These instructional materials are piled up in four broad categories as: (1) display media, like chalkboard, flip chart and magnetic boards, (2) Projected materials, for example slides, film strips, overhead transparencies and motion pictures, (3) printed materials as photographs, charts and drawings and (4) materials for viewing such as models and exhibits (Kemp, 1985; Traves, 1973; Twoli, Maundu, Muindi, Kiio & Kithiji, 2007).

2.3 Selection of instructional materials for teaching Chemistry

The selection of appropriate instructional materials for teaching Chemistry depends on many factors. According to Twoli et al (2007), instructional materials should be selected based on their purpose, the content to be covered, their suitability, their cost and conditions of use. An instructional material which meets this criterion works in enabling Chemistry teachers to realize: (1) their lesson objectives, (2) to make the learning situations more realistic and concrete, (3) to make learning easier and quicker, (3) to present the information in an interesting manner, (4) to stimulate critical thinking in students and (5) to supply concrete basis for conceptual thinking.
Another way of selecting of instructional materials can be based on: (a) aims of the lesson, (b) their appeal to a specific group of learners so as to provide for individual differences, (c) their suitability to the age, intelligence and experience of learners, (d) their availability at the time they are needed for use and (e) their ability to involve many sensory perceptions (Romiszoski, 1974; Saunders, 1974; Michealis, 1968 and Burugu, 1991). Instructional materials can also be selected based on their individual characteristics to bring about learning (Wandera, Tungu & Alumade, 2008). The instructional resources should be; (1) large enough for visibility, (2) neat and tidy, (4) durable and cost effective, (5) easy to manipulate while using and (6) safe to use. Selection of suitable instructional materials can also be hampered by some restrictions (Burugu 1991). These constrains are; (i) scarcity of desired resources, (ii) teaching strategy adopted by the teacher, (iii) teacher’s character to favor continuous use of some instructional resources and not others and (iv) the teacher’s liking or fear of some teaching resources.

None of these suppositions is conclusively addressing the challenges involved in the selection and usage of appropriate instructional materials for Chemistry. The practical nature of Chemistry implies that its textbooks contain well labeled diagrams for experimental set ups and systematic procedures for carrying out practical activities. Therefore a teacher has a limited role in deciding to choose or not choose any given teaching resource since the selected instructional materials (laboratory apparatus and equipment) should correspond to the one depicted in an experimental set ups or those stated in the procedure of carrying out a given practical activity. Consequently, the Chemistry teachers require the competency of using instructional materials as directed by the experiments at hand. This competency to use different varieties of laboratory apparatus and equipment was supposedly covered in SMASSE trainings.
2.4 Role of instructional materials in Chemistry

All good instructional materials should meet the needs of the learners, fulfill the requirements of the subjects, and facilitate the teaching and learning process (Wandera et al, 2008). Proper usage of instructional materials: (1) enhances retention of knowledge, (2) stimulates and sustains interest in learning, (3) provides firsthand experience with the realities of the physical and social environment, (4) helps to overcome the limitations of the classroom and make what may be inaccessible, through use films, slides, videos, and photographs,(5) encourages active participation of learners, especially those that can be handled and manipulated by the learners, (6) makes it easier for the teacher to explain concepts, as explanations become brief and precise, (7) discourages rote learning and make abstract ideas more concrete, (8) makes learning to be resource–based,(9) helps learners to develop their power of imagination, observation, reasoning, and creativity and (10) promotes the development of interpersonal skills amongst learners such as cooperation and sharing. Additionally, Burugu (1991) believes that instructional resources assist students in improving their ability to read, to observe, to listen, and to communicate their ideas properly.

According to Karingithi (1988), instructional materials present teachers and their students with a common starting point and a common path to be shared on an equal footing during the process of teaching and learning. He believes these gets teachers and students thinking on similar aspects, given that all are focused on observing the same teaching resource; manipulating it, studying it and interpreting it, thereby creating shared experiences which they can relate to, during the teaching and learning discussions.
The assertions are in harmony with the role of instructional materials in Chemistry. However, these assertions have not considered the nature of evaluating Chemistry in national examinations. Chemistry is examined theoretically and practically, suggesting that the very laboratory apparatus and equipment which are used in teaching will be used again when taking examinations. Therefore proper usage of instructional materials in teaching has double advantages to students of Chemistry. Apart from the aforementioned assertions, they become better familiarized with the functioning and usage tools which will be availed to them during their final examinations. For this reason, presence and correct utilization of instructional materials influences to a high degree the performance of students in Chemistry.

2.5 Availability of instructional materials for Chemistry in schools

Tewksbury and Macdonald (2005) acknowledges that, “If a teacher has many instructional materials at his disposal, he will have an opportunity to choose the most appropriate tool for the task at hand”. Moreover, the Gacathi education report recommended that textbooks and other instructional materials are basic tools for learning and must therefore be available to learners in adequate quality and quantities, at time that they are required and at an affordable cost (Gacathi, 1976). It has also been observed that the modern teacher has a vast range of instructional materials as compared to his counter parts thirty or forty years ago, because the educational community obtaining contemporary instructional materials from the inventions which are emerging due to new developments in modern technology (Gerlach & Ely, 1971; Fenton, 1967; Ellington, 1985 and Mungai, 1992). Some of the developments are: printing, recording, photography, cinematography, radio, television and the computers. They are all contributing to a vast collection of resources that are now accessible to nearly every teacher.
However, various studies have been carried out to establish the availability of instructional materials in primary and secondary schools in Kenya and the findings reveal an exact opposite. There is an extensive shortage of instructional materials both at primary school and secondary school levels of the 8-4-4 system of education (Shiundu, 1980; Wambua, 1988; Wainaina, 1984; Osindi, 1982; Ochieng, 1987; Okoko, 1975; Oure, 1985; Khisa, 1980; Tuei, 1990; Komen, 1991; Kariuki, 1988; Misoy, 1987 and Munyika, 1985). Similarly, the SMASSE's base line survey of 1998 reported an acute shortage of instructional resources (Njuguna, 1999 and Waititu & Orado, 2009). This is a strong indicator that many teachers were using "inappropriate teaching methodology" due to absence of resources in schools.

SMASSE project is the latest entrant in the education sector with claims of inadequate teaching resources in secondary schools in Kenya. Unlike the earlier studies, the SMASSE project started an initiative to facilitate both the availability and correct usage of instructional materials for teaching mathematics and science subjects. This initiative was termed as the ASEI movement and PDSI approach, popularly referred to as ASEI/PDSI approach (Oyaya & Njuguna, 2000). ASEI is an acronym signifying; Activities, Student – centered, Experiments, Improvisation while PDSI stands for; Plan, Do, See and Improve. The project equipped teachers with skills of acquiring instructional materials using improvisations and modifications of some resources to perform more than functions than that which they were made to accomplish.

2.6 Acquisition of instructional materials for Chemistry

Modes of acquiring instructional materials have been identified to be mostly through donations, hiring, making purchases, renting and own production (Brown and Lewis, 1959). Simple and locally available materials have also been found to work satisfactorily (Gacegoh, 1990). For those teachers who make their own teaching aids from locally available materials should
endeavor to prepare them from low-cost materials and be made relevant to the experiences and needs of their learners (Wales, 1967 and Njoka & Jowi, 1981).

Acquisition of the instructional materials depends on the availability of funds. Many secondary schools lack instructional materials due to lack of adequate funds. The SMASSE project put forward a new dimension of acquiring instructional materials. It involved carrying out improvisations where there is scarcity and also to perform modifications on the existing the instructional resources so that they can suit multiple needs of the classroom (SMASSE, 2005). This new mode of acquisition was meant to enable schools with insufficient funds to source for their instructional resources locally from within their environment. SMASSE project envisioned that Chemistry teachers are better suited for the role of improvising and modifying instructional materials.

2.7 The SMASSE project

2.7.1 History of SMASSE project in Kenya

SMASSE project was first launched in Kenya in 1998 as a joint venture between the government of Kenya through the MOEST and the government of Japan through Japan International Cooperation Agency (JICA). The inception of SMASSE project arose out of concern from MOEST and other educational stakeholders to improve the performance of students in Mathematics and Science subjects in national examinations (Njuguna, 1999). The project existed as a pilot study program in nine districts from 1998 to 2003 and as a national program from 2003 to 2008 (SMASSE, 2004 and Wambui & Nyacomba, 2006). From its inception, the SMASSE training has been concentrating on teachers of Mathematics and Science subjects and education managers. Mathematics and Science subjects had continuously registered poor results in national
examinations. The training was aimed at improving the teaching and learning of these subjects by in-servicing their serving teachers at secondary school level (JICA, 2007). This study isolated those aspects of the training that were related to Chemistry more directly.

2.7.2. The SMASSE training for Chemistry teachers

The SMASSE project baseline studies identified the main causes of dismal performance of these subjects in K.C.S.E examinations to be; poor attitude of teachers to the teaching, poor teaching methodologies and practices due to lack of instructional materials in schools and teachers’ poor content mastery of the subjects which they teach (Wambui & Nyacomba, 2006). Therefore the SMASSE training initiated a pedagogic paradigm shift by introducing of ASEI/PDSI approach.

Conclusively, the ASEI/PDSI approach was majorly responsible for encouraging and equipping serving teachers with right skills to carry out teaching sessions which are characterized by many student activities, small scale experiments and varieties of improvisations in those scenarios where conventional instructional materials were lacking or insufficient. This approach was to be implemented by teachers with the help of an ASEI/PDSI lesson plan (Oyaya & Njuguna, 2000; SMASSE, 2004; SMASSE, 2005; SMASSE, 2006 and SMASSE, 2007).

Some of topics within the secondary Chemistry syllabus that the training inducted teachers are (1) laboratory management, safety and techniques, (2) rationale for project work in Chemistry, (3) thermo chemistry: Hess’s law & heat of combustion, (4) the mole: empirical formulae & back titration, (5) organic Chemistry: hydrocarbons & polymers, (6) ammonia: burning ammonia in oxygen & reduction of copper (II) oxide by ammonia, (7) chemical equilibria: effect of concentration on equilibrium & simulating a dynamic equilibrium, (8) electrochemistry:
reflections on current situation & assorted experiments & construction of selected improvised equipment and (9)metals:- reaction of magnesium with steam & thermit reaction.

However, the anticipated benefits of ASEI/PDSI approach are yet to be realized. A close look at the training manuals for Chemistry, reveals that the training failed to clarify some aspects of four areas of concern; the characteristics of learner-centered teaching, the characteristics of an effective teacher, the characteristics of small scale experiments in terms of their design and their evaluation and the mannerisms of teachers and their students during the execution of student activities in classrooms. One of these deficiencies of the training deserves some more explanations, the characteristics of learner-centered teaching.

2.7.3. The shortcomings of SMASSE training

The training advocated for teaching methodologies that were learner-centered by encouraging teachers to carry out Chemistry lessons which are filled with many small scale experiments being carried out by students under the guidance of their teachers, but the project failed to explain features of how such experiments ought to be conducted in terms of teacher’s roles and students’ roles in the entire learning process.

Logowski (2002) has provided five salient features of learner-centered teaching (LCT). These are (1) LCT contain explicit instructions; teachers teach students to think, solve problems, evaluate evidence analyze arguments and generate hypothesis. Learning skills develops faster if they are taught clearly along with the content. (2) LCT engages students in the hard, messy work of learning. Currently, teachers are doing many learning tasks for students like; ask questions, add details to their answers, offer examples and organizing the content. In the long run, the teacher gets more practice than students. (3) LCT encourages students to reflect on what they are learning
and how they are learning it. Therefore teachers ought to challenge the assumptions of their
students and include assignments components in which students reflect, analyze and critique
what they are learning and how they are learning it. (4) LCT motivates students by giving them
control over learning processes. At the moment, teachers are making too many decisions about
learning for students; they decide what students should learn, how they learn it, the pace at which
they learn it, conditions under which they learn it and then the teacher determines if students
have learned. This kills motivation because learners are dependent. Teachers look for responsible
ways of sharing power with their students. (5) LCT encourages collaboration. Teachers ought to
develop structures that promote shared commitment to learning so that learning is seen as an
individualistic and collective responsibility. Each teacher's sensitivity to observe the
aforementioned characteristics of LCT during their instruction process makes adequate use of
students' activities to bring about intended learning meaningfully.
CHAPTER THREE
RESEARCH DESIGN AND METHODOLOGY

3.0 Introduction

This chapter is dealing with research methodology described under the following sections in turn; research design, variables, location of the study, target population, sampling techniques and sample size, construction of research instruments, pilot study through which the validity and reliability of the research instruments was ascertained, data collection techniques and logistical ethical considerations.

3.1 Research design

This study adopted a descriptive survey design because the information was being sought was collected from the respondents at once (Fraenkel & Wallen, 2000). According to Fraenkel and Wallen (2000), descriptive survey design is most favored when; (1) information is being collected from a sample rather than from the entire population, (2) the main way of collecting information is through asking questions, and the answers to these questions constitutes data of the study, (3) the information collected from a given sample is used to quantify the characteristics of the entire population that includes sample and (4) a researcher wants to acquire a lot of information at a relatively low cost in terms of time and money consumed. Therefore, the descriptive survey design was used to expose existing trends in the teachers' sourcing and usage of instructional materials for teaching Chemistry in Bungoma East district, Kenya.

3.2 Research Variables

The dependent variables for this study were the central SMASSE training principles, for this case; the learner participation in classrooms, the existence of hands on activities and small scale
experiments in Chemistry lessons. The study considered teacher characteristics, learner characteristics, instructional materials and teaching strategies to be the main independent variables. The outcome for the study was the overall performance of Chemistry in K.C.S.E examinations.

3.3 Location of the study

This study was carried out in Bungoma East district. Selection of this district as a fitting was based on the number and composition of its schools. At the time for the study, Bungoma East district had a total of fifty (50) public and private schools. These public schools were widely varied in terms of students’ enrolment and school’s infrastructure just like other districts in the country. On the basis of these variations, public schools had a representative amongst the three major types of schools in Kenya, namely; national schools, county schools and district schools. The researcher created another a fourth type as C.D.F aided schools due to existence of some newly established schools but whose infrastructure and students’ enrolment is far below the aforementioned types of schools.

Besides, Bungoma East district was endowed with a SMASSE district INSET centre situated in one of the public schools. The presence of this facility suggests that a large percentage of the practicing Chemistry teachers were fully knowledgeable about the activities and objectives of the SMASSE training. Once more, Bungoma East district was readily accessible and much more familiar to the researcher, this factor made it possible to access all the sampled schools during collection of data in good time.
3.4. Target population

Bungoma East district had fifty (50) schools, out of which; 1 was a national school, 9 were county schools, 34 were district schools, 4 C.D.F aided schools and 2 private schools. There were a total of 165 Chemistry teachers, 2615 form three students and 50 heads of science department.

3.5. Sampling techniques and sample size

3.5.1 Sampling techniques

The sample for this study was obtained by applying two sampling techniques one after the other. Stratified random sampling was applied first due to its ability to minimize variability within a given types of schools (the strata) and maximize variability between different types of schools (Van dalen (1966). These types of schools were national, county, district, C.D.F and private. Stratified random sampling was adopted to guarantee an inclusion of each type of schools in the final sample that was to be used for carrying out the study. The use of stratified random sampling resulted in creating a sample that was as representative as possible to increase accuracy (Orodho, 2010). Table 3.1 is showing number of participating schools per given category after using stratified random sampling.

Thereafter, random sampling technique was carried out within each of the school category to identify the specific schools that were to form the sample. Every single school in a homogenous group stood an equal chance of being picked to participate in this study. According to Van dalen (1966), simultaneous application stratified random sampling and random sampling gave rise to the best representative sample.
To succeed in this endeavor, the researcher first obtained a list of all schools within Bungoma East district from the D. E. O's office. Then the names of each of the schools within each category were written on small identical pieces of papers. Each one of the papers contained the name of one school. They were then folded up to conceal the identity of individual schools. The researcher then requested somebody, who was unaware about their contents, to pick a given number of papers randomly from each grouping of schools according to the specifications provided in Table 4.

3.5.2 Sample size

Consequently, eighteen (18) schools out of a total of fifty were selected as the representative sample. This was 36% of the targeted population. Distribution of schools that were selected per category were; one (1) national, four (4) county, ten (10) district, one (1) private and two (2) C.D.F as it has been provided in Table 4. According to Ary, Jacobs and Razavieh (2002) at least 10% per strata is appropriate for statistical analysis, however, a larger sample is the best.

Table 3.1: Sampling grid for secondary schools per category

<table>
<thead>
<tr>
<th>School category</th>
<th>Total Population</th>
<th>Sample size</th>
<th>Percentage (%) of sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>1</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>County</td>
<td>9</td>
<td>4</td>
<td>44</td>
</tr>
<tr>
<td>District</td>
<td>34</td>
<td>10</td>
<td>29</td>
</tr>
<tr>
<td>Private</td>
<td>2</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>C.D.F</td>
<td>4</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>50</strong></td>
<td><strong>18</strong></td>
<td><strong>36</strong></td>
</tr>
</tbody>
</table>
Out of the sample size of participating schools (Table 3.1), the number of Form 3 Chemistry lessons (Table 3.2) to be observed and the number of participating Chemistry teachers (Table 3.3) were similarly determined.

**Table 3.2: Sampling grid for Form 3 Chemistry lessons observed**

<table>
<thead>
<tr>
<th>School category</th>
<th>Sampled schools</th>
<th>No. of chemistry lessons within sampled schools</th>
<th>Sample size</th>
<th>Percentage (%) of sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>1</td>
<td>40</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>County</td>
<td>4</td>
<td>80</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>District</td>
<td>10</td>
<td>100</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Private</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>C.D.F</td>
<td>2</td>
<td>10</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>18</strong></td>
<td><strong>235</strong></td>
<td><strong>25</strong></td>
<td><strong>11</strong></td>
</tr>
</tbody>
</table>

Some categories of schools had more than one Form 3 class due to high enrolment of students for example in national, county and district schools. That is why their combined total number of Chemistry lessons was also high, therefore only 10% of their combined total number lessons were observed. Schools with a low enrolment had only one Form 3 class, for this reason the researcher sampled 20% of the lessons. There were twenty-five (25) Chemistry lessons that were observed in the entire study, this represents 11% of all the lessons that were available (235) in the sampled schools.

Similarly, the number of participating Chemistry teachers was based on their supply per given school. The national school had ten (10) teachers out of which six (6) were picked. County schools had a total of forty-five (45) teachers out of which twelve (12) were picked. District
schools had 102 teachers out of which twenty (20) were selected. All the remaining categories were supplied four (4) teachers out of which two (2) were picked. There were a total of 42 Chemistry teachers who participated in the study, representing 25% of all the teachers within the Bungoma East district.

Table 3.3: Sampling grid for Chemistry teachers

<table>
<thead>
<tr>
<th>School category</th>
<th>Total no. of Chemistry teachers in the district</th>
<th>Sample size</th>
<th>Percentage (%) of sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>10</td>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td>County</td>
<td>45</td>
<td>12</td>
<td>27</td>
</tr>
<tr>
<td>District</td>
<td>102</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Private</td>
<td>4</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>C.D.F</td>
<td>4</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>165</strong></td>
<td><strong>42</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>

3.6. Construction of Research Instruments

This study used three research instruments namely; questionnaire Chemistry teachers, a lesson observation schedule and a checklists for instructional resources designed for ascertaining the presence of instructional materials used for teaching Chemistry that are available in secondary schools. Each of these research instruments was focusing on a particular group of respondents for collecting specific type of information. Here is a detailed description of each instrument and its role in the study.
3.6.1. A Questionnaire for Chemistry teachers

This study made use of a semi-structured questionnaire for collecting data from Chemistry teachers (Appendix A). A semi-structured questionnaire was preferred due to its potential of increasing the accuracy and consistency of answers that were being sought. Efficiency of a semi-structured questionnaire are evident not only when dealing with respondents who may have difficulties in expressing their impressions and ideas adequately in words but also when intending to allow for more freedom in responses so that respondents can have a chance to express their unique circumstances where a structured questionnaire may not have captured satisfactorily (Van dalen, 1966, Fraenkel & Wallen, 2009).

Each Chemistry teacher was required to complete one questionnaire on their own. The questionnaire was soliciting information about current trends in sourcing and usage of instructional materials in Chemistry classrooms as influenced by the SMASSE project trainings. It was questionnaires were divided into five broad sections. Section one captured personal characteristics of individual Chemistry teachers, section two was focused on establishing ways in which teachers has been using instructional materials during their teaching and learning process (TLP), section three was set aside for verifying the existence of instructional resources for teaching Chemistry in schools, section four was dedicated to exposing the criteria which teachers are using to select their teaching aids and section five was designed to identify modes of acquiring instructional resources in schools.

However, some cautionary measures were taken to overcome a few shortcomings arising from the using of questionnaires to collect data in a research study. Van dalen (1966) and Wiersma (1985) have pointed out that in many studies involving the use of questionnaires, some
respondents give responses which portray them in a more favorable light so as to protect their self interests by striving to conform to socially accepted patterns. Secondly, Van dalen and Wiersma noted that many respondents rarely scrutinize information items listed a questionnaire seriously, instead they report what was assumed to have taken place. Due to this deficiency, both Van dalen (1966) and Wiersma (1985) recommended that specific questions within the questionnaire can be isolated for special considerations. Consequently, the researcher double checked some significant data that was obtained through the use of questionnaires. That is why a lesson observation schedule was included as one of the research tools.

3.6.2. A lesson Observation Schedule

There are certain types of data which is best captured by making observations of how people are acting or how things look like (Fraenkel & Wallen, 2009). Therefore the researcher designed a lesson observation schedule (Appendix B) for collecting data which a questionnaire could not capture precisely. This suggests that some of the data was to be collected through the making of observations on how the TLP was unfolding in Chemistry classrooms. To accomplish this, the researcher visited form 3 Chemistry lessons to witness how teachers and their students were interacting to bring about learning. Most especially, to ascertain the viability of SMASSE training principles in day to day teaching of Chemistry. Non-participant mode of observation was adopted, where the researcher was allowed to sit on the sidelines and then watch how the TLP progressed.

To increase clarity in the data collected, the researcher carried out focused observations by narrowing his attention on specific essential characteristics of teachers and their students (Fraenkel and Wallen, 2009). In an effort to secure this accuracy, the lesson observation schedule

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was crafted with a variety of items to highlight two aspects; (1) the teacher’s preparedness for their chemistry lessons in terms of possessing; schemes of work, the ASEI/PDSI lesson plan, lesson notes and necessary instructional resources and (2) assessing the teacher’s manner of utilizing the instructional materials in the TLP.

3.6.3. A checklist of resources available

There was need as well to compile a comprehensive inventory of instructional materials which are available in secondary schools for teaching Chemistry. The research instrument for this task was a checklist of resources available (Appendix C). The checklist was crafted with an intention of capturing the general overview of how the instructional materials are acquired, utilized, stored and maintained by the science department in various secondary schools.

3.7 Pilot study

Pre-testing of the research instruments was carried out in one of the randomly selected district schools. A district school was chosen because this category had many secondary schools within the location of the research study. Results of the Pilot study were used to provide benchmark for scrutinizing the research instruments in terms of identifying the presence of any ambiguities and inadequate or unnecessary items. From the findings of the pilot study, necessary revisions to the research instruments were made with regard to eliminating perceived ambiguities and simultaneously inserting implied extra items (Wiersma, 1985). Pilot studies also played a vital role in revealing the total amount of time and other logistical resources required for administering each of research instrument successfully. After piloting had been carried out, the findings were used to assess the validity and reliability of the research instruments.
3.7.1 Validity of research instruments

A research instrument is said to be valid if it measures what it was designed to measure. This implies the appropriateness, meaningfulness, correctness and usefulness of any inferences a researcher draws based on data obtained using an investigative instrument (Fraenkel & Wallen, 2009). Many suggestions abound on how a researcher can find out the validity of research instrument in qualitative data. Validity can be gauged through triangulation (Koul, 2007 and Fraenkel & Wallen, 2009). Triangulation is the crosschecking of consistency of data obtained using several research instruments. Fisher (2010) has proposed a number of principles that can be applied when crosschecking the validity of research instruments which are used in collecting qualitative data. These principles are; (1) reflexive critique, (2) dialectical critique, (3) collaborative resources, (4) risk to one’s own values and (5) theory, practice and transformation. Fisher’s principles formed a primary basis for validating the research instruments employed in this study.

Finally the research instruments were be deemed fit for use after factoring in the opinions of the researcher’s supervisors with respect to whether the question items in all the instruments were relevant to the objectives and the variables which were under investigation in this study (Best & Kahn, 2009).

3.7.2 Reliability of research instruments

A research instrument is said to be reliable if it consistently yields the same results after repeated measurements are taken on the same respondents under same conditions (Van dalen, 1966). The reliability of the research instruments was determined using computer software called Statistical Package for Social Sciences (SPSS). Immediately after carrying out a pilot test, the question
items in each research instrument were coded and keyed into the SPSS software to automatically compute the reliability coefficient. The reliability index ($r$) was found to be 0.75. Therefore, the research instruments were regarded as reliable after posting a high reliability index that is greater than 0.7 (Engelhart, 1972; Breakwell, Hammond, Fife-Schaw & Smith, 2006 and Jackson, 2009).

8.8 Data Collection Techniques

The researcher personally visited each of the selected schools to administer the research instruments. Upon arrival, the researcher sought the head teachers’ consent to interact with the Chemistry teachers. After the preliminary salutations and binding assurances of confidentiality to all the information which would be shared with respect to this study, the researcher requested teachers to answer the questionnaire. At the same time, the checklist was issued to the head of science department for completing it. At the very end, the researcher sought to attend the form three Chemistry lessons to have the lesson observation schedule completed.

9 Logical and ethical considerations

After securing a letter authorizing the execution of this study from the Kenyatta University Graduate School (Appendix F), the researcher successfully applied for a research permit from the government through the National Council for Science and Technology (Appendices H and I). Again, the researcher successfully requested for a permission to visit selected secondary schools within Bungoma East district from the D.E.O (Appendix G).

10 Data analysis plan

The raw data was entirely analyzed using computer software SPSS in line with the following procedure. Firstly, each set of the three research instruments was serially numbered from the first to the last. Then for every set, a code dictionary was developed and subsequently applied in
coding all the research instruments used in the study. Coding reduced the raw data to just three
electronic SPSS databases; (1) the questionnaire.sav, (2) the lesson observation schedule.sav
and (3) the checklist.sav. At this point, data analysis was carried out to obtain the required
statistics. The findings presented in form descriptive statistics using percentages, frequency
tables, and histograms.
CHAPTER FOUR

PRESENTATION OF FINDINGS AND DISCUSSION

4.0. Introduction

This study was focused on evaluating the influence which SMASSE training has had on Chemistry teachers' ability to source and use instructional materials in their teaching occasions. Raw data was collected using three research instruments; a questionnaire for Chemistry teachers, a lesson observation schedule and a check list for the resources available in schools that are meant for teaching Chemistry. Chapter four is presenting the findings and resultant discussions in correspondence to the research objectives as outlined hereunder;

1) Demographic characteristics of respondents
2) Availability of instructional resources for teaching Chemistry in schools,
3) Modes of sourcing for materials for Chemistry instruction,
4) Degree of learner participation in Chemistry classrooms,
5) Influence of SMASSE training on chemistry teachers' classroom practices,

The study was carried out in 18 (36%) schools within Bungoma East district for a period of two weeks. During this time, the researcher administered; the questionnaires to 42 (25%) Chemistry teachers, the checklists for resources available to 18 (36%) heads of science department in each participating school and had 25 (11%) lesson observation schedules completed by self. Afterwards, the researcher developed a comprehensive code dictionary for each research instrument and then entered all the raw data in the SPSS computer software for analysis. The software translated raw data into ;(1) the questionnaire.sav, (2) the lesson observation schedule.sav and (3) the checklist.sav. At this point, data analysis was carried out then the findings were presented using percentage - frequency tables and histograms. Interpretations and
discussions which arose from those findings have been put forward in the following sections in consistency with the research objectives.

4.1 Demographic characteristics of respondents

The background information for Chemistry teachers is presented based on their gender, professional qualifications, teaching experience, lessons taught per week and their having attended any of the sessions of the SMASSE training.

4.1.1. Distribution of Chemistry teachers by gender

With regard to distribution of Chemistry teachers by means of gender, this study found that Bungoma East district has 30 (71%) male teachers and 12 (29%) female teachers. This information is represented in Figure 4.1.

Figure 4.1: Distribution of Chemistry teachers by gender in Bungoma East district.
These statistical values can be simplified to read that for every five male Chemistry teachers, there exist two of their female colleagues. These findings are favorable for encouraging high achievement in boys because Skelton and Read (2006) observed that feminized teaching approaches in absence of male teachers lead to underachievement in boys. However, their female counterparts too deserve living examples to send a clear message that girls are as well capable of excelling in science subjects like Chemistry. Again, the performance of girls at a secondary school level is not affected by a teacher’s gender (Skelton and Read, 2006). There is a need to strike a balance, so that boy schools are dominated by male teachers to provide for modes of instruction that are favorable and sensitive to their forms of learning. On the same position, the small numbers of female Chemistry teachers call for some corrective measures to meet their mandatory minimum constitutional requirements on gender representation in the public sector.

4.1.2. Professional qualifications of Chemistry teachers

In terms of professional qualifications, the study revealed that 26 (62%) of practicing Chemistry teachers were in possession of a B. Ed (science), 5(12%) had a diploma in education, again 5 (12%) were still undergraduate university students working on part time basis, 4 (10%) had B.sc, and a single respondent (2%) each for diploma in electrical engineering and A-levels representing. These findings are shown in Table 4.1.
Table 4.1: Distribution of Chemistry teachers by their professional qualifications

<table>
<thead>
<tr>
<th>Professional qualification</th>
<th>Frequency (N=42)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Ed(Science)</td>
<td>26</td>
<td>62</td>
</tr>
<tr>
<td>B.Sc</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Diploma in Education</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Undergraduate University Student working on part time basis</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Diploma in Electrical engineering</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>A-levels</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

The right qualifications for one to teach Chemistry at secondary level are B. Ed (Science) and diploma in education. Collectively 31 (74%) of the Chemistry teachers possessed the right professional qualifications for their job, while 6 (14%) were in possession of qualifications which are not related to teaching and 5 (12%) were still in the university but their courses of study remain unknown. Figure 4.2 is an expansion of Table 4.1. Figure 4.2 indicates that Chemistry teachers with the highest professional qualification of B. Ed (science) are found in National schools at 100%, in County schools at 83% and District schools at 50%. On the other hand, untrained Chemistry teachers were in C.D.F aided schools at 100%, in District schools they were 35%, in private schools they were 50% and in County schools they were 8%. 

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According to Rice (2003) and Goldhaber and Brewer (1996) a teacher's highest education qualifications have a positive correlation to students' performance in examinations. Therefore, Figure 4.2 demonstrates that most of the students attending the national, county and district schools are destined to perform well in their national examinations. Since such teachers are empowered with appropriate pedagogic skills and are capable of applying a variety of teaching strategies as different learning situations may demand.
4.1.3 Teaching experience of Chemistry teachers

With regard to teaching experience, the findings showed that 15 (36%) of teachers have been teaching Chemistry for 0-3 years, 12 (29) for 4-6 years, 4 (10%) for 7-10 years, 1 (2%) for 11-14 years and 10 (24%) have taught for over 15 years. The findings are presented in Table 4.2.

Table 4.2: Distribution of teaching experience amongst Chemistry teachers

<table>
<thead>
<tr>
<th>Teaching experience</th>
<th>Frequency (N=42)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3 years</td>
<td>15</td>
<td>36</td>
</tr>
<tr>
<td>4-6 years</td>
<td>12</td>
<td>29</td>
</tr>
<tr>
<td>7-10 years</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>11-14 years</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Above 15 years</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100</td>
</tr>
</tbody>
</table>

A report by centre of public education in Lesotho (2005) showed that teachers with a teaching experience of more than five years were more effective in their teaching while those with lesser teaching experience had a strong negative effect on the students' performance in mathematics. The teaching of Chemistry and the teaching of Mathematics are closely related. Again, the SMASSE training was meant for Mathematics teachers as well. Due to this closeness between Mathematics and Chemistry, it implies that teaching experience of a teacher can also affect students' performance in Chemistry.

A general observation of Table 8 indicates that 27 (64%) of Chemistry teachers have worked for a period of six years and less. This can be regarded as minimal experience in an essential science.
subject like chemistry. On this account, SMASSE training justifiably came to help such young teachers with essential guidance in terms of providing various instructional skills concerning the improvement of teachers' understanding of their students, mastery of their subject matter and being acquainted with many other teaching practices.

4.1.4. Number of lessons per week for Chemistry teachers

As presented in Table 4.3, this study disclosed that 3 (7%) of chemistry teachers had less than 15 lessons per week, 8 (19%) had 16-20 lessons per week, 24 (57%) had 21-25 lessons per week, 4 (10%) had 26-30 lessons per week and 3 (7%) had over 30 lessons per week.

Table 4.3: Distribution of teaching workload in lessons for Chemistry teachers

<table>
<thead>
<tr>
<th>Number of lessons per week</th>
<th>Frequency (N=42)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 15</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>16-20</td>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td>21-25</td>
<td>24</td>
<td>57</td>
</tr>
<tr>
<td>26-30</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Above 30</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100</td>
</tr>
</tbody>
</table>

The Centre of Public Education (2005) has indicated that a teacher’s workload has a direct bearing on various aspects concerning teaching like (1) quality of teaching (2) contributes to a teacher’s balance between home life and work life (3) the time available for teachers to know their students well (4) a teacher’s professional support to colleagues and (5) teachers’ contemplation of leaving the teaching profession. From Table 4.3, it is observed that collectively 35 (83%) of Chemistry teachers have a manageable workload of 21-25 lessons per week and
This group of teachers has adequate time to comfortably accomplish those teaching aspects mentioned by The Centre of Public Education (2005). This implies that they are able to plan for and execute their Chemistry lessons with relative ease. However, some remedy measures deserve to be instituted to scale down the workloads for those teachers 13% who were handling more than 26-30 lessons per week because they are like to be less effective in discharging their duties as Chemistry teachers. Such a correction serves to enhance their individual teacher’s overall efficiency with respect the planning and execution of their classroom duties and other attendant administrative responsibilities at school.

4.1.5: Attendance of SMASSE training by Chemistry teachers

As illustrated in Table 4.4, the Chemistry teachers have attended at least one session of the SMASSE training were 31(74%), those who have never attended any training were 9(21%), but those who attended it for a different subject other than Chemistry were 2(5%).

<table>
<thead>
<tr>
<th>Did a teacher attend SMASSE training?</th>
<th>Frequency(N=42)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>31</td>
<td>74</td>
</tr>
<tr>
<td>No</td>
<td>9</td>
<td>21</td>
</tr>
<tr>
<td>Attended it for another subject</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100</td>
</tr>
</tbody>
</table>

Figure 4.3 is an expansion of Table 4.4 to reflect the attendance of SMASSE training by Chemistry teachers across each type of school within Bungoma East district.
Figure 4.3 has made it clear that in National school category, 1 out of the 6 teachers did not attend SMASSE training, representing 17% cases of failure to attend, in County schools category, 1 out of 12 teachers did not attend, representing 8% cases of failure to attend, in District school category, 5 out of 13 teachers did not attend, representing 38% of failure to attend, in private school category, all teachers had attended, representing 100% attendance and on the contrary, in C.D.F aided schools, there was no teacher who had attended the training, representing 100% failure to attend SMASSE training.
As stated by Louks-Horsley et al (1998) teachers play a key role in promoting learning in schools, therefore, they deserve a multiplicity of training opportunities for personal improvement. These training opportunities can exist within their respective schools from their own workings or from other teachers through mentoring or exist outside their schools through workshops, meetings of professional associations and presentations from educational consultants. The SMASSE training presented chemistry teachers with a combination of the aforementioned avenues for self-improvement. It is evident from Table 10 and Figure 5 that 33 (79%) of chemistry teachers have conjointly attended at least one session of the SMASSE training, an avenue for teacher development. It is expected that the training presented them with adequate opportunities to acquire necessary skills with regard to applying several modes of instruction and ways of developing and using instructional resources which the project was promoting.

4.2. Availability of instructional resources meant for teaching chemistry

This study sought to establish whether instructional materials meant for the teaching of Chemistry were available in schools and in adequate quantities in terms of both the teachers’ and students’ use. Furthermore, there was an effort to ascertain whether teachers were availing instructional materials in their Chemistry lessons as advocated for by SMASSE training. Of greatest significance was the existence of equipped science laboratories, Chemistry text books among other teaching aids.

4.2.1. Availability of equipped laboratories in schools

The researcher wanted to find out if schools have laboratories set aside for teaching and learning Chemistry. Findings showed that 15 (36%) of the Chemistry teachers confirmed to be having a laboratory just reserved for teaching Chemistry alone, 21 (50%) reported to be having a single
laboratory serving all the science subjects, 4(10%) reported an absence of a conventional laboratory, but indicated that in their schools have come up with make-shift structures which are functioning as a science laboratory and 2 (5%) of teachers total absence of a laboratory in their schools. The findings representing types of laboratories in schools are given in Table 4.5.

Table 4.5: Distribution of type of laboratories available in schools

<table>
<thead>
<tr>
<th>Type of laboratory in school</th>
<th>Frequency (N=42)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab for Chemistry only</td>
<td>15</td>
<td>36</td>
</tr>
<tr>
<td>One lab for all sciences</td>
<td>21</td>
<td>50</td>
</tr>
<tr>
<td>A make shift structure</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>No Laboratory</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Extension of Table 4.5 to establish the spread of these laboratories across different types of schools within Bungoma East district gave rise to Figure 4.4.
Figure 4.4: Distribution of various kinds of laboratories available per given type of school

Analyzing Figure 4.4 discloses that in a National school category, there was a special laboratory meant for teaching Chemistry only, this scenario is a replica of what was observed in 42% of County schools and 20% of District schools. On the other hand, 58% of County schools have one laboratory structure for all science subjects at secondary level, this situation was a replica of what exists in 60% of District schools and all the private schools. In 20% of District schools, there was no laboratory but a small make shift structure substituting a laboratory. Remarkably, C.D.F aided schools had no laboratory completely or a resemblance of a laboratory.
There are certain aspects of learning that can only be attained through laboratory instruction. Logowski (2002) identifies these aspects to be; manipulative skills, understanding the use of apparatus, fostering an appreciation for scientific inquiry like carrying out experiments, providing concrete examples to abstract concepts and enabling to develop a sense of success. As displayed by a combination of Table 4.5 and Figure 4.4, students in national and some county schools have special laboratories reserved for the teaching Chemistry alone. Such students have a potential of benefitting fully from aspects of laboratory instruction described by Logowski (2002). Again, it evident−other schools have made an effort to have either a single laboratory availed for all science subjects or to create a make-shift structure to ensure that some practical work is taking place.

However, the C.D.F aided schools reported total absence of a laboratory. This occurrence could be due to scarcity of funds since this type of schools are newly established and are surviving at the good will of constituency C.D.F kitty. Students from this type of school lack exposure to laboratory experience and are expected to perform poorly in examinations due to the evaluation policy adopted by KNEC for Chemistry of combining practical and theory papers for one’s final grade in K.C.S.E examinations.

4.2.1.1: Supply of laboratories with facilities and equipment

Amongst those schools which confirmed the presence of one of the types of laboratories, the study further attempted to find out whether these laboratories have necessary facilities and equipment. As provided in Table 4.6, the findings showed that 30 (71%) of the chemistry teachers confessed to be having stocked laboratories while 12 (29%) declined.
Table 4.6: Number of confirmations for presence of facilities in laboratories

<table>
<thead>
<tr>
<th>Are facilities and equipment present in a laboratory?</th>
<th>Frequency (N=42)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>30</td>
<td>71</td>
</tr>
<tr>
<td>No</td>
<td>12</td>
<td>29</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100</td>
</tr>
</tbody>
</table>

For those cases where respondents admitted to having provisions, the study made an extra effort to establish in case those facilities and equipment are adequate in terms of teacher’s and students’ use. The outcomes are given in Table 4.7.

Table 4.7: Distribution of adequately stocked laboratories in schools

<table>
<thead>
<tr>
<th>Are facilities in a laboratory in adequate quantities?</th>
<th>Number of teachers (N=42)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>16</td>
<td>38</td>
</tr>
<tr>
<td>No</td>
<td>19</td>
<td>45</td>
</tr>
<tr>
<td>No response</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100</td>
</tr>
</tbody>
</table>

The findings showed that 16 (38%) of Chemistry teachers positively confirmed the availability of adequate laboratory equipment and facilities in their schools, those who disapproved were 19 (45%). A combined scrutiny of Tables 4.6 and 4.7 conclusively reveal that 38% of schools have made a considerable effort to equip their laboratories with facilities and equipment, while 45% of schools were found to lack adequate facilities even though 17% of respondents never gave a response on this item of adequacy. This “No” response might have originated from the very teachers (29%) who gave a “No” response earlier on in Table 4.6. A no response can be extrapolated to indicate a total inadequacy, since sensible Chemistry teachers cannot hesitate to
report if their schools have adequately stocked laboratories. The study further wanted to establish the distribution of adequate laboratory facilities and equipment across various types of schools within Bungoma East district. The findings were displayed graphically in Figure 7 to indicate this aspect of adequacy across various types of schools.

![Figure 7: Adequacy of Laboratory Facilities by Type of School](image)

**Figure 4.5: Availability of adequately stocked laboratories per type of school**

It has been demonstrated by Figure 4.5 that adequate facilities were present in all national and private schools, in 33% of County schools and in 15% of District schools. However, the situation
was different in 67% of County schools, in 85% of District schools and all the C.D.F aided schools; their facilities were not adequate in term of teachers’ and students’ use. Therefore, it can be deduced that many schools have laboratory facilities and equipment but these facilities are not adequate for teachers’ and students’ use. This scenario directly influences the teaching strategies chosen by teachers for use in their classroom instruction. Figure 6 demonstrates an existence of two distinct extremes with regard to adequacy of laboratory supplies. Teachers and students from the national and private schools have a sufficient supply of facilities at their disposal and on the contrary, the C.D.F aided schools neither have a laboratory nor any of the laboratory facilities. As a result, teachers of these schools along with their students are seriously disadvantaged in terms of exposure to requisite laboratory experiences as prescribed by Singer et al (web 18) and Logowski (2002). District schools were found to occur in the middle of these two extreme positions, a situation of having facilities which are not enough to serve the instructional needs of teachers and students.

4.2.2: Availability of chemistry textbooks in schools

There are two categories of Chemistry textbooks in circulation, the course books and reference books. The study investigated in various schools to identify popular Chemistry textbooks among teachers. It was disclosed that out of the 18 sampled schools, 17 (94%) were found to be using Secondary Chemistry for Form three, the students’ book by Kenya Literature Bureau (K.L.B), two (11%) were using Foundation Chemistry Book 3, four (22%) were using Explore Chemistry Form 3 and eleven (61%) were using comprehensive Secondary Chemistry Form 3. The degree of either an approval or a rejection of each of the Chemistry course books are provided in Table 4.8.
Table 4.8: Degree of using each Chemistry course book in schools

<table>
<thead>
<tr>
<th>Which Chemistry course books does the school use regularly?</th>
<th>Yes (N=18)</th>
<th>No (N=18)</th>
<th>Total frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
</tr>
<tr>
<td>Secondary Chemistry Form 3 students' book (3rd ed)</td>
<td>17</td>
<td>94</td>
<td>1</td>
</tr>
<tr>
<td>Foundation Chemistry Book 3.</td>
<td>2</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>Explore Chemistry Form 3</td>
<td>4</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>Comprehensive Secondary Chemistry Form 3</td>
<td>11</td>
<td>61</td>
<td>7</td>
</tr>
</tbody>
</table>

It is apparent from the findings that teachers and students are using Secondary Chemistry Form 3, the students’ book (3rd ed) widely (94%) followed closely by Comprehensive Secondary Chemistry Form 3 (61%). Other course books were found to be rarely in use. The text structure and layout these course books follows the proof-first format, which presents Chemistry the way it is practiced by experts (Committee of Undergraduate Science Education in America, 1997).

Apart from course books, an investigation was further carried out to determine whether or not other reference materials were as well available in schools. Similarly, details of the degree of either an approval or a rejection of each of the Chemistry reference materials are provided in Table 4.9. It is evident from Table 159 that three publications were reasonably widely accepted. These books are; High-flyer series: K.C.S.E Revisions in Chemistry (56%), Top Mark: Chemistry K.C.S.E. Revision Series (44%) and Test it & fix it: Chemistry K.C.S.E Revision Series (44%). Conversely, other reference books were found to be rarely in use. The text structure and lay out these course books follows the principle-first format, which states a concept.
at the onset and then presents evidence to support it (Committee of Undergraduate Science
Education in America, 1997).

Table 4.9: Degree of using each Chemistry reference book in schools

<table>
<thead>
<tr>
<th>Are there any additional reference Chemistry books the school uses?</th>
<th>Yes (N=18)</th>
<th></th>
<th>No (N=18)</th>
<th></th>
<th>Total frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Peak Revision: KCSE Chemistry</td>
<td>3</td>
<td>17</td>
<td>15</td>
<td>83</td>
<td>18</td>
</tr>
<tr>
<td>Longman KCSE Revision Chemistry..</td>
<td>7</td>
<td>39</td>
<td>11</td>
<td>61</td>
<td>18</td>
</tr>
<tr>
<td>K.C.S.E Revision Series: Chemistry with answers.</td>
<td>3</td>
<td>17</td>
<td>15</td>
<td>83</td>
<td>18</td>
</tr>
<tr>
<td>High flyer series: K C S E Revisions In Chemistry.</td>
<td>10</td>
<td>56</td>
<td>8</td>
<td>44</td>
<td>18</td>
</tr>
<tr>
<td>K C S E Golden Tips: Chemistry.</td>
<td>7</td>
<td>39</td>
<td>11</td>
<td>61</td>
<td>18</td>
</tr>
<tr>
<td>How to pass K C S E Chemistry Question&amp; Answers: Form 3 &amp; 4</td>
<td>1</td>
<td>6</td>
<td>17</td>
<td>94</td>
<td>18</td>
</tr>
<tr>
<td>Top Achievers series: Topical K C S E Chemistry and a marking scheme.</td>
<td>4</td>
<td>22</td>
<td>14</td>
<td>78</td>
<td>18</td>
</tr>
<tr>
<td>Top Mark Chemistry K.C.S.E. Revision Series.</td>
<td>8</td>
<td>44</td>
<td>10</td>
<td>56</td>
<td>18</td>
</tr>
<tr>
<td>School Laboratory Management.</td>
<td>3</td>
<td>16</td>
<td>15</td>
<td>83</td>
<td>18</td>
</tr>
<tr>
<td>Gateway Secondary Revision: Chemistry.</td>
<td>6</td>
<td>33</td>
<td>12</td>
<td>67</td>
<td>18</td>
</tr>
<tr>
<td>Test it &amp;fix it : Chemistry K. C. S.E Revision Series.</td>
<td>8</td>
<td>44</td>
<td>10</td>
<td>56</td>
<td>18</td>
</tr>
</tbody>
</table>

Full citation details for all form 3 chemistry publications are provided in Appendix D.

An inclusive inspection of Tables 4.8 and 4.9 in an effort to pin point the textbook structure that
teachers in many schools prefer using, it becomes clear that popular Chemistry course books(94% and 61%) are widely accepted by a greater margin than the popular Chemistry reference books(56%,44% and 44%). A keener look at the afore mentioned course books reveals a text
structure and lay out which contains practical activities, systematic procedures for carrying out these practical activities and well labeled diagrams for experimental set ups.

4.3 Modes of sourcing instructional materials for chemistry in schools

Commonly used instructional materials in chemistry are: (1) printed materials, examples are textbooks, pamphlets, handouts and manuals, (2) display media, like charts, pictures, realia and models, (3) laboratory apparatus, this includes the glassware and equipment, (4) laboratory supplies in terms of chemicals, (5) laboratory fittings, they comprise piped water, gas, sinks, fume chambers and preparation rooms and (6) audio-visual materials (Miller, 2000).

The researcher wanted to establish the methods being used in schools to acquire instructional materials for Chemistry. There was an effort to ascertain the existence of any instructional materials which were specifically obtained through improvisations or modifications as guided by SMASSE trainings. The study went further to verify the suitability of improvised and modified instructional materials with regard to their efficiency in Chemistry lessons.

4.3.1 Methods of acquiring instructional materials

It was established from the chemistry teachers that instructional materials are being obtain by means of school administrations 36 (86%), through teachers' own makings 22 (52%), collection from the environment 15 (36%), donations 13 (31%), borrowing from other schools 5 (12%) and those prepared by learners through a teacher's guidance were 8 (19%). These findings are displayed in Table 4.10.
Table 4.10: Modes of sourcing instructional materials for Chemistry in schools

<table>
<thead>
<tr>
<th>Which methods of acquiring instructional materials is the school using?</th>
<th>Yes (N=42)</th>
<th>No (N=42)</th>
<th>Total frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
</tr>
<tr>
<td>Collected from the environment</td>
<td>15</td>
<td>36</td>
<td>27</td>
</tr>
<tr>
<td>Prepared by learners</td>
<td>8</td>
<td>19</td>
<td>34</td>
</tr>
<tr>
<td>Prepare by teachers</td>
<td>22</td>
<td>52</td>
<td>20</td>
</tr>
<tr>
<td>Borrowing from other schools</td>
<td>5</td>
<td>12</td>
<td>37</td>
</tr>
<tr>
<td>Bought by school administration</td>
<td>36</td>
<td>86</td>
<td>6</td>
</tr>
<tr>
<td>Through Donations</td>
<td>13</td>
<td>31</td>
<td>29</td>
</tr>
</tbody>
</table>

For a straightforward interpretation of these findings, the researcher compiled a list of the best three modes of acquiring instructional materials for each type of school from the crowded statistical values in Table 4.10. A summary of this list is Table 4.11.
A general overview of the findings in Tables 4.10 and 4.11 reveals that most schools are acquiring their instructional materials for teaching Chemistry by way of; individual school administrations making purchases, own production through Chemistry teachers and making collections from within the immediate school environment.

Chemistry is a practical subject and it should be taught using practical methods. The teaching of a practical subject demands for the presence of appropriate teaching aids which work to assist a teacher in simplifying abstract concepts and theories that originate from experiments (Biswajit, 64).
Examining the combined findings of Tables 16 and 17 with a hind sight to the list of commonly used instructional materials in Chemistry (Miller, 2000), reveals that the most viable method of sourcing for teaching materials in Chemistry should be purchasing. Own productions by teachers and collections school environment only helps in getting simple display media like; charts, pictures, realia and models. Again as earlier pointed out in Section 2.1, the practical nature of Chemistry extends from its teaching to its evaluation. The practical paper of Chemistry does not rely on display media; it relies on laboratory equipment and facilities. This assertion weakens the viability of justifying the acquisition of instructional materials for through teachers' own productions and making collections from the immediate environment of the school.

### 4.3.2 Improvisation and modification of instructional materials for Chemistry in schools

The study explored the aspect of Chemistry teachers carrying out improvising and modifying of equipment/apparatus/materials for their use in teaching. Figure 4.6 shows the findings that were obtained.

![Pie chart showing frequency of teachers executing improvisation/modification of resources](image)

Figure 4.6: Frequency of teachers executing improvisation/modification of resources

It was observed that 24 (57%) Chemistry teachers confirmed to be carrying out improvisations and modifications while 18 (43%) of them responded negatively to this item. These findings
demonstrate that in general, there is some considerable effort by teachers to carry out improvisations and modifications in chemistry. The researcher scrutinized the findings in figure 4.6 further to reveal the extent of this improvisations and modifications across various types of schools in Bungoma East district. This analysis yielded the findings presented in figure 4.7.

Figure 4.7: Execution of improvisation/modification of resources per given type of school

As illustrated by figure 4.7, it was found that improvisation and modification is most prevalent in two types of schools namely, the county and the district schools at 58% and 65% respectively. In both the national and private schools, cases of Chemistry teachers improvising and not
Improvising instructional materials were equivalent. However, there were no reported instances of either improvisations or modifications of resources happening in the C.D.F aided schools.

1.3.3 Frequently improvised / modified instructional materials

Throughout its existence in Kenya, SMASSE training has consistently advocated for teaching strategies that are learner centered. Application of such strategies necessitates the presence of appropriate instructional materials within a teacher’s reach. One of the forms encouraged by the training to guarantee accessibility to instructional materials was improvisation and modification of equipment/apparatus/materials from within the immediate school environment.

Therefore, this study wanted to name teaching resources which are commonly being improvised or modified through the efforts of the chemistry teachers in schools. The findings indicated that materials being improvised in schools were charts 15 (83%), models 11 (61%), pamphlets 4 (22%) and handouts at 1 (6%) as displayed in Table 4.12.
Table 4.12: A list of frequently improvised instructional materials by Chemistry teachers

<table>
<thead>
<tr>
<th>What are some of the instructional materials that teachers were improvising/ modifying?</th>
<th>Yes (N=18)</th>
<th>No (N=18)</th>
<th>Total frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
</tr>
<tr>
<td>Pamphlets</td>
<td>4</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>Charts</td>
<td>15</td>
<td>83</td>
<td>3</td>
</tr>
<tr>
<td>Models</td>
<td>11</td>
<td>61</td>
<td>7</td>
</tr>
<tr>
<td>Hand outs</td>
<td>1</td>
<td>6</td>
<td>17</td>
</tr>
</tbody>
</table>

From Table 4.12, it can be deduced that the charts and models are commonly improvised materials by teachers. The study also identified those instructional materials which are being improvised with the help of students under the guidance of their teachers. The findings are contained in Table 4.13.

Table 4.13: A list of frequently improvised instructional materials by students

<table>
<thead>
<tr>
<th>What are some of the instructional materials which students were improvising?</th>
<th>Yes (N=18)</th>
<th>No (N=18)</th>
<th>Total frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
</tr>
<tr>
<td>Charts</td>
<td>11</td>
<td>61</td>
<td>7</td>
</tr>
<tr>
<td>Models</td>
<td>11</td>
<td>61</td>
<td>7</td>
</tr>
</tbody>
</table>

As per table 4.13, students helped their teachers in developing charts at 11(61%) and models at 11 (61%). A general analysis of tables 18 and 19 shows that frequently improvised and modified instructional materials through a combined effort of chemistry teachers and their students are
charts and models. Due to the practical nature of Chemistry, the instructional use of charts and models do not uphold satisfactorily the practical aspects of the subject.

4.3.4 Suitability of improvised/modified instructional materials in teaching

This study also endeavored to investigate the appropriateness of the improvised and modified instructional materials for teaching chemistry. The findings are placed in Table 4.14.

Table 4.14: Perceptions of teachers on suitability of improvised/modified instructional materials for teaching Chemistry

<table>
<thead>
<tr>
<th>Do improvised materials assist a teacher in attaining the learning objectives?</th>
<th>Frequency(N=42)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>29</td>
<td>69</td>
</tr>
<tr>
<td>No</td>
<td>13</td>
<td>31</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100</td>
</tr>
</tbody>
</table>

This study established that the Chemistry teachers who confirmed being assisted by improvised/modified instructional materials to attain their learning objectives were 69% (29), while those who declined were 31% (13). These findings demonstrate that improvised and modified materials are playing a meaningful role in promoting the learning of Chemistry.

4.3.5 Indicators for suitability of improvised instructional resources in Chemistry

This study wanted Chemistry teachers to enumerate aspects of learning responses which they have observed in their students during lessons to affirm that improvised and modified resources are appropriate for instructional purposes. Their responses are summarized in Table 4.15.
Table 4.15: A list of observed actions amongst students to verify the suitability of improvised instructional materials in promoting learning

<table>
<thead>
<tr>
<th>Which Mannerisms were observed in students by teachers to indicate that improvised materials were helpful?</th>
<th>Frequency (N=42)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased interest in Chemistry</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Responded correctly to questions</td>
<td>11</td>
<td>26</td>
</tr>
<tr>
<td>Improved their manipulative skills</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Increased their participation in lessons</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Teachers who gave no response to this item</td>
<td>17</td>
<td>41</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

As listed in Table 4.15, teachers who observed increased interest in the subject among their learners were 6 (14%), those who reported seeing students offering more correct responses to questions asked were 11 (26%), those who saw increased students' participation in classrooms were 5 (12%) and those who noticed improved manipulative skills in learners were 3 (7%). However, many Chemistry teachers failed to provide a response to this item on their questionnaires at 17 (41%).

It has been stated that learning indicators act as useful guidelines to teachers for planning lessons in terms of valuing the worth of introducing new instructional activities and in assessing the success of current instructional methods (Jones et al, 1994). Again, Grabe & Grabe (2007) have outlined the observable characteristics among students which prove that meaningful learning has occurred. The students should; (1) be active, interacting with fellow students and manipulating their environment; (2) be constructive, reflecting on learning activities to assign meaning to them, (3) be intentional, being aware of the learning goals and their progress to them, (4) be
authentic, being mindful that learning is context based and relative to life and (5) be co-operative, being conscious that learning occurs through working with others and when participating in a learning community.

Looking at the perspectives of Jones et al (1994) and Grabe &Grabe (2007) about learning and simultaneously examining Table 21 reveals that many Chemistry teachers (41%) are less concerned with finding out whether their students have grasped what is being taught in classrooms. Furthermore, students who showed perfection in their manipulative skills were so few (2%), bearing in mind that Chemistry is examined practically as well and as previously pointed out in Section 2.1, the overall performance of a candidate in Chemistry is heavily by a candidate’s individual score in the practical paper.

4.3.6 Some topics/experiments in Chemistry whose instructional materials remain scarce

The researcher inquired from the teachers whether there are some topics or specific experiments within the secondary Chemistry syllabus whose appropriate instructional resources remain rare to this date, even with the sourcing techniques imparted by SMASSE training. The findings are compiled in Table 4.16.
Table 4.16: Topics/experiments not being conducted in Chemistry lessons in schools

<table>
<thead>
<tr>
<th>Topics/experiments that are completely not carried out by teachers in Chemistry lessons</th>
<th>Frequency (N=42)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Experiments involving Alkali metals (Potassium, sodium and Lithium)</td>
<td>2</td>
<td>58</td>
</tr>
<tr>
<td>2. Preparation of various poisonous gases</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>3. Demonstration of radioactive radiations</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>4. Most experiments within Organic Chemistry I &amp; II</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>5. Experiments involving Electrolysis of substances</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>6. Qualitative analysis of compounds.</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>7. Fractional Distillation</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>8. Heating of Sulphur until it melts.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>9. Practical aspects of the topic “The mole”.</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>10. Teachers who gave no response to this item</td>
<td>15</td>
<td>36</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100</td>
</tr>
</tbody>
</table>

In an effort to boost Chemistry teachers’ content mastery, the training inducted them in some topics within the secondary syllabus that had for long been considered as problematic to teach. These demanding topics have been reproduced in Section 2.7.2 of this report. A look at Table 4.16 reveals that some of those topics/experiments are still problematic to Chemistry teachers. These topics are organic Chemistry I and II (12%), practical aspects of the mole (7%), experiments involving electrolysis (2%) and preparation of various poisonous gases (17%) since it falls within the “Laboratory Management, Safety and Techniques” and this topic was covered
in the training. Reoccurrence of these topics as problematic is an indicator that SMASSE project principles have not yet been fully embraced by teachers of Chemistry.

4.4 Utilization of resources in the teaching and learning of Chemistry

Regarding the usage of instructional materials, the study tried to investigate the workability of small scale experiments as purposed by the SMASSE training for teachers. Simultaneously, additional efforts were put in place to determine which modes of instruction teachers are using in teaching Chemistry and hence verify the degree of learner-participation in class. The researcher investigated the preparedness teachers for their lessons by crosschecking if they were in possession of: their schemes of work, their ASEI/PDSI lesson plans, their teaching notes and the appropriate instructional materials in class ready just before lessons started.

4.4.1: Readiness of teachers with schemes of work for Chemistry

The researcher observed twenty five lessons altogether, it was found that in 18 (72%) lessons, Chemistry teachers had their schemes of work while in 7 (28%) lacked, but they informed the researcher that they could not be locate where they were placed. These findings are displayed in Table 4.17.

<table>
<thead>
<tr>
<th>Was a teacher having schemes of work?</th>
<th>Frequency (N=25)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>18</td>
<td>72</td>
</tr>
<tr>
<td>Could not located</td>
<td>7</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>100</td>
</tr>
</tbody>
</table>

The proportion of teachers who possessed the schemes of work is commendable (72%), however for those who lacked, are likely miss out on four benefits pointed out by Twoli et al (2007) that; (1) in case of any change in teachers, it does not break the continuity of teaching, (2) they ensure
adequate time is allocated to each topic within the syllabus, (3) they facilitate the assembly of relevant teaching resources before a lesson starts and (4) ensures an rearrangement of topics according to their level of difficulty.

4.4.2: Readiness of teachers with ASEI/PDSI lesson plans for Chemistry

Concerning the ASEI/PDSI lesson plans, the study found that all teachers were not preparing lesson plans for teaching Chemistry. The findings are shown in Table 4.18.

Table 4.18: Number of lessons in which Chemistry teachers had ASEI/PDSI lesson plans

<table>
<thead>
<tr>
<th>Was a teacher having an ASEI/PDSI lesson plan?</th>
<th>Frequency (N=25)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>100</td>
</tr>
</tbody>
</table>

According to Twoli et al. (2007), a lesson plan enables teachers to visualize how their actual teaching is likely to unfold. Designers of the SMASSE training brought some modifications to enrich the ordinary lesson so as to accommodate the pedagogic shift being generated by the ASEI/PDSI approach (SMASSE, 2006; SMASSE, 2005; SMASSE, 2010). Therefore, the failure by Chemistry teachers to prepare these lesson plans affects the proper implementation of ASEI/PDSI approach of teaching Chemistry.

4.4.3: Readiness of teachers with teaching notes for Chemistry

With reference to teaching notes, it was found that in 22 (88%) lessons, chemistry teachers were relying on lesson notes which have lasted several years, in 2 (8%) lessons teachers were teaching using a text books directly, and in 1 (4%) lesson teacher was using newly drafted teaching notes. The findings have been presented in Table 4.18.
Table 4.18: Number of lessons in which Chemistry teachers had teaching notes

<table>
<thead>
<tr>
<th>Was a teacher in possession of lesson notes?</th>
<th>Frequency(N=25)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, newly prepared just for this lesson</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Yes, had been in use for several years</td>
<td>22</td>
<td>88</td>
</tr>
<tr>
<td>No notes, used a text book in teaching Chemistry</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>100</td>
</tr>
</tbody>
</table>

In accordance with Hearth (web 19), writing comprehensive teaching notes is a process of selecting and adopting facts from a large collection of information. Hearth (web 19) has disclosed teaching notes should demonstrate the following six basic features, they should: (1) be a summary description of the topic and its context to familiarize students on the main issues, (2) concentrate on the learning objectives and target audience to mention the intended key issues, (3) suggest how the lessons will be conducted; for example discussions, group work, demonstration, practical work or assignment, (4) offer comprehensive answers to examination questions, (5) suggest additional readings to work in conjunction with the notes and (6) provide a feedback column to an individual teacher for interpreting their suitability in terms of their ability to address a written assessment or tackle pop up questions from students during the teaching and learning process. The researcher carried out an observation on teaching notes which teachers were using in their lessons; no particular teacher had drafted notes which were bearing all the six features of good notes as highlighted by Hearth (web 19). Most teaching were concentrating on giving a summary description of the topic.
4.4.4: Readiness of teachers with instructional materials beforehand in lessons

In connection with the availability of necessary teaching aids in classrooms before lessons started, the study found that in 10 (40%) lessons, teachers had availed appropriate instructional materials in advance while in 15 (60%) lessons teachers were in possession their writing materials only. These results are given in Table 4.20.

Table 4.20: Number of lessons in which Chemistry teachers had instructional materials beforehand

<table>
<thead>
<tr>
<th>Was a teacher having instructional materials in the lesson beforehand?</th>
<th>Frequency (N=25)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>No, had the writing materials only</td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

A testament to a probable usage of instructional materials in teaching is their availability in a classroom before a lesson takes off. From clarified in Table 4.20, a likelihood of utilizing instructional materials when teaching Chemistry existed in 40% lessons only while in the other 60% lessons, teachers were apparently set to miss out on engaging their students with many small scale learning activities as envisioned by the SMASSE training.

4.4.5: Teaching strategies being used in chemistry lessons

In an effort to determine the fittingness of the teaching strategies which Chemistry teachers were using in their lessons, the researcher first considered the topic that was under discussion and then how teachers and their students were interacting during the instruction process.
4.4.5.1: Form 3 Chemistry topics which were being taught teaching in schools

Regarding topics which teachers were teaching, the study revealed that in 7 (28%) lessons, Nitrogen and its compounds was being taught, in 11 (44%) lessons, Organic Chemistry I: Hydrocarbons was being taught, in 3 (12%) lessons, The mole: Molar solutions was being taught and in 4 (16%) of lessons, The Mole: Avogadro’s constant was being taught. A summary of these findings are available in Table 4.21.

Table 4.21: Form 3 Chemistry topics that were being taught in lessons

<table>
<thead>
<tr>
<th>Which topic was a teacher teaching in class?</th>
<th>Frequency (N=25)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen and its compounds</td>
<td>7</td>
<td>28</td>
</tr>
<tr>
<td>Organic Chemistry I: Hydrocarbons</td>
<td>11</td>
<td>44</td>
</tr>
<tr>
<td>The Mole: Molar solutions</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>The Mole: Avogadro’s constant</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>100</td>
</tr>
</tbody>
</table>

A reference to Section 2.7.2 indicates that all the topics in Table 4.21 were covered in part by SMASSE training for Chemistry teachers. Therefore, it’s expected that teachers were better positioned to conduct their Chemistry lessons with an accompaniment of many small-scale experiments being handled by students the as prescribed by the training.

4.4.5.2: How teachers were organizing students in Chemistry lessons

It was found that in 11 (44%) lessons, teachers treated the students in a whole class as a single unit throughout their teaching, in 9 (36%) lessons, teachers engaged their learners in small groups first before combing them as a whole class towards the end and in 5 (20%) lessons,
teachers involved their learners individually first before combing them as a whole class towards the end. These finding are disclosed in Table 4.22.

Table 4.22: How teachers were organizing students in Chemistry lessons

<table>
<thead>
<tr>
<th>How was a teacher organizing learners in a lesson?</th>
<th>Frequency (N=25)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students combined as a whole class</td>
<td>11</td>
<td>44</td>
</tr>
<tr>
<td>Students handled individually, then as a whole class</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Students handled in small groups, then as a whole class</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

According o Singer et al (web18) learners who are exposed to laboratory experiences develop teamwork skills. While Tewksbury and Macdonald (2005) attest that an appropriate learning situation is where students are fully engaged in observing, speaking, writing, listening, thinking, drawing and doing. These double assertions clearly indicate that proper learning environment is taking place in exclusively 20% of the Chemistry lessons. This is where meaningful learning discourses are happening amongst students and between students and their teachers. In 44% of the lessons, teachers were applying the expository teaching strategies which the SMASSE training came to discourage.

4.4.5.3: Degree of learners’ involvement in Chemistry lessons

Relating to the extent of student involvement in learning, it was observed that in 18 (72%) lessons, teachers were fully engaging their learners in the teaching process by way of students: responding to questions, participating in group discussions, performing demonstrations, carrying out assigned experiments and solving a given exercise. In 7 (28%) lessons, teachers were not
occupying their students fully in the learning process; they were listening to their teacher. The findings are reported in Table 4.23.

Table 4.23: Confirmation of learner participation in Chemistry lessons

<table>
<thead>
<tr>
<th>Was a teacher involving the students fully in the learning process?</th>
<th>Frequency (N=25)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>18</td>
<td>72</td>
</tr>
<tr>
<td>No</td>
<td>7</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>100</td>
</tr>
</tbody>
</table>

In accordance with Tewksbury and Macdonald (2005), meaningful learning occurs when a person is actively participating with regard to making observations, speaking, writing, listening, drawing, and doing. Similarly, Heidi (web16) and Raymond (web17) when making references to the cone of experience model affirm that students learn more when teaching use teaching strategies which involve them in “doing” things. Therefore, it can be inferred that in 72% of Chemistry lessons, there is good teaching taking place since teachers are engaging their learners fully and this is likely to give students an ability to retain the knowledge which they have been taught. The other 28% of the lessons still deserve a paradigm shift as envisioned by SMASSE the training.

4.4.5.4: How teachers were utilizing instructional materials in Chemistry lessons

As displayed in Table 4.24 teachers are utilizing instructional materials in different ways in their respective lessons. In 12 (48%) Chemistry lessons, instructional materials were used for introducing a topic, in 22 (88%) lessons for illustrating a concept, in 7 (28%) lessons for reviewing a topic, in 5 (20%) lessons for giving out an assignment, in 2 (8%) for establishing interest in the subject and in 25 (100%) lessons giving out notes.
Table 4.24: How teachers were using instructional materials in Chemistry lessons

<table>
<thead>
<tr>
<th>How was a teacher using instructional material in class?</th>
<th>Yes (N=25)</th>
<th>No (N=25)</th>
<th>Total frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
</tr>
<tr>
<td>To introduce a topic</td>
<td>12</td>
<td>48</td>
<td>13</td>
</tr>
<tr>
<td>To illustrate a concept</td>
<td>22</td>
<td>88</td>
<td>3</td>
</tr>
<tr>
<td>To review a topic</td>
<td>7</td>
<td>28</td>
<td>18</td>
</tr>
<tr>
<td>To give out an assignment</td>
<td>5</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>To give out notes</td>
<td>25</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>To establish interest</td>
<td>2</td>
<td>8</td>
<td>23</td>
</tr>
</tbody>
</table>

It has been acknowledged by Kiringithi (1988) that the function of instructional materials in teaching is to provide a common starting point and a common path for a teacher and students to match forward intellectually on an equal footing. Correspondingly, Wandera et al (2008) has mentioned that instructional resources make it easier for a teacher to explain concepts and for students to retain knowledge. This study found that in all Chemistry lessons, teachers were using instructional materials to give out notes. This aspect is not what Kiringithi (1988) and Wandera et al (2008) had earlier envisioned as a role of instructional materials.

4.4.5.5: How students were using instructional materials in Chemistry Lessons

Table 4.25 has presented the findings on exactly how students were using instructional materials in their Chemistry lessons. It was witnessed in 25 (100%) lessons that students were using instructional materials to respond to questions posed by teachers, in 8 (32%) lessons for recalling previous work, in 2 (8%) lessons for attempting an exercise and in all the lessons there was no single case of students using instructional materials to ask their teacher questions.
Table 4.25: How students were utilizing instructional materials in Chemistry lessons

<table>
<thead>
<tr>
<th>How were students using of instructional materials in class?</th>
<th>Yes (N=25)</th>
<th>No (N=25)</th>
<th>Total frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
</tr>
<tr>
<td>To attempt an exercise</td>
<td>2</td>
<td>8</td>
<td>23</td>
</tr>
<tr>
<td>To ask questions</td>
<td>0</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>To recall previous work</td>
<td>8</td>
<td>32</td>
<td>17</td>
</tr>
<tr>
<td>To respond to questions</td>
<td>25</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

Instructional materials are supposedly meant to promote: the interpersonal skills of cooperation and sharing amongst learners, their power of imagination, observation, reasoning and creativity (Wandera et al, 2008). With reference to Table 4.25, students are not being exposed to these aspects exhaustively by their teachers, owing to mannerisms displayed by students like responding to questions from teachers (100%) and recalling previous work (32%). These student behaviors indicate that teachers are directing their learners on what to look for in any experimental set up carried out. This is why students never used instructional materials to ask their teachers questions in all the Chemistry lessons.

4.4.5.6: Prevailing teaching strategies in Chemistry lessons

With regard to teaching strategies existing in Chemistry classrooms, this study established that in 3 (12%) lessons teachers were using demonstrations, in 13 (52%) lessons teachers were using informal lecture method, in 8 (32%) lessons teachers were using practical work and in 1 (4%) a teachers was using group discussions. Figure 4.8 is a graphical representation of these findings.
Figure 4.8: Prevailing teaching strategies in Form 3 Chemistry lessons

As pointed out by Biswajit (2008), the nature of learning Chemistry comprises three conceptual levels; the macro, the micro and the symbolic. Besides, the micro and symbolic levels work to interpret the macro level. Implying that students should be working independently with pieces of
apparatus during Chemistry lessons so as to infer suggested concepts from experimental set ups. For that reason, the findings depicted by Figure 10 have once again revealed a continued application of expository teaching strategies in Chemistry at secondary school level. Consequently, it can be construed that the primary goals for the introduction of SMASSE training are yet to be fully embraced and be realized in the teaching and learning of Chemistry.

4.5: The influence of SMASSE training on Chemistry teachers

It has already reported in Table 4.4 and Figure 4.3 categorically that 74% of teachers have attended SMASSE training for Chemistry while 5% have attended it for other subjects which the project was offering. Therefore, when taken collectively, the Chemistry teachers who were conversant with the SMASSE principles are now 79% while those who remain ignorant are 21%. This study made further efforts to establish the perceptions of teachers towards the SMASSE training and their willingness to attend future training sessions.

4.5.1: Perceptions of Chemistry teachers on SMASSE project trainings

Teachers were given a list of items which SMASSE training was supposedly meant to impart on them. The expected response to each item was a simple “Yes” or “No”. A summary of the findings are shown in Table 4.26.
Table 4.26: Perceived benefits to teachers for attending SMASSE training

<table>
<thead>
<tr>
<th>Which statement best describes what SMASSE training has helped you to achieve?</th>
<th>Yes (N=42)</th>
<th>No (N=42)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
</tr>
<tr>
<td>1. Has increased my mastery of the Chemistry content</td>
<td>11</td>
<td>26</td>
</tr>
<tr>
<td>2. Has improved my competency in teaching Chemistry</td>
<td>14</td>
<td>33</td>
</tr>
<tr>
<td>3. Has increased my ability to plan the content to be taught per given time</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>4. Has given me expertise in devising new teaching techniques</td>
<td>24</td>
<td>57</td>
</tr>
<tr>
<td>5. Has given me skills to improvise instructional materials.</td>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td>6. Has given me confidence to teach Chemistry</td>
<td>13</td>
<td>31</td>
</tr>
<tr>
<td>7. Has fostered my ability to teach topics which were previously considered as problematic</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>8. Has enabled me to use of many small scale experiments in teaching.</td>
<td>10</td>
<td>24</td>
</tr>
</tbody>
</table>

A summative observation of Table 4.26 shows that Chemistry teachers have not benefited seriously from the training as had been anticipated by the planners of the SMASSE project training. It is only one item that attracted positive affirmation; that the training has increased teachers' expertise in devising new teaching techniques at 24 (57%).

Other items overwhelmingly attracted contrary views from Chemistry teachers, respondents declined to have benefited from the training. An enumeration of items which teachers refused to acknowledge and their degree of negation is presented hereunder. Chemistry teachers declined to that the training helped them to: (a) fostered their ability to teach topics which were previously considered as problematic 37 (88%), (b) increased their ability to plan the content to be taught per given time 35 (83%), (c) gave them skills to improvise instructional materials 34 (81%), (d)
enabled them to use of many small scale experiments in teaching 32 (76%), (e) increased their mastery of the Chemistry content 31 (74%), (f) gave them confidence to teach Chemistry 29 (69%) and (g) improved their competency in teaching Chemistry 28 (67%). This revelation is disheartening putting into consideration the amount of resources which were used in setting up the SMASSE project training right from pilot stage up to the present moment when it has become a national program.

4.5.2: Willingness of Chemistry teachers to attend SMASSE training in future

This study sought the opinion of the Chemistry teachers as to whether they were willing to continue attending the SMASSE training in future and provide a justification for their given response. The results in relation to their future attendance are presented in Table 4.27.

<table>
<thead>
<tr>
<th>Do you wish to continue attending SMASSE training in future?</th>
<th>Frequency (N=42)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>30</td>
<td>71</td>
</tr>
<tr>
<td>No</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>No response</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100</td>
</tr>
</tbody>
</table>

It was found that teachers who expressed willingness to continue attending the training were 30 (71%) while those who objected to their prospective future attendance were 7 (17%) . But then those who never provided a response were 5 (12%).

Reasons in support of their stated opinions were varied. For teachers who were for forthcoming attendance their justifications were to: (1) learn how to integrate ICT education, (2) share
information with other teachers on better teaching techniques and (3) get informed about the emerging issues in education. For those Chemistry teachers who were against any future attending, their reasons for declining were: (a) topics are being discussed repetitiously, (b) the training ought to have a definite period and (c) the holidays for teachers being are taken away.
CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0. Introduction
This chapter presenting a summary of study findings, ensuing conclusions and conclusive recommendations based on the outcome of the study findings.

5.1 Summary of the study findings
This study was carried out to evaluate abilities of Chemistry teachers to acquire and to use appropriate instructional materials in their lessons as influenced by the precursor, their yearly SMASSE training. The summary has been presented with a correlation to the research objectives.

5.1.1: Summary findings based on Objective 1
The study sought to establish whether Bungoma East district secondary schools have instructional materials meant for teaching Chemistry, to ascertain their adequacy and to verify their availability in classrooms during the teaching and learning process.

Concerning the presence of science laboratories in schools, the findings showed that the Chemistry teachers who reported to be having a special laboratory meant for Chemistry were 36%, those who had a single laboratory serving all the science subjects were 50%, those who had no conventional laboratory, but indicated to be having a make-shift structures functioning as a science laboratory were 10% and those who had no laboratory completely were 5% (Table 4.5).

The study further revealed that there was a special laboratory meant for teaching Chemistry in all national schools, 42% of county schools and 20% of district schools (Figure 4.4). On the other hand there was one laboratory structure serving all science subjects in 58% of County schools, 60% of district schools and all the private schools. Make shift structures existed in 20% of
district schools that was functioning as a science laboratory. However, C.D.F aided schools had no laboratories completely.

Regarding presence of laboratory facilities and equipment in schools, it was found that teachers who confirmed having stocked science laboratories were 71% while those who declined were 29% (Table 4.6). Concerning the adequacy of these laboratory facilities and equipment for teachers’ and students use, it was found that teachers who validated having adequate facilities were 38%, while those teachers who disproved were 45%. Conversely, 17% of Chemistry teachers provided no response to an item relating to adequacy of instructional resources (Table 4.7).

With reference to ascertaining adequacy of facilities in various types of schools, it was found that sufficient laboratory facilities and equipment existed in all national and private schools, 33% of County schools and 15% of District schools. Contrastingly, these instructional materials were found to be inadequate in 67% of county schools, 85% of district schools and all the C.D.F aided schools (Figure 4.5).

On crosschecking classrooms for the presence of instructional materials beforehand, the study found that in 40% of Chemistry lessons teachers had availed the appropriate teaching aids in advance while in 60% of the lessons, teachers were in possession their writing materials only (Table 4.20).

5.1.2: Summary findings based on Objective 2

The study attempted to establish the methods which schools are employing to acquire their instructional materials for Chemistry and whether any improvisation/modification of teaching aids is taking place as envisioned by the SMASSE training. Then determine the suitability of improvised/modified resources during classroom instruction.
With regard to modes of acquiring instructional materials in schools, 86% of Chemistry teachers reported that school administrations were securing them through purchasing, 52% of teachers were developing their own resources, 36% of teachers were collecting their instructional resources from within the environment, 31% of teachers reported having received them through donations, 12% of teachers confessed to that they were borrowing from other schools while 19% of teachers were guiding their learners in preparing them (Table 4.10).

As shown by Figure 8, it was found that 57% of Chemistry teachers confirmed to be carrying out improvisation/ modification of their teaching aids while 43% of them declined. Across various types of schools it was established that improvisation/ modification of resources is most prevalent in two types of schools; the county and the district schools at 58% and 65% respectively, whereas in national and private schools cases of improvising and not improvising were equivalent. However, there were no reported instances of improvisation/ modification of resources in the C.D.F aided schools. Instructional materials which were commonly being improvised by teachers and students were reported to be charts and models (Figure 4.7, Tables 4.12 and 4.13).

The study disclosed that 69% of teachers found improvised/modified instructional materials to be helpful in terms of helping them to attain the intended learning objectives, although 31% of teachers declined having benefited from improvised/modified materials. Teachers gave the following explanations to indicate the suitability of improvised materials for teaching Chemistry as; 14% observed increased interest in the subject amongst their learners, 26% of teachers were receiving more correct responses from their students, 12% experienced increased students’ participation in classrooms and 7% noticed improved manipulative skills in their learners. Even
though, 41% of Chemistry teachers never provided a response to this item (Tables 4.14 and 4.15).

5.1.3: Summary findings based on Objective 3

The study attempted to determine the practicability of small scale experiments within Chemistry lessons as motivated by the SMASSE training for Chemistry teachers, verify the prevailing teaching strategies and hence establish the degree of learner-participation in classrooms.

It was found that teaching strategies which are predominant in Chemistry lessons are 12% demonstrations, 52% using informal lecture method, 32% practical work and 4% group discussions (Figure 4.8). Concerning the degree of learner participation in Chemistry classrooms, it was found that in 72% of the lessons teachers were engaging by way of students responding to questions, participating in group discussions, performing demonstrations, carrying out assigned experiments and solving a given exercise, but in 28% lessons, teachers were not occupying their students fully (Table 4.23).

In an effort to ascertain the practicability of hands on activities in classrooms, the study looked at how various Chemistry teachers were organizing their learners during the lessons. It was noted that in 44% of Chemistry lessons, teachers handled the entire class as a single unit throughout their teaching, in 36% lessons, teachers dealt with their learners in small groups before bringing them together as a whole class and in 20% of the lessons, teachers supervised their learners individually first before again bringing them together as a whole class (Table 4.27).

The study further examined how students were using the instructional materials in the aforementioned teachers’ regulation of their classes (in Table 4.27), it was observed that in 100% of the Chemistry lessons, learners used resources to respond to questions posed by their teachers, in 32% of the lessons for recalling previous work, in 8% of the lessons for attempting an
exercise. In contrast, there was no single case of students using instructional materials to ask questions or solicit information from their teacher (Table 4.25).

Additionally, the study looked at how Chemistry teachers were using instructional materials in their lessons. It was discovered that in 48% of the lessons, instructional materials were used for introducing a topic, in 88% of the lessons for illustrating a concept, in 28% of the lessons for reviewing a topic, in 20% of the lessons for giving out an assignment and in 8% of the lessons for arousing interest of students in the subject. Furthermore, it was observed that all Chemistry teachers used their resources to give out notes (Table 4.24).

A topic under discussion has some influence on teaching strategies which teachers can adopt in classrooms. This study assessed the compatibility between the topics which Form 3 students were learning and the corresponding teaching strategies that teachers were applying. It was revealed that in 28% lessons, Nitrogen and its compounds was being taught, in 44% lessons, Organic Chemistry I: Hydrocarbons was being taught, in 12% lessons, The mole: Molar solutions was being taught and 16% lessons, The Mole : Avogadro’s constant was being taught (Table 4.21). Coincidentally, the Chemistry teachers had been exposed to segments of all these topics during their SMASSE trainings (Section 2.7.2).

5.1.4: Summary findings based on Objective 4

The study sought to investigate the influence which SMASSE training has had on Chemistry teachers’ modes of teaching in classrooms and their understanding of Chemistry.

It was found that Chemistry teachers have not benefited seriously from attending SMASSE training as it had been anticipated. They declined having being influenced by most of the opinions that were being propagated by the training (Table 4.26). A summary of the teachers negative responses with respect to their training are listed hereunder.
Chemistry teachers declined to acknowledge that the SMASSE training:

- fostered their ability to teach topics which were previously being viewed as problematic to teachers 88%
- increased their ability to plan the content to be taught per given time 83%
- gave them skills to improvise instructional materials 81%
- enabled them to use of many small scale experiments in teaching 76%
- increased their mastery of the Chemistry content 74%
- gave them confidence to teach Chemistry 69%
- improved their competency in teaching Chemistry 67%

Regarding increase in the expertise of devising new techniques of teaching, 57% of teachers confirmed having benefited from the training.

Regardless of the reported negativity which the training attracted, it was found that teachers who expressed their willingness to continue attending it were 71% while those who registered their objections to its continuous attendance were 17%. Surprisingly, Chemistry teachers who never provided a response to this item were 12%.

5.1.5: Summary of supplementary findings

In terms of teachers’ distribution based on their highest professional qualifications, it was established that teachers who are fully trained with B. Ed (science) were found in National schools at 100%, in County schools at 83% and District schools at 50%. On the other hand, untrained Chemistry teachers were in C.D.F aided schools at 100%, in District schools they were 35%, in private schools they were 50% and in County schools they were 8% (Figure 4.2).
On the subject of textbooks which are frequently in use, the study found that chemistry course books are more popular than Chemistry reference materials (Tables 4.8 and 4.9). The prevalent course books were Secondary Chemistry for Form three, the students’ book at 94% usage and Explore Chemistry Form 3 at 61% usage. While the reference materials were High-flyer series: K.C.S.E Revisions in Chemistry at 56%, Top Mark: Chemistry K.C.S.E. Revision Series at 44% and Test it & fix it: Chemistry K.C.S.E Revision Series at 44%. Both course books and reference materials are in use, however, it was ascertained overwhelmingly that the degree of using the course books is much higher than that of using reference materials in schools.

With respect to ASEI/PDSI lesson plan, the study revealed that none of the Chemistry teachers was drafting this instructional tool prior to their lessons (Table 4.18).

In terms of teacher’s readiness by having teaching notes, it was found that in 88% Chemistry lessons, teachers were using notes that lasted several years, in 8% lessons teachers were teaching with a text book directly, and in 4% lessons teachers were relying newly drafted teaching notes (Table 4.19).

5.2: Implications of the findings

5.2.1 Availability of laboratory facilities and equipment.

Apart from C.D.F aided schools, all other types of schools have a laboratory or a semblance of a laboratory meant for the teaching of Chemistry. These laboratories were reported to be having necessary facilities and equipment, but these facilities were not adequate in terms of teacher’s and students’ use in most schools. Besides, many teachers (60%) were not availing requisite instructional materials in their lessons but they were in possession of their writing materials only. This description paints a scenario where students being taken to laboratories for theoretical
Chemistry lessons since teachers are ill equipped to meet the compulsory demands of practical work characteristically present in many topics. As a result, students are not adequately being prepared to face the practical aspects of evaluating Chemistry in national examinations.

5.2.2 Acquisition of instructional materials for Chemistry

It was observed that leading forms of acquiring resources in schools were through purchasing by respective school administrations, teachers own makings and collection from the immediate environment of the school. There were also 57% of Chemistry teachers who confirmed to be carrying out improvisations/modifications of instructional materials for their teaching. The commonly improvised instructional materials in schools were identified to be charts and models. Introduction of SMASSE training was meant to create an alternative access to resources through improvisations. However, no meaningful improvisations were found to be taking place in schools with the exception of charts and models. Availability of charts and models in lessons do not adequately address the practical needs of a subject like Chemistry. The study showed that purchasing instructional materials is the predominant and viable form of acquisition.

5.2.3 Degree of learner participation in classrooms

Topics that were being discussed in lessons had been handled in the SMASSE training, the predominant teaching methodology in those lessons was the use of an informal lecture method, followed distantly by practical work and demonstrations. Moreover, in 72% lessons teachers were fully engaging their students in the learning process. However, learner participation was limited to answering questions posed by the teacher. This mode of teaching Chemistry is denying students a chance to develop their manipulative skills which they essentially require while sitting for the Chemistry practical paper. Again, students are being denied a chance to learn through
exploration and discovery. Teachers’ questions tend to direct students on what should be observed and be learned. Consequently, curiosity, creativity and interest are not sufficiently aroused amongst the learners during the teaching process. Besides, this teaching methodology where students are not involved in doing things to understand the content taught promotes rote learning (Figure 2.1). Therefore in the long run, little of the learned information is retained by the students.

Additionally, the most prevalent textbooks for Chemistry in schools were found to be the course books. Course books have a text structure and layout that follows a format of proof-first organization, where an argument develops gradually up to a conclusion. This type of books presents Chemistry in the way it is practiced by experts. Their outstanding features are existence of labeled diagrams for experimental set ups and systematic procedures for carrying out practical activities (Section 2.2.1). However, it was found that only 38% of Chemistry teachers had adequate facilities in their laboratories (Table 13), and in 60% of Chemistry lessons teachers had no instructional materials except writing materials (Table 4.20). Therefore, it is emphatic that most Chemistry teachers are leading their learners through practical activities using expository teaching strategies.

5.2.4 Influence of SMASSE training on Chemistry teachers

Apart from assisting teachers to increase their expertise of devising new techniques of teaching chemistry, the study found that SMASSE training has not achieved its planned objectives of bringing about a pedagogical paradigm shift in Chemistry lessons. Teachers declined having been influenced by most of the perspectives which the training was trying to exposing to them.
5.2.5 Implications of supplementary findings

More trained Chemistry teachers were found within well established (national and county) types of schools, whereas the emerging (C.D.F aided) schools are depending on heavily on untrained teachers. Untrained teachers lack the expertise to apply various teaching strategies as a number of situations may demand. Consequently, students from well established schools are likely to continue performing better than their counterparts in from the emerging schools.

Furthermore, the students schooling in C.D.F aided schools are severely disadvantaged since the study showed that there are no laboratories (Figure 4.4), no adequate facilities (Figure 4.5), no improvisations were taking place (Figure 4.7), they were not found to be purchasing any instructional resources but were relying on making collections from the environment (Table 4.11). Besides, Chemistry teachers in C.D.F schools were found to be professionally untrained (Figure 4.2) and have not attended SMASSE training (Figure 4.3).

5.3: The conclusions of the study

This study was seeking to evaluate the influence of SMASSE training on teachers’ ability to source and to use instructional materials in teaching Chemistry in schools. From the findings, it can be concluded that the SMASSE training has had a minor impact on the instructional tendencies of Chemistry teachers.

Most schools have laboratories, but these laboratories are not adequately stocked with facilities and equipment. Suitable Chemistry textbooks are being used for instructing students but teachers are not availing appropriate instructional materials in classrooms during lessons.
Prevailing method of acquiring instructional materials is through purchasing by school administrations. There were reported cases of improvisation and modification of resources, however, its only charts and models being improvised.

The degree of learner participation in Chemistry lessons is mostly limited to answering their questions posed by their teachers. It was also disclosed that trained teachers are more prevalent in established institutions like national and county schools.

The emerging the C.D.F aided schools are severely disadvantaged in terms having the requisite instructional facilities and qualified Chemistry teachers.

5.4: The recommendations of the study

The following are the main recommendations resulting from this study. They have been considered in two formats, the recommendations for action and the recommendations for further research.

5.4.1: Recommendations for action

1. SMASSE training was focusing on “lesson improvement”, yet expository teaching strategies have remained prevalent in Chemistry lessons. Therefore, there is need to change the goals of SMASSE training to focus on “teacher improvement”. Since it is the teachers’ role to plan and execute learning activities in classrooms.

2. Findings showed that teachers declined to acknowledge having been influenced by the training. Therefore, SMASSE training should make an annual publication for Chemistry addressing all issues raised and discussed in various INSET centers across the country,
providing details exactly how teachers can improvise resources beyond charts and models. A copy of this publication should be made available in all secondary schools to be a stand by guide for teachers’ use whenever need arises.

3. Findings showed that most schools have laboratories which are inadequately stocked with facilities and equipment. Therefore, the MOEST should provide a list of basic minimum requirements, which all school laboratories must strive to meet. For the newly established schools still facing financial difficulties, the government should step in with financial grants to assist such schools in meeting these minimum requirements.

4. The findings revealed that expository teaching strategies are still prevalent in Chemistry lessons. Therefore, the MOEST should conduct impromptu visits to schools to ensure that Chemistry teachers are fully adhering to proper teaching methodologies advocated for by the SMASSE training. This should extend to include the ascertaining of the availability of the schemes of work, ASEI/PDSI lesson plan and meaningful utilization of instructional resources in all teaching sessions.

5. The findings exposed that teachers are utilizing correct text books for Chemistry. However, practical activities are being taught theoretically, therefore, The government should develop modalities to start awarding marks to students’ manipulative skills in the chemistry practical papers during national examinations. This will actively influence chemistry teachers to meaningful provide meaningful guidance to their students on key aspects of practical work throughout their everyday teaching.
6. The findings showed that there are some topics/experiments whose appropriate instructional materials remain scarce hitherto. Consequently, the MOEST should develop and supply audio-visual resources for such topics/experiments. This will create an avenue for multi-sensory learning opportunities to students.

5.4.2: Recommendations for further research

The researcher recommends that:

1. There is need to carry out a similar study for other science subjects, which have been the focal point of the SMASSE project.

2. It is essential to conduct a similar study in an urban locality to establish whether the resultant findings are comparable to those reported in this study.

3. Carrying out a similar study using a different research design with a greater focus on details is necessary.

4. There is need to carry out a similar study with a broader sample size.
REFERENCES


Logowski, J.J. (2002). The Role of the laboratory in chemical education. Austin Texas, U.S.A.


Appendix A

QUESTIONNAIRE FOR CHEMISTRY TEACHERS

I am conducting a study to determine the extent, which SMASSE project has played in ensuring that instructional materials for teaching Chemistry are available, accessible and adequately being utilized in the teaching and learning of Chemistry.

You have been selected as one of the respondents. Your responses are going to be of great importance to this study. The information that you are going to provide will be treated confidentially and will be used for research purposes only. Please answer each of the questions as honestly and accurately as possible. Please note that some questions have more than one response. The questionnaire is basically simple to complete, you can answer by ticking [✓] a response in the box (es) provided. Where appropriate, also fill the spaces provided with your opinion. DO NOT WRITE YOUR NAME.

(A). General Information

1. Type of your school:
   a. National school
   b. County school
   c. District school
   d. Private school
   e. C.D.F aided school

2. Are you a male or a female?
   a) Male
   b) Female
3. What is your highest professional qualification?
   a) B. Ed (science) 
   b) B. Sc 
   c) Diploma in education 
   d) Undergraduate university student, teaching on part time 
   e) KCSE 
   - Any other, specify ________________________________

4. For how long have you been teaching Chemistry?
   a) Less than 3 years 
   b) 4 – 6 years 
   c) 7 – 10 years 
   d) 11 -14 years 
   e) Above 15 years 

5. Indicate your total number of lessons per week 
   a) Below 15 
   b) 16 – 20 
   c) 21 – 25 
   d) 26 – 30
e) Above 30

**(B). From your SMASSE training, what is the role of Instructional Materials**

6. When do you use instructional materials?

   a) To enhance permanent retention of knowledge
   b) To arouse and sustain students’ interest in learning
   c) To make it easier to explain key concepts
   d) To discourage rote learning (Learning by memorization).
   e) To make abstract ideas more concrete.
   f) To enable learners to develop a keen sense of observation and reasoning.
   g) To encourage active learners’ participation in learning process.
   h) To enable learners to develop manipulative skills.
   i) To provide for learners’ individual differences.
   j) To expose students to practical aspects of Chemistry.

7. How have you been using instructional activities in your Chemistry lessons?

   a) To introduce a topic
   b) To develop a theory
   c) To clarify a concept
   d) To summarize a topic
   e) To evaluate a topic

**(C). Availability of Instructional Materials**

8. Indicate the type of laboratory found in your school.

   a. A laboratory specifically meant for Chemistry.
b. Laboratory meant for all science subjects

c. A make shift structure acting as a lab

d. Any other, specify__________________________________________

9. Is your laboratory stocked with necessary equipment and facilities meant for the teaching and learning Chemistry?
   a) Yes
   - b) No

10. If your answer in (10) was yes, are equipments and facilities in the laboratory adequate in terms of quantity for both teachers' and students' use?
   a) Yes
   b) No

11. Which of the following listed instructional resources have you been using frequently in teaching and learning of Chemistry?
   a) Charts
   b) Models
   c) Pictures
   d) Realia (real objects)
   e) Hand outs.
   f) Laboratory chemicals and reagents
   g) Others, specify__________________________________________

12. If your response in (10) was "NO", how have you been ensuring that each student participates in the learning activities as encouraged by SMASSE training?
a. Through class demonstrations
b. Students working in small groups
c. Explaining concepts using diagrams on chalk board
d. Explaining concepts using charts
e. Use lecture method
f. Any other, specify ________________________________

13. Where are Chemistry books kept in your school?
   a) In a library
   b) In a book store
   c) In a staff room
   d) Any other, specify ________________________________

14. Does the school issue Chemistry books to students for classroom use?
   a) Yes
   b) No

15. Does the school allow students to borrow Chemistry books for individual use?
   a) Yes.
   b) No.

16. If your answer in 15 is yes, do students borrow the Chemistry books?
   a) Yes.
   b) No.
17. Give some examples of the Chemistry books which are frequently borrowed by individual students for their private use.


(D). Selection of instructional materials for Chemistry

18. Which of the following factors normally influence your choice of picking instructional materials for Chemistry?

a) Lesson objectives
b) Topic under discussion
c) The size of the class
d) Recommendation in the teacher’s guide book
e) Cost of the instructional materials
f) Availability of the instructional materials
g) Others, specify ____________________________

(E). With reference to SMASSE training, how have you been acquiring instructional materials for Chemistry lessons.

19. Which of the following statements represent how your school acquires instructional materials for Chemistry?

a) Collected from the environment
b) Prepared by learners
c) Prepared by teachers


d) Through borrowing from other schools


e) Bought by the school administration


f) Through donations


g) Others, specify ____________________________

I. If your school sometimes receives Chemistry instructional materials in form of donations, state who the donors are.

a. ____________________________

b. ____________________________

c. ____________________________

20. Has your school ever acquired instructional materials for a particular topic in Chemistry through improvisation or modification of the existing ones in this year?

a) Yes

b) No.

21. If your response in (20) is yes, did the improvised and (or) modified instructional materials help you to achieve the learning objectives of your lesson as planned?

a) Yes

b) No

c) Others, specify ____________________________
22. Mention some of the experiments within the Chemistry syllabus which you have carried out using instructional materials that had been improvised and (or) modified this year.

a) 

b) 

c) 

23. In your opinion, are the improvised and (or) modified instructional materials in Chemistry bringing about desired learning outcomes in students as stated in the learning objectives?

a) Yes

b) No

24. If your response in (23) is yes, mention some common indicators observed in Chemistry students which lead to your conclusion

a) 

b) 

c) 

25. List some of the experiments within the Chemistry syllabus which you are not carrying out because the instructional materials have remained difficult to acquire.

a) 

b) 

c) 

26. Since the introduction of SMASSE project in Kenya in 2003, have you attended any of its annual In-service training (INSETs) for Chemistry?
27. If your response in (26) is yes, which of the following statements best describes what you have gained from the SMASSE project INSETs.

a) They increased my Chemistry knowledge in relation to the Chemistry which I teach.

b) They increased my professional competence in teaching Chemistry.

c) They increased my ability to judge the right content per given time for my Chemistry classes.

d) They increased my expertise, now I can devise new teaching techniques depending on a topic under discussion.

e) They let me to adopt new teaching techniques in my Chemistry classes.

f) They increased my competence in stimulating students’ interest in Chemistry as a subject.

g) They enabled me to teach some Chemistry topics which previously I had not taught but existed in the syllabus.

h) They increased my confidence in my ability to teach Chemistry.

i) They led me to modify laboratory demonstrations, techniques and experiments existing in the Chemistry syllabus.

j) They made me to develop additional laboratory demonstrations, techniques and experiments to the existing ones.
k) They have enabled me to improvise instructional materials

28. In your opinion, is it still necessary “for you” as a Chemistry teacher, to continue attending SMASSE project INSETs?
   a) Yes
   b) No

29. Give a brief explanation supporting your response in (28).

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

THANK YOU.
Appendix B

A LESSON OBSERVATION SCHEDULE

Name of the School

Topic

Does the teacher mention the lesson objectives at the start of the teaching session?

Yes

No

1. PREPARATION
   (A). Schemes of work
   
   a) Is the Chemistry teacher in possession of the Chemistry schemes of work?
      a. Yes
      b. No.
      c. Available but could not be reached

   b) Do the schemes of work indicate against each topic the instructional materials to be used?
      a. Yes
      b. No.

   c) If the response in 1b above is yes, which of these instructional resources are indicated in the schemes of work?
      a. Text books being used
      b. Specific laboratory reagents and apparatus
      c. General laboratory reagents and apparatus
      d. Charts
e. Models
f. Realia

g. Writing materials, like chalks & chalkboard

d) Is the teacher in possession of updated Chemistry lesson notes?
   a. Yes, has newly prepared lesson notes.
   b. Yes, has notes which have been in use for several years
   c. No.
   d. Teacher uses a textbook directly

(B). Lesson plan

a) Does the Chemistry teacher posses the ASEI/PDSI lesson plan?
   I. Yes
   II. No.

b) Are the instructional materials mentioned in the schemes of work indicated in the ASEI/PDSI lesson plan?
   I. Yes
   II. No.

c) Is the Chemistry teacher in possession of instructional materials stated in the schemes of work?
   I. Yes
   II. No
   III. Only writing materials are available.
2. Utilization of instructional materials in the Chemistry lesson by the teacher and students.

a) How does the Chemistry teacher use the instructional materials?

I. To introduce the topic
II. To illustrate a concept
III. To review a topic
IV. To give out an assignment
V. To give out notes
VI. To establish interest
VII. Others, specify

b) How do students use the learning materials.

I. To attempt an exercise
II. To ask questions
III. To recall previously learned knowledge
IV. To respond to questions
V. Others, specify

3. How are students organized while attending to teaching and learning activities.

a) As a whole class
b) In small groups
c) Individually
d) Individually, then as a whole class
e) In small groups, then as a whole class
4. When the students are engaged in the teaching and learning activities, how does the Chemistry teacher manage them?
   a) Gives directions to students in advance.
   b) Moves around the class from one group/individual to another supervising/explaining/marking books.
   c) Sits/stands/moves about back and forth in front of the class as students work.
   d) Delegates the supervision of students to laboratory assistant

5. How does the Chemistry teacher give instructions to students?
   a) Using precise short statements to give a procedure
   b) Using worksheets with clearly outlined procedure
   c) Using the black wall to provide a written procedure
   d) The teacher talks while facing the black wall at times

6. Does the teacher involve students fully in carrying out the learning activities in terms of letting students infer the concepts being implied using the provided instructional materials?
   a. Yes
   b. No

7. Did the learning activities employed by the Chemistry teacher enable him/her to attain the lesson objectives within the stated time?
   a. No. Learning activities were carried over to the next lesson.
b. No. But the teacher proceeds to state and explain the expected outcome from the learning activities.

c. Yes. And the students' response to teacher's questions was mostly good.

d. Yes. But students were able to respond to teacher's questions, only after concepts being taught are pre-empted by their Chemistry teacher most of the time.

8. Were there some instructional materials in classroom that were not used at all?
   a. Yes
   b. No

9. In cases where the teacher had no instructional materials completely, how did he/she conduct the lesson?

   The teacher worked mostly:
   a. Using very precise explanations rich in appropriate scientific terminologies.
   b. Using incoherent explanations lacking in right use of scientific terminologies.
   c. Using worked examples on the chalkboard
   d. Using diagrams on the chalkboard

10. The lesson was majorly characterized by:
   a. Demonstrations
   b. Formal lecture method
   c. Informal lecture method
   d. Practical work
   e. Discussions
Appendix C

A CHECKLIST OF RESOURCES AVAILABLE
(To be completed by Chemistry teachers/Heads of science department)

GENERAL INFORMATION

A). Type of your school:
   a. National school  
   b. County school  
   c. District school  
   d. Private school  
   e. C.D.F aided school

B). The Chemistry books which are recommended by the ministry of education for teaching Chemistry at Form Three level have been listed below. Tick (√) the ones you are using in your teaching.


C). The following is a list of additional Chemistry books. Tick (√) the ones you are using to teach your Form three Chemistry class.


D). List the reference materials which you are using in teaching your Form Three Chemistry Class, for example Encyclopedias, Scientific dictionaries, Journals and other non-book materials like newspaper cuttings, films, slides, charts, models e.t.c

1. 

125
E). Teacher-made resources

Identify some Chemistry instructional materials present in your school that were made by the Chemistry teacher and used in the teaching and learning process of various topics in Chemistry, examples are pamphlets, models, charts e.t.c.

1) .................................................................
2) .................................................................
3) .................................................................

F). Student-made resources

Identify some Chemistry instructional materials present in your school that were made by the students and used in the teaching and learning process of various topics in Chemistry, examples are pamphlets, models, charts e.t.c.

1) .................................................................
2) .................................................................
3) .................................................................

G). Commercially-acquired resources

Identify some types of Chemistry instructional materials which are present in your school but they were not made by either students or chemistry teachers and indicate on the grid provided how frequent they are being used in the teaching and learning process of various topics in Chemistry. Tick (✓) to indicate those available and tick (✓) again to show the level of using them in teaching and learning Chemistry.
<table>
<thead>
<tr>
<th>Type of instructional material</th>
<th>Availability</th>
<th>Degree of utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Very frequently</td>
</tr>
<tr>
<td>Charts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory Apparatus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory Chemicals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Realia(real objects)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audio-visual Materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pictures</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### H). Storage and Maintenance

a. Does your school have storage facilities for Chemistry instructional materials?

i. Yes [ ]

ii. No [ ]

b. If your response in (a) is yes, indicate the available facilities of storage by ticking [✓] a response in box(es) provided against each type of instructional material.

<table>
<thead>
<tr>
<th>Type of instructional material</th>
<th>Place of storage.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Open shelves.</td>
</tr>
<tr>
<td>Charts</td>
<td></td>
</tr>
<tr>
<td>Models</td>
<td></td>
</tr>
<tr>
<td>Laboratory Apparatus</td>
<td></td>
</tr>
<tr>
<td>Laboratory Chemicals</td>
<td></td>
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<tr>
<td>Realia(real objects)</td>
<td></td>
</tr>
<tr>
<td>Slides</td>
<td></td>
</tr>
<tr>
<td>Audio-visual Materials</td>
<td></td>
</tr>
<tr>
<td>Pictures</td>
<td></td>
</tr>
</tbody>
</table>
c. If your response in (a) is "No", where do you keep the instructional materials used in teaching Chemistry?


d. Do you keep an inventory of the stored Chemistry instructional materials?

i. Yes

ii. No


e. How often do you check the condition of the stored Chemistry instructional materials and equipments to prevent, detect and repair damage?

i. Once a week

ii. Rarely

iii. Irregularly

iv. Doesn’t check


f. List some of the problems that your school faces in the storage of Chemistry instructional materials and equipments.

i. 

ii. 

iii. 


g. Suggest how the problems in (f) can be overcome.

i. 

ii. 

iii. 


THANK YOU.
Appendix D

Common Form 3 chemistry textbooks currently in circulation


APPENDIX E

A Letter approving the research Proposal

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

Internal Memo

FROM: Dean, Graduate School
DATE: 5th May, 2012

TO: Raphael Nangabo
C/o Educational Communication & Technology Dept.

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

This is to inform you that Graduate School Board, at its meeting of 30th April, 2012, approved your Research Proposal for the M.Ed Degree entitled "The Role of SMASSE Project in Sourcing and Usage of Instructional Materials for Teaching Chemistry in Bungoma East District, Kenya."

You may now proceed with your data collection.

Thank you.

JOHN M. ODONGI
FOR: DEAN, GRADUATE SCHOOL

Supervisors:
1. Dr. Nicholas N. Twoli
   C/o Department of Educational Communication & Technology
2. Dr. Ndichu Gitau
   C/o Department of Educational Communication & Technology

Committed to Creativity, Excellence & Self-Reliance
The Permanent Secretary,
Ministry of Higher Education, Science & Technology,
P.O. Box 30040,
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION MR. RAPHAEL NANGABO – REG. NO. E55/CE/12567/09

I write to introduce Mr. Nangabo who is a Postgraduate Student of this University. He is registered for M.Ed degree programme in the Department of Educational Communication & Technology.

Mr. Nangabo intends to conduct research for a proposal entitled, “The Role of SMASSE Project in Sourcing and Usage of Instructional Materials for Teaching Chemistry in Bungoma East District.”

Any assistance given will be highly appreciated.

Yours faithfully,

MRS. LUCY N. MBAABU
FOR: DEAN, GRADUATE SCHOOL

Committed to Creativity, Excellence & Self-Reliance
APPENDIX G

Authority to carry out research from the D.E.O

MINISTRY OF EDUCATION

District Education Office
Bungoma East District
P.O. Box 750-50205
WEBUYE

Telephone: Webuye 055-41140
Wireless: 0202389556
Email-bungomacasteducation@yahoo.com

When replying please quote

Ref: No.BGME/GA/89/88

Date: 17th May, 2012

The Headteachers
BUNGOMA EAST DISTRICT

RE: AUTHORITY TO CARRY OUT A RESEARCH
MR. RAPHAEL NANGABO - REG. NO. E55/CF/12567/09

The above named who is a student at Kenyatta University has been authorized to carry out research on The Role of SMASSE Project in Sourcing and Usage of Instructional Materials for Teaching Chemistry in Bungoma East District.

Since the findings of the research is important for the fulfillment of Master of Education degree in Education Technology, this office requests you to accord him the necessary co-operation.

Thank you.

FOR: DISTRICT EDUCATION OFFICER
BUNGOMA EAST DISTRICT

LUGALYA AGGREY

FOR: DISTRICT EDUCATION OFFICER
BUNGOMA EAST DISTRICT

c.c

The Chairperson
Department of Educational Communication & Technology
P.O. Box 43844, 00100
NAIROBI.
APPENDIX H

Authority to carry out a research from the Government

REPUBLIC OF KENYA

NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Our Ref: NCST/RCD/14/012/1073

Raphael Nangabo
Kenyatta University
P.O.Box 43844-00100
Nairobi.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on "The role of SMASSE project in sourcing and usage of instructional materials for teaching chemistry in Bungoma East District, Kenya," I am pleased to inform you that you have been authorized to undertake research in Bungoma East District for a period ending 31st December, 2012.

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

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

DR. M. K. RUGUTT, PhD, HSc.
DEPUTY COUNCIL SECRETARY

Copy to:

The District Commissioner
The District Education Officer
Bungoma East District.

"The National Council for Science and Technology is Committed to the Promotion of Science and Technology for National Development."
APPENDIX I

A Research Permit

Research Permit No. NCST/RCD/14/012/1073

Date of issue 27th July, 2012

Fee received KSH. 1,000

THIS IS TO CERTIFY THAT:

Prof./Dr./Mr./Mrs./Miss/Institution

Raphael Nangabo

of (Address) Kenyatta University

P.O.Box 43844-00100, Nairobi.

has been permitted to conduct research in

Location

Bungoma East

District

Western

Province

on the topic: The role of SMASSE project in sourcing and usage of instructional materials for teaching chemistry in Bungoma East District, Kenya.


applicant’s
signature

secretary

National Council for Science & Technology