PROSPECTIVE TEACHERS’ PREPAREDNESS TO FACILITATE CHEMISTRY INSTRUCTION AT SECONDARY SCHOOL LEVEL IN NAIROBI TEACHING PRACTICE ZONE - KENYA

By

MIHESO JOSEPHAT MACHINA

E55/CE/11523/08

A thesis submitted to the school of education in partial fulfilment of the requirements for the Master of education degree of Kenyatta University

SEPTEMBER, 2012
DECLARATION

This thesis is my original work and has not been presented for any degree in any other university.

Signature............................................. date..........................................................

Miheso Josephat Machina

Department of Educational Communication and Technology

We confirm that the work reported in this thesis was carried out by the candidate under our supervision.

Signature.............................................Date..........................................................

DR. G. WAWERU
Department of Educational Communication and Technology-School of Education,
Kenyatta University

Signature.............................................Date..........................................................

DR. NICHOLAS TWOLI
Department of Educational Communication and Technology-School of Education,
Kenyatta University
DEDICATION

This work is dedicated to my dear wife Flora and our children for their support and encouragement. My late Parents Miheso A. A. A. and Mama Agnes Nafula, who laboured hard to give us their limitless eternal purports, the fuel for excellence, directing our straying thoughts and putting our virtues in to action in pursuance for academic fineness.
ACKNOWLEDGEMENTS

The successful development and completion of this work would not have been possible without the tutelage and support that I received from my supervisors Dr. Nicholas Twoli and Dr. Gichohi Waweru for being unfailingly available for me throughout the entire course of my study. Their wealth of knowledge, ability and willingness to guide and encourage enabled me to pursue and complete this course in time.

I wish to thank Kenyatta University and the Department of Educational Communication and Technology for the opportunity to pursue this course. I am greatly indebted to all my lecturers at the Department of Educational Communication and Technology for providing me with the guidance and encouragement to broaden my academic, intellectual and professional horizons.

My special appreciation goes to Kenyatta University Teaching Practice Sub-Zone Coordinators in respective teaching practice zones, the Prospective teachers and their learners in respective teaching practice schools for their cooperation during the data collection exercise. I sincerely wish to appreciate and thank the Head/Teachers of respective TP schools for allowing me into their work stations at short notice. To my sisters Prisca and Marguerite who continuously encouraged me whenever I felt pissed off throughout my course of the study, I say thank you.

To God be all the glory and honour
## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>DECLARATION</td>
<td>ii</td>
</tr>
<tr>
<td>DEDICATION</td>
<td>iii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>v</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>vii</td>
</tr>
<tr>
<td>DEFINITIONS OF KEY CONCEPTS AND TERMS</td>
<td>viii</td>
</tr>
<tr>
<td>ABBREVIATIONS AND ACRONYMS</td>
<td>ix</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>x</td>
</tr>
<tr>
<td>CHAPTER ONE  INTRODUCTION AND STATEMENT OF THE PROBLEM</td>
<td>xi</td>
</tr>
<tr>
<td>1.1  BACKGROUND OF THE STUDY</td>
<td>1</td>
</tr>
<tr>
<td>1.2  STATEMENT OF THE PROBLEM</td>
<td>9</td>
</tr>
<tr>
<td>1.3  THE PURPOSE OF THE STUDY</td>
<td>11</td>
</tr>
<tr>
<td>1.4  OBJECTIVES OF THE STUDY</td>
<td>11</td>
</tr>
<tr>
<td>1.5  RESEARCH QUESTIONS</td>
<td>11</td>
</tr>
<tr>
<td>1.6  SIGNIFICANCE OF THE STUDY</td>
<td>12</td>
</tr>
<tr>
<td>1.7  SCOPE AND LIMITATIONS</td>
<td>13</td>
</tr>
<tr>
<td>1.8  ASSUMPTIONS</td>
<td>13</td>
</tr>
<tr>
<td>1.9  CONCEPTUAL FRAMEWORK</td>
<td>13</td>
</tr>
<tr>
<td>1.10 VARIABLES</td>
<td>14</td>
</tr>
<tr>
<td>1.11  CHAPTER SUMMARY</td>
<td>14</td>
</tr>
<tr>
<td>CHAPTER TWO REVIEW OF RELATED LITERATURE</td>
<td>16</td>
</tr>
<tr>
<td>2.1  INTRODUCTION</td>
<td>16</td>
</tr>
<tr>
<td>2.2  PLANNING TO TEACH IN SECONDARY SCHOOL SCIENCE CLASSROOMS</td>
<td>16</td>
</tr>
<tr>
<td>2.3  INSTRUCTION AND TEACHER PREPARATION</td>
<td>17</td>
</tr>
<tr>
<td>2.4  PEDAGOGICAL CONTENT KNOWLEDGE AND PROSPECTIVE TEACHER EDUCATION</td>
<td>19</td>
</tr>
<tr>
<td>2.5  INSTRUCTIONAL METHODS AND PROSPECTIVE TEACHER’S PREPARATION</td>
<td>22</td>
</tr>
<tr>
<td>2.6  CONSTRUCTIVIST VIEW AND TEACHER PREPAREDNESS</td>
<td>24</td>
</tr>
<tr>
<td>2.7  EXPERIENTIAL LEARNING AND CHEMISTRY INSTRUCTION</td>
<td>28</td>
</tr>
<tr>
<td>2.8.0  LABORATORY WORK AND SCIENCE EDUCATION</td>
<td>29</td>
</tr>
<tr>
<td>2.8.1  DEDUCTIVE OR VERIFICATION LABORATORY</td>
<td>31</td>
</tr>
<tr>
<td>2.8.2  INDUCTIVE LABORATORY</td>
<td>32</td>
</tr>
<tr>
<td>2.8.3  TECHNICAL SKILLS LABORATORY</td>
<td>32</td>
</tr>
<tr>
<td>2.8.4  SCIENCE PROCESS SKILLS</td>
<td>33</td>
</tr>
</tbody>
</table>
2.8.5 SMALL-GROUP PROBLEM-SOLVING LABORATORY WORK ........................................... 34
2.8.6 LABORATORY SAFETY ................................................................................................. 35
2.9 LEARNING RESOURCES AND CHEMISTRY LEARNING ........................................ 35
2.10 ASSESSMENT AND CHEMISTRY LEARNING .............................................................. 37
2.11 RELATED STUDIES DONE IN KENYA ......................................................................... 41
2.12 CHAPTERSUMMARY ................................................................................................ 39

CHAPTER THREE METHODOLOGY .................................................................................. 44
3.1 INTRODUCTION ............................................................................................................. 44
3.2 STUDY DESIGN ............................................................................................................ 44
3.3 LOCATION OF STUDY .................................................................................................. 45
3.4 TARGET POPULATION ................................................................................................ 45
3.5 SAMPLING PROCEDURE ............................................................................................. 45
3.6.0 INSTRUMENTS FOR DATA COLLECTION ............................................................... 47
3.6.1 TEACHERS QUESTIONNAIRE GUIDE ................................................................... 47
3.6.2 LESSON OBSERVATION SCHEDULE .................................................................. 48
3.6.3 CHEMISTRY LEARNERS ATTITUDE QUESTIONNAIRE ......................................... 48
3.7 PILOT STUDY ................................................................................................................ 49
3.9 DATA ANALYSIS PROCEDURE .................................................................................. 51

CHAPTER FOUR ANALYSIS, PRESENTATION AND DISCUSSION ........................................ 54
4.1.0 CHARACTERISTICS OF THE RESPONDENTS ......................................................... 55
4.1.1 FIRST CHOICE OF UNIVERSITY COURSES BY PROSPECTIVE TEACHERS .......... 55
4.2.0 INTENTION OF PROSPECTIVE TEACHERS TO STAY IN THE TEACHING PROFESSION .......... 56
4.3.0 RELEVANCE OF CHEMISTRY CONTENT TAUGHT AT UNIVERSITY TO SECONDARY SCHOOL CURRICULUM ........................................................................................................ 59
4.3.1 TOPICS NOT WELL ADDRESSED AT UNIVERSITY .................................................. 61
4.3.2 TOPICS FOUND CHALLENGING TO TEACH IN SECONDARY SCHOOLS ............... 63
4.4.1 PROFICIENCIES FOR CLASSROOM ACTIVITIES ............................................... 67
4.5 FREQUENCY OF USE OF A VARIETY OF INSTRUCTIONAL METHODS IN CHEMISTRY .......... 71
4.5.1 PROFICIENCY FOR PROSPECTIVE TEACHERS PRACTICAL ACTIVITIES ............... 76
4.5.2 ASSESSMENT METHODS ......................................................................................... 80
4.6.0 LEARNERS ATTITUDES TOWARDS CHEMISTRY INSTRUCTION ......................... 83
4.7.0 CHAPTER SUMMARY ............................................................................................... 77

CHAPTER FIVE CONCLUSIONS AND RECOMMENDATIONS .............................................. 85
5.1 INTRODUCTION ........................................................................................................... 85
5.2 RELEVANCE OF CHEMISTRY COURSE CONTENT TO THE SECONDARY SCHOOL SYLLABUS .... 85
5.3.0 PLANNING AND PREPARATIONS FOR CLASSROOM MANAGEMENT AND TEACHING ...... 86
5.3.1 SCHEMES OF WORK AND LESSON PLANS; ................................................................. 86
5.3.2 INSTRUCTIONAL PROCEDURES AND STRATEGIES ..................................................... 87
5.4 PROFICIENCY FOR PRACTICAL ACTIVITIES .................................................................. 87
5.5 LEARNER’S ATTITUDE TOWARDS CHEMISTRY INSTRUCTION ...................................... 88
5.6 IMPLICATIONS OF THE STUDY ................................................................................... 88
5.7.0 RECOMMENDATIONS ............................................................................................. 89
5.7.1 PREPARATION FOR INSTRUCTION ....................................................................... 90
5.7.2 PROFICIENCY IN HANDLING PRACTICAL ACTIVITIES ........................................... 91
5.7.3 RECOMMENDATIONS FOR FURTHER RESEARCH .................................................. 92
REFERENCES .................................................................................................................. 94

APPENDIX: I TEACHERS’ QUESTIONNAIRE GUIDE ........................................................... 102
APPENDIX: II CHEMISTRY LEARNERS’ ATTITUDE QUESTIONNAIRE ................................. 107
APPENDIX: III CHEMISTRY TEACHER’S OBSERVATION SCHEDULE ................................ 109
APPENDIX: IV SAMPLE LESSON PLANS .......................................................................... 114
APPENDIX V: RESEARCH PERMIT ................................................................................... 117
**LIST OF TABLES**

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1.1 Performance in KCSE Chemistry Examinations; Years 2006 -2009</td>
<td>3</td>
</tr>
<tr>
<td>Table 1.2 Sample size grid of schools by type and category</td>
<td>47</td>
</tr>
<tr>
<td>Table 4.1 Gender-Intend to stay in teaching cross tabulation</td>
<td>57</td>
</tr>
<tr>
<td>Table 4.2 Chi-Square Test</td>
<td>58</td>
</tr>
<tr>
<td>Table 4.3 Weighted Mean scores on factors that hinder instruction</td>
<td>67</td>
</tr>
<tr>
<td>Table 4.4 Proficiencies for lesson design and implementation</td>
<td>68</td>
</tr>
<tr>
<td>Table 4.5 Benchmarks for interpretation</td>
<td>69</td>
</tr>
<tr>
<td>Table 4.6 Proficiencies for procedural knowledge</td>
<td>74</td>
</tr>
<tr>
<td>Table 4.7 Proficiencies for content knowledge</td>
<td>75</td>
</tr>
<tr>
<td>Table 4.8 Prevalence of Prospective teachers’ practical acts</td>
<td>77</td>
</tr>
<tr>
<td>Table 4.9 Proficiencies for Learner/Teacher relationship</td>
<td>79</td>
</tr>
<tr>
<td>Table 4.10 Proficiencies for communication interaction</td>
<td>82</td>
</tr>
<tr>
<td>Table 4.11 Learner frequency cross tabulation on Chemistry liking</td>
<td>83</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1.1 Conceptual framework</td>
<td>14</td>
</tr>
<tr>
<td>Figure 1.2 Pedagogical Content Knowledge Model</td>
<td>20</td>
</tr>
<tr>
<td>Figure 4.1 First choice of university courses by prospective teachers</td>
<td>55</td>
</tr>
<tr>
<td>Figure 4.2 Second teaching subjects</td>
<td>56</td>
</tr>
<tr>
<td>Figure 4.3 Content relevance and TP period sufficiency</td>
<td>59</td>
</tr>
<tr>
<td>Figure 4.4 Topics not well addressed at the university</td>
<td>62</td>
</tr>
<tr>
<td>Figure 4.5 Topics TP teachers found challenging to teach</td>
<td>63</td>
</tr>
<tr>
<td>Figure 4.6 Topics/Concepts Learners found difficult to comprehend</td>
<td>64</td>
</tr>
<tr>
<td>Figure 4.7 Reasons for difficulty of Topics and Concepts</td>
<td>66</td>
</tr>
<tr>
<td>Figure 4.8 Frequency of various teaching methods</td>
<td>72</td>
</tr>
<tr>
<td>Figure 4.9 Frequency of different modes of assessment</td>
<td>81</td>
</tr>
</tbody>
</table>
Definition of key concepts and terms

**Assessment**: The process of obtaining information that is used for making decisions about students, curricular and educational policy.

**Facilitation**: The process of transforming subject content knowledge for teaching using correct pedagogical strategies.

**Instruction**: This is a planned sequence of activities or practices by which a learner interacts with relevant resources, including the teacher in order to acquire a pre-determined behavioural outcome.

**Nairobi Teaching Practice Zone**: An arbitrary teaching practice zone demarcated by Kenyatta University authorities that covers schools in Nairobi County and parts of Kiambu and Kajiado counties for purposes of teaching practice exercise only.

**Pedagogy**: The correct use of instructional strategies

**Prospective Teachers**: Students in teacher training colleges or universities preparing to become professional teachers

**Preparedness**: Readiness of student teachers to align with the intended, planned and enacted curriculum in content knowledge, pedagogy and curriculum knowledge.

**Proficiency**: Quality of having great facility and competence in any art or science

**Quality instruction**: Teacher/Learner classroom interaction that results in better, more thoughtful teaching and greater learner engagement and achievement.
# List of abbreviations and acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLAQ</td>
<td>Chemistry Learners Attitude Questionnaire</td>
</tr>
<tr>
<td>CBC</td>
<td>Competency Based Curriculum</td>
</tr>
<tr>
<td>JICA</td>
<td>Japanese International Cooperation Agency</td>
</tr>
<tr>
<td>KCE</td>
<td>Kenya Certificate of Education</td>
</tr>
<tr>
<td>KCSE</td>
<td>Kenya Certificate of Secondary Education</td>
</tr>
<tr>
<td>KNEC</td>
<td>Kenya National Examinations Council</td>
</tr>
<tr>
<td>LOS</td>
<td>Lesson Observation Schedule</td>
</tr>
<tr>
<td>PCK</td>
<td>Pedagogical content knowledge</td>
</tr>
<tr>
<td>SMASSE</td>
<td>Strengthening of Mathematics and Science at Secondary Education</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for Social Sciences</td>
</tr>
<tr>
<td>STI</td>
<td>Science Technology and Innovation</td>
</tr>
<tr>
<td>TP</td>
<td>Teaching Practice</td>
</tr>
<tr>
<td>TQG</td>
<td>Teachers Questionnaire Guide</td>
</tr>
<tr>
<td>ICT</td>
<td>Information Communication and Technology</td>
</tr>
<tr>
<td>IEA</td>
<td>International Evaluation Association</td>
</tr>
<tr>
<td>UNESCO</td>
<td>United Nations Scientific and Cultural Organisation</td>
</tr>
</tbody>
</table>
ABSTRACT

Teacher preparation institutions in Kenya are currently facing challenges in science education that are emanating from low levels of student performance at secondary school level. The poor student achievement in Chemistry is perceived to be partially resulting from poor classroom instruction among practicing teachers that may be as a result of teacher preparation programmes offered at the teacher training colleges and Universities. The purpose of this study was to establish the preparedness of Kenyatta University prospective teachers to facilitate Chemistry instruction at secondary school level. The study used Kenyatta University prospective teachers on teaching practice and their Form Two learners in the Nairobi Teaching Practice Zone as the study sample. The target population were all the Kenyatta University Chemistry prospective teachers. And the secondary school Chemistry learners. The study adapted a descriptive cross sectional survey research design. A sample of forty six Chemistry prospective teachers and two hundred and fifty nine form two learners were selected using purposive, stratified and random sampling techniques. Data was collected using a mixed methods approach, where both qualitative and quantitative approaches were used. The research instruments used included a teacher’s and learners’ questionnaires and a lesson observation protocol. Descriptive statistics were used to present the data in form of frequency tables and charts. A Chi-square test was used to present the level of relationship between the male and female’s prospective teachers’ intention to stay on in the teaching profession. The Statistical Package for Social Sciences SPSS version 14 software computer package was used to analyse the collected data. The main findings showed that; most of the TP teachers (67.4%) felt that the Chemistry course content taught at the university does not reflect the expectations of the secondary school Chemistry syllabus and that some of the topics/concepts required at secondary school level were not well addressed at the University. The findings further indicated that most of prospective teachers (64.5, %) felt that the three months TP period was not sufficient for the course and were of the opinion that two terms or a six months duration would be sufficient. As regards their career choices, 30.5% of the respondents chose medicine as their first choice course of study at the university, with education coming in second with 21.7%. This could be an indication that education is becoming a career of choice for many students joining higher education. Although, most of the trainee teachers had the required basic skills to handle secondary school Chemistry instruction, they did not expose learners to a variety of suitable methods of instruction and appeared to lack confidence to engage learners in thought provoking student experimental laboratory work. Majority of the prospective teachers had well organised Schemes of work and lesson plans with relevant information but these teaching tools were not followed during classroom instruction. Use of e-learning, field work and projects as methods of instruction were missing altogether. The most common methods of instruction applied were question and answer and teacher demonstration. The highest modes of classroom assessment methods applied were observation and oral questioning with assignments being the rarest. Learners have a very high positive attitude towards Chemistry instruction.eighty two point one percent (84.1%) of the learners indicating they liked the subject. It is hoped that the findings and recommendations from this study will be used to inform education stakeholders and policy makers in reforming teacher training programs in line with the dictates of Kenya’s vision 2030. The findings will also help enhance learner’s achievement and classroom performance outcomes as well as improve on teacher proficiency for quality Chemistry instruction at the Kenya Certificate of Secondary Education (KCSE) level of education.
CHAPTER ONE
INTRODUCTION AND STATEMENT OF THE PROBLEM

1.1 Background of the study
This chapter discusses the background of the study, statement of the problem, conceptual framework, purpose of the study, objectives of the study, research questions, significance of the study, assumptions, scope and limitations and definition of terms as used in the study. Chemistry is one of the core science subjects taught at the secondary school education level in Kenya and other countries in the world. When concern is expressed about attainment, Chemistry is often singled out as being a particularly worrying problem among the basic science subjects, the others being Physics and Biology. The importance of Chemistry is further emphasized when future career choices of the learners are being considered. This is because, about seventy four percent of all the courses offered at both public and private universities in Kenya require Chemistry as a core subject combination.

Science can be defined as the systematic study of the natural phenomena and it helps us understand and relate better to the universe at large (Keree, 2009). Chemistry on the other hand can be defined as the scientific study of the structure, composition, properties and reactions of matter and the transformations they undergo. This makes Chemistry a subset of science. Science and technology are closely related in that science deals with the exploration, description, explanation and prediction of occurrences, while technology is the practical manifestation or direct application of scientific knowledge, which enlarges man’s physical and intellectual powers (Akinnawonu, 2008).

The government of Kenya is committed to implementing strategies that will ensure the provision of quality and relevant education and training for all its citizens. The
current long-term development policy of the government is to transform the country into a newly industrialized middle income economy by the year 2030, (Kenya Vision 2030.). This vision must be supported by clearly thought out priorities and strategies.

One of the government’s strategies is to provide its citizens with a globally competitive quality education, training and research for development and enhanced individual well being (UNESCO, 2004; KESSP, 2005). A second strategy is to have international ranking for her children in achievement in Mathematics and Science, while the third strategy is to increase the proportion of Kenyan students studying science related courses in public universities to fifty percent of the total student enrolment (Kenya Vision, 2030; KESSP, 2005). Recent calls for improvement in education are based on the premise that international competition in the global marketplace requires a future workforce that is educationally well equipped (IEA, 1998). With the ever increasing impact of technology on the daily lives of individuals throughout the world, skills in Mathematics and Science are becoming more and more critical from an international perspective. There is need therefore for Kenya to rank her children’s performance internationally as the country is part of the global market.

The government of Kenya recognises the importance of science and technology in the realisation of vision 2030. Chemistry can therefore be seen as contributing to the intellectual development of individual students and preparing them to be informed and functioning citizens in the emerging contemporary society as well as providing them with competencies needed to take their places in the fields of science, technology, industry, commerce, among others. In view of the importance of Chemistry in the contemporary society, the efficacy of Chemistry teaching and learning deserves continued and sustained research. The student performance in
Science in general and Chemistry in particular, is however worrying and the country may not be able to achieve her envisaged vision if this trend is not urgently addressed.


**Table 1.1 Candidates Performance in Chemistry for the years 2006 - 2009.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Paper</th>
<th>Candidate</th>
<th>Maximum score</th>
<th>Mean score</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>1 Theory</td>
<td>80</td>
<td>20.79</td>
<td>14.95</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Theory</td>
<td>80</td>
<td>17.56</td>
<td>13.82</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Practical</td>
<td>40</td>
<td>11.48</td>
<td>5.10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>200</td>
<td>49.82</td>
<td>14.95</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>1 Theory</td>
<td>80</td>
<td>19.67</td>
<td>15.26</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Theory</td>
<td>80</td>
<td>19.22</td>
<td>13.45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Practical</td>
<td>40</td>
<td>11.87</td>
<td>4.95</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>200</td>
<td>50.78</td>
<td>31.00</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>1 Theory</td>
<td>80</td>
<td>18.28</td>
<td>14.78</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Theory</td>
<td>80</td>
<td>15.74</td>
<td>13.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Practical</td>
<td>40</td>
<td>11.46</td>
<td>5.42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>overall</td>
<td>200</td>
<td>45.48</td>
<td>31.78</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>1 Theory</td>
<td>80</td>
<td>12.23</td>
<td>9.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Theory</td>
<td>80</td>
<td>14.49</td>
<td>12.04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Practical</td>
<td>40</td>
<td>10.86</td>
<td>4.55</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>200</td>
<td>38.23</td>
<td>24.56</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Kenya National Examinations Council Examinations 2009 Examination Report.

From Table 1.1, it can be observed that the overall candidature for the subject has continued to grow over years. This may be because the subject is a major option among the science subjects offered at secondary school level. Most science courses at
the universities and other middle level colleges require Chemistry as a core science subject combination.

The overall mean score for the subject however continues to drop, for example in the years 2007 to 2009, there was a drop from 50.78 to 38.23 in the subjects mean score. The high standard deviations over the years depict large deviations from the mean denoting greater variability of scores in their performance thus indicating that the learners are not consistent in their performance. The KNEC reports for KCSE Chemistry performance, identifies the teacher as one of the causes for the poor performance among other factors. This trend requires urgent interventions by all education stakeholders if the country hopes to attain her objective of becoming a newly industrialized middle income economy by the year 2030. To address these challenges, the government of Kenya has put in place various programs, especially for practicing teachers. One of the programs is the Strengthening of Mathematics and Science at Secondary Education (SMASSE) project. With the support of the government of Japan through the Japanese International Cooperation Agency (JICA), this program is designed to enhance the quality of teaching and learning of Mathematics and Science in secondary schools through In-Service Education and Training (INSET) for Mathematics and Science teachers.

The SMASSE project targets attitudinal factors, teaching methodology and improvisation of low cost teaching and learning materials. These interventions do not seem to have any positive impact, based on the current student performance as shown in table 1.1 above. Prospective teacher training programs offered to prospective teachers, ought to be considered, when addressing quality instruction because this is where subject content knowledge and the teacher’s level of intellectual development is solely addressed.
Teacher education refers to the practices and procedures designed to equip prospective teachers with the knowledge, attitudes, behaviour and skills to perform their tasks effectively in the classroom, school and the wider community. Teacher education is often divided into three stages, the initial teacher training or education, a pre-service course before prospective teachers enter the classroom as fully qualified teachers, the induction stage, which is the process of providing training, guidance and support, to new teachers during the first few months or year in a particular school and teacher development or continuing professional development, an in-service process for practicing teachers. Initial teacher education for high school teachers, takes place exclusively in tertiary institutions which include the universities and diploma teacher training colleges.

Training Bachelor of Education students into qualified teachers requires a university based teacher preparation program, that is well grounded in the subject knowledge, skills and research, committed to prospective teachers being able to understand the subject matter they wish to teach, understand and effectively use good teaching practices and have sustained opportunities to teach children in classroom settings, supported with appropriate resources.

The most direct and effective way of raising instructional quality is to improve teachers’ knowledge and pedagogical skills (Liu & Liggi, 2009). According to Greyling (2009), teachers form the most important element in the delivery of quality education as agents of curriculum implementation. Teacher training therefore requires critical consideration. According to Sessional Paper No.1/2005 of Kenya, the aim of teacher education programs focus at developing communication skills, professional attitudes and values that equip a teacher with knowledge and ability to develop the educational needs of the child.
the study of Chemistry at secondary school is presented as a practical subject where scientific concepts, principles and skills are developed through experimental investigations. (Kenya Institute of Education Syllabus, 2002). In brief, the syllabus objectives require that learners be able to;

- Select and use appropriate apparatus to make accurate measurements, observations and draw logical conclusions during experimental investigations, while observing safety precautions.
- Understand and use appropriate scientific language in describing physical and chemical processes,
- Apply the knowledge and skills acquired in technological and industrial development,
- Acquire adequate knowledge and skills in Chemistry for further education and training and be able to apply the acquired knowledge and skills in solving problems in everyday life.

The Chemistry syllabus therefore heavily emphasises the concept, process and applications domains of science instruction. The attitude domain is inherent in Chemistry instruction as learner’s working in groups or as a class form a social entity. To achieve the objectives of the Chemistry syllabus at school level and improve learner’s performance therefore requires prudent and quality teacher preparedness.

Quality education is best reflected in learning achievements of learners. A useful analytical approach often used to look at educational quality is to apply a systems approach of input, process and output, interacting to produce quality outcomes intended from the education programme (Ayot & Patel, 1987). In an educational system, the major inputs are the learners, teachers, learning materials/facilities and an enabling environment. These inputs put together in the right manner and combinations using appropriate instructional strategies make teaching and learning effective. The outcome of this interaction is learning achievement in form of acquisition of knowledge, skills, behaviour and attitudes intended for the learners.
According to the secondary education strategy (2007), the major determinants of quality education include:

- Curriculum content
- Relevant instructional materials
- Conducive learning environment
- The quality of the teaching force
- Assessment and monitoring of learning achievements and
- Addressing internal inefficiencies of education at all levels.

Quality education should therefore shift from mere passing of examinations to encompassing the discovery of talents, development of analytical, cognitive and creative potentials as well as enhancing positive self image, spiritual and ethical values of the learners. Effective steps should therefore be taken to implement measures for the achievement of the identified purposes, including those for teacher’s professional development and improvement of curriculum and learning materials.

The National Board for Professional Teaching Standards (NBPTS, 2002) provides five core propositions that reflect accomplished teachers who can effectively enhance student learning as those teachers who;

- Are committed to their learners and their learning. They understand how learners learn and adjust their practice based on the learners’ abilities, skills, knowledge, interest, among others, and foster self esteem, motivation and respect for others.

- Know the subjects they teach and how to teach these subjects to their learners. They command knowledge of the subject matter and are aware of how to pass that knowledge to their learners. They are conscious of the learner’s background knowledge and understand and utilize the varied recourses to assist in instruction.

- Are responsible for managing and monitoring student’s learning. They are able to engage their learners and capture their interest by utilizing all of the instructional techniques in their repertoire. They assess the learners and use the results to inform their instruction.
• Think systematically about their practice and learn from experience. They are reflective practitioners who engage in lifelong learning drawing on their past experiences subject matter knowledge and understanding of human development to make principled judgements about their practice.

• Are members of learning communities, and work collaboratively with others to best utilize resources available to their learners, engage parents in their children’s learning process and are able to contribute to areas like instructional policy and curriculum development.

Dispositions have been defined by the National Council for the Accreditation of Teacher Education NCATE, (2002), as the values, commitments and professional ethics that influence behaviours toward students, families, colleagues and communities and affect student learning, motivation and development as well as educators own professional growth. NCATE further defines effective teachers as those who posses content knowledge in their subject area, pedagogical skills and positive growth.

Quality teaching is not a widely agreed upon or a uniformly accepted notion. It is defined very differently or is grounded in different assumptions. These differences can be viewed in at least three different perspectives associated with teachers’ cognitive resources, their performance and their effect (Kennedy, 2008). Empirical support for the conception of quality teaching for each of these is often inconsistent or even contradictory. According to Delandshere & Petrosky (2004), Teacher education is a major factor in improving teaching quality. Central to the quality of teaching are teacher’s deep understanding of what they need to teach and the pedagogical practices that can be used to represent such understanding to students.

Teacher training institutions in Kenya are currently facing many challenges because of low levels of student performance at secondary school level as depicted in
Table 1.1. This is despite the high level of resource allocation devoted to maintaining and improving efficiency and effectiveness in the teaching and learning process. Seventy three per cent (73%) of the government’s social sector and forty percent (40%) of the national recurrent expenditure is channelled to the education sector (Kenya Education Sector Integrity Study Report, 2010). The low performance in science subjects may among other factors be attributed to poor classroom instruction among classroom teachers which may be as a result of inconsistent teacher preparation programs offered at the universities and other teacher training colleges. Teacher education institutions in Kenya have continuously expanded their intakes as a result of self-sponsored parallel degree programs, at the expense of quality education. Concerns have been raised by various education stakeholders, over the role of these institutions as regards the pedagogical skills being imparted on the prospective teachers, in their preparation to become proficient teachers.

1.2 Statement of the problem

The persistent poor performance of students in basic Science subjects in general and Chemistry in particular at KCSE has not been empirically documented. Classroom instruction largely depends on teacher preparation programs and how these programs integrate both general pedagogic knowledge and subject content knowledge for effective classroom practice.

There appears to be a mismatch between skills acquired by university graduates and the demands of the education sector, which is characterised by students poor performance in national examinations especially in core subject areas such as Mathematics, English and basic Sciences (Sessional Paper 1/2005) of Kenya. According to the World Bank, there is a profound mismatch between the radically
new key competencies demanded of students in the knowledge society and the teaching skills acquired from teacher training colleges and in-service training programmes (World Bank, 2005). The secondary school Chemistry curriculum thus appears to rarely relate to contemporary issues in science and technology. Learners seem to be struggling with chemical concepts, theories and principles hence the perception that Chemistry is a dull, abstract and boring subject that is detached from student active learning. Teachers should therefore endeavour to put the scientific concepts into social, historical and cultural context.

Curriculum relevance is a condition not only for improving the quality of secondary school graduates but also for retaining students in school. To respond to the challenges facing our education system, there is need for a re-assessment of the teacher preparation programmes in order to make them more relevant and improve teacher training by making our prospective teachers consistent in their performance as reflective practitioners. Teaching practice is a critical stage as it represents the first opportunity for teachers to practice their instructional techniques, hence the choice of the University Chemistry prospective teachers as the target population for the study. This study examined Kenyatta University Chemistry prospective teacher’s classroom practices and learner’s outcomes during their classroom instruction. This was to inform on the suitability of the current teacher education programs towards the achievement of the secondary school Chemistry syllabus objectives. The study was aimed at investigating the preparedness of the Chemistry prospective teachers to mount successful chemistry lessons, their subject matter content proficiency; assessment modes used during classroom instruction and learner experimental activities.
1.3 The purpose of the study
The purpose of this study was to improve Chemistry education through effective instruction based on established teacher proficiency in content, pedagogy and curriculum knowledge.

1.4 Objectives of the study
The study objectives were to;

1) Analyse the extent to which Kenyatta University Chemistry teacher training course outlines are relevant to the secondary school Chemistry curriculum expectations.

2) Determine the planning and preparation used by Kenyatta University prospective teachers to implement Chemistry instruction.

3) Determine the ability of Kenyatta University Prospective teachers to provide instruction opportunities for the achievement of the Chemistry subject instructional objectives

4) Determine the proficiency of Kenyatta university prospective teachers in handling Chemistry practical lessons in school laboratories.

1.5 Research questions

1) How relevant are the Chemistry syllabi or programs offered at the university to the Chemistry syllabus expectations at secondary school?

2) What preparations are carried out by prospective teachers in planning for effective classroom management and teaching to ensure effective facilitition of classroom Chemistry instruction?
3). What instructional procedures and strategies are provided for the achievement of the specific objectives in Chemistry classroom instruction?

4). How proficient are the prospective Chemistry teachers in handling practical activities during Chemistry laboratory lessons?

5). What are the learner’s attitudes towards Chemistry classroom instruction?

6). What methods of assessment are offered by TP teachers to enhance classroom instruction?

1.6 Significance of the study

The findings of this study will provide information that could be of major importance to the strengthening of the teacher education programmes in the area of Chemistry. Depending on the findings, the teacher training programs may be modified with a view of strengthening and consolidating the programs so that they may produce teachers who are not only competent in their subject content mastery, but also flexible and responsive to the ever changing needs of education in the contemporary society, through informed policy decisions. The findings may thus help put in place appropriate strategies for the enhancement of adequate prospective teacher preparation programs that conforms with the current trends in education in line with the new development blue print, Kenya Vision 2030. The findings of the study may also help in guiding prospective teachers in evaluating the quality of their classroom instruction and how to improve on the same so as to enhance their profession as proficient Chemistry teachers.
1.7 Scope and limitations

The study was carried out in the Nairobi Teaching Practice (T.P) zone, and focused on Kenyatta University Chemistry prospective teachers on Teaching Practice. The survey covered selected public and private schools in Nairobi’s TP zone, where the prospective teachers were posted for their teaching practice.

1.8 Assumptions

This study was based on the assumptions that all sampled schools do not offer Chemistry as a general subject. All Kenyatta University campuses offer uniform Chemistry curricular to all their education students taking Chemistry option.

1.9 Conceptual Framework

What Chemistry students learn depends to a great extent on what their teachers teach them. Teachers are in turn guided in their choice of content and approach to the teaching of the subject by the course outlines or syllabuses, approved textbooks and other teaching and learning resources. These documents are externally determined by curriculum developers and textbook authors responding to the national objectives of education as set out by the education policy makers. The conceptual framework in this study adapted an examination of the Chemistry curricula at three levels; the intended curriculum as transmitted by national or system level authorities in education, the implemented curriculum as interpreted and translated by teachers according to their experiences and syllabus guidelines for particular classes, and the attained curriculum, the curriculum learned by students as manifested in their achievements and attitudes. The curriculum at each of these levels is influenced by the context in which it occurs and the contexts are determined by a number of external and internal learning conditions and factors such as the curriculum model, teaching strategies, learner’s
entry behaviour, and school community. Student achievement is affected by several characteristics, which according to Jimenez, & Pinzon (1999), include: characteristics of the school, the teacher and the learners. Fig 1.1 summarises the conceptual framework for this study.

**Fig.1.1 Conceptual Framework for the study;**

![Conceptual Framework Diagram]

1.10 Variables

The teaching approaches, curricular course outlines, classroom management and learner’s attitude were the independent variables, while student’s active learning achievements was taken as the dependent variables.
Curriculum course programs offered to prospective teachers, the effective interaction between the learners, the prospective teacher and available resources, will affect the planned classroom processes. Learner’s behaviour and attitude towards Chemistry learning is dependent on teacher characteristics and student background, which determines the attained curriculum and overall learner achievement.

1.11 Summary

This chapter was organised in nine sections. The background to the study, purpose, objectives of the study, research questions, significance of the study, scope and limitations, assumptions and the conceptual framework.

It has been established in this chapter that, there is need for a study to be conducted on preparedness of university prospective teachers in facilitating Chemistry instruction at secondary school level. Using the conceptual framework based on the tripartite model of curriculum development and applying a systems approach of input, process and output, information on how teacher training programs and how these programs integrate both general pedagogical knowledge and subject content knowledge for effective facilitation of classroom practice by prospective teachers will be established.

It is clear from the information in this chapter how performance in science subjects generally and Chemistry in particular can contribute to students intellectual development as well as preparing them for the contemporary knowledge based economy and the realisation of vision 2030. The purpose and significance of this study as indicated in this chapter makes the efficacy of continued and sustained research in Chemistry relevant and necessary.
CHAPTER TWO
REVIEW OF RELATED LITERATURE

2.1 Introduction

The fields of science, technology and innovation which are essential for the realisation of vision 2030, Kenya’s long term development policy of transforming the country into a globally competitive and prosperous nation with high quality of life for her citizens by the year 2030, require a strong foundation in Mathematics and Basic science subjects that include Chemistry, Biology and Physics at secondary school level. Studies to identify factors that influence the learning of Chemistry at secondary school have been carried out by several researchers. Most of the literature review in this study has been cited from foreign studies. This was due to the limited number of related local studies. This chapter deals with available literature on teaching and learning of Chemistry. The literature review is organised in the following sections; Planning to teach in secondary science classrooms, Instruction and teacher preparation, Pedagogical content knowledge and prospective teacher training, Instructional methods and teacher preparation, Constructivist view and teacher preparation, Experiential learning and Chemistry instruction, Laboratory work and science education, Resources and Chemistry instruction, Assessment and Chemistry learning, Related studies done in Kenya.

2.2 Planning to Teach in Secondary School Science Classrooms.

Planning involves the organization of all the human, material and other resources for learning processes. It concerns knowing every detail of what is to be done, using what, by who and when. In classroom settings, planning ensures achievement of set objectives within the available time. Planning gives teachers an opportunity to assess and determine which approach, method and skills are suitable for the type of content
to be taught or objectives a teacher hopes to achieve. This is because some objectives are best achieved through experimental work, while others require expository approaches (Twoli, 2006). Planning helps subject teachers to budget for the preparation and revision of schemes of work and lesson plans, which include; writing instructional objectives, selection of suitable content and resources to achieve set objectives, preparation of reagents and pre-testing experiments, modes of assessments and harmonisation of individual plans with the school timetable. Classroom management is important as it helps in maintaining discipline, grouping as well as monitoring learner activities. This allows for individual learners participation in small groups or pairs, while taking into account individual differences among students’ ability. Students should be kept in orderly and productive experiences following the school set out rules and policies regarding safety and behaviour during classroom and laboratory instruction. There should be a clear link between the activities and the concept being taught. This study therefore attempted to investigate the planning and preparations carried out by university prospective teachers before classroom/laboratory instruction commences.

2.3 Instruction and Teacher Preparation

The curriculum presented by the classroom teacher constitutes the implemented curriculum. It is determined by syllabuses, textbooks, methods of presentation, facilities and is to some extent, a product of the individual teacher’s beliefs about Chemistry and the teaching of Chemistry.

Quality teaching focuses attention on and provides consistent messages about pedagogy in public schools. Three dimensions of pedagogy that have been linked to improved student outcomes include pedagogy that is fundamentally based on
promoting; high intellectual levels, a quality learning environment, and one that develops and makes explicit to learners the significance of their work.

One of the major changes in science education over the years has been the shift from teaching of content or subject matter to the process of learning science. According to Kolso (2001), as cited in Molly (2005), the shift is from science as ready-made, to science in the making. In the past, science education programs tended to emphasize content such as principles, facts, laws and theories, which may still be the case in most teacher training colleges. Science education programs should instead stress the ideas and processes of science such as conceptual schemes, problem solving, analytical reasoning, logical thinking and creativity. There is need for a paradigm shift from content based curriculum to competence based curriculum science teaching and learning, where learners use prior knowledge and experience to acquire new knowledge and skills by cooperating with others.

Current research in science instruction puts emphasis on how students learn and tends to probe children’s ideas about natural phenomena. It is aimed at understanding ways in which students seek to explain the world and to consider the implications of this for science learning and teaching. Such researches have produced new ideas about learning, that include the importance of hands-on activities, utilization of new resources such as e-learning and multimedia presentations thus making students critical thinkers, giving them a sense of contact with real science and ensuring that they have opportunities to express their own ideas. Based on these new research findings, the constructivist approach to teaching science has come in for considerable attention. Students bring to a learning experience their own understanding, attitudes and skills through meaningful interactions between themselves, the environment,
other students and their teachers. Students then redefine, replace and reorganize their initial explanations, attitudes, and skills.

New ideas on learning and teaching science lead to a changing role for the science teacher. Teachers change from authorities in the knowledge of their subjects to skilful managers of a much less learner directed style of learning. The science teacher is charged with engaging learners in tasks which throw the onus to acquire knowledge back onto the learners, by involving them in more active learning.

Teachers need to extend their work far beyond the confines of the classroom and the school, which means that teachers have to play a collaborative role in working with other teachers both within and outside the school. This study was aimed at determining the common teaching methods applied by trainee teachers in their classroom instruction.

2.4 Pedagogical Content Knowledge and Prospective Teacher Education

Content knowledge refers to the science knowledge a teacher should posses. It includes concepts and principles understood through relationships unifying science domains, processes of investigations and applications of mathematics in science research (National Science Teachers Association, 1998). Understanding content however relies on much more than simple rote memorisation of facts.

The content knowledge for prospective science teachers is developed primarily in science courses taught by science faculties in middle level teacher training colleges and universities. All science student teachers should be provided with a carefully designed, balanced content curriculum leading to a demonstrated knowledge of the concepts and relationships they are preparing to teach.
Pedagogy on the other hand includes the actions and strategies of teaching, organization of classroom experiences, providing for diverse learner needs, evaluation and implementation of learners’ prior notions and transformation of ideas into understandable pieces (National Science Teachers Association, 1998). Science teachers should be able to provide all learners with the opportunity to learn from science instruction make sense out of science and make the learners want to do more science. This will involve multiple pedagogical tasks that will include addressing all students’ needs, planning activities that allow and encourage students to learn and reason about problems thus, instilling in them the desire to learn more science.

The content section expects teachers to make connections and see relationships between concepts, while the pedagogy section seeks to help students learn about scientific problems. The content section therefore, expects science teachers to learn and teach about the process of inquiry, while the pedagogy section expects teachers to plan experiences for their learners to make inquiries. This presents the intersection in the learning how to teach the process of inquiry. The intersection represents pedagogical content knowledge Figure 1.2, as the interplay between pedagogy and content.

Fig. 1.2: Pedagogical Content Knowledge model.
This intersection contains within it, the most regularly taught topics in ones subject, the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations and demonstrations. Making similar connections relies on the understanding of both the content students are learning and how students learn. According to Shulman (1987), the emphasis on teacher’s subject knowledge and pedagogy is being treated as mutually exclusive domains. The practical consequence of such exclusion being production of teacher education programs with a focus on either subject matter or pedagogy dominated.

Pedagogical content knowledge represents the blending of content and pedagogy into understanding how particular aspects of subject matter are organised, adapted and represented for instruction. Shulman (1987), argues that having knowledge of subject matter and general pedagogical strategies though necessary, are not sufficient for capturing the knowledge of good teachers and that for teachers to be successful, they would have to confront both issues of content and pedagogy simultaneously by embodying the aspects of content most germane to its teachability. The most important aspect in pedagogical content knowledge is the manner in which subject matter is transformed for teaching, which occurs when teachers interpret the subject matter, finding ways to represent it and make it accessible to learners. Research on teacher education indicates a paradigm shift towards Pedagogical Content Knowledge. Schulman (1987), gives different categories of knowledge base for teacher education as; general content knowledge, general pedagogical knowledge, curriculum knowledge, pedagogical content knowledge, knowledge of learners and their characteristics, knowledge of educational contexts and knowledge of educational ends. The concept of pedagogical content knowledge therefore refers to the special amalgam of content and pedagogy that is uniquely the province of teachers and their
own special form of professional understanding. It emphasizes comprehension, reasoning, transformation and reflection. A model of pedagogical reasoning and action involves comprehension and transformation of subject knowledge into teachable representations, instruction, evaluation of student’s learning and teacher performance, reflection and new comprehension. This is an attempt to illustrate reflective practice during the teaching process.

To address this dichotomy, this study sought to find out how teacher training colleges and universities are trying to relate the Chemistry content and the subject pedagogical skills in their teacher preparation programs.

2.5 Instructional Methods and Prospective Teacher Preparation

The teaching of any subject is determined by the competencies of the teacher. To a large extent, the competences are determined by the type of training the teacher received from the training college.

Effective teaching and learning is dependent on the instructional strategies used. Learning difficulties can be solved to a great extent by using appropriate teaching methods. Different approaches can be adopted for instruction in order to induce, promote and direct learning. Teachers can impart knowledge by lecture method, team teaching, demonstration method, discussion method, e-learning, activity method, tutoring, complementary methods among others, Subair, as cited by Deepa & Garija (2001). Various disciplines have their own central concepts. The concepts of a discipline form a network of relationships within the discipline, that each has its own language, symbols and means of communication and that the disciplines have their own techniques and skills (Hirst, 1972). Science depends crucially on experiment and observation. The teaching and learning of Chemistry must therefore take place in a
laboratory and should involve real contact with those aspects of nature which are to be studied. It should employ discovery with hands on experiences, class discussion, guided inquiry, cooperative learning, manipulation, e-learning, coupled with other non-laboratory experiences like field trips and excursions.

Instruction in science should develop and use experimental design in scientific inquiry, use the language of science to communicate and apply scientific concepts, skills and processes in every day experiences. Chemistry teachers should provide learners with opportunities to experience the richness and excitement of scientific discovery of the natural world, investigate phenomena and make informed decisions regarding contemporary issues as well as explore science related careers and interests to motivate learners.

Several researches done worldwide on the best methods of instruction tend to follow the scientific method of the child centred approach. Heafford (1965), argues that pupils can learn facts by rote but their capacity to forget is enormous. They will therefore learn if the processes employed are active and if they are encouraged to think about the topic, discuss it and participate in experiments. According to Thomas & Snider (1969), discovery method of instruction is intrinsically motivating and although external reinforcement may be used to get a learning episode started, it is insufficient for continued motivation. Discovered concepts are more meaningful and remembered longer. research by Taylor & Armstrong (1975), on the personality factors associated with the predicted role of activity centred versus text book centred instruction, found out that the prospective elementary science teachers gave the characteristic of activity method as an increased amount of involvement of elementary students with science materials, utilisation of classrooms as laboratories and the function of the student as a primary investigator. The teacher may therefore act as a
stimulator of divergent activities done by the student as a source of knowledge. The best approach to teaching science should aim at shifting teaching and learning from transmission of knowledge to activity based teaching, teacher centred, lecture method to experiment, recipe type of experiments to inquiry where students learn skills, such as observation, inference, and experimentation in an interactive way. Students should combine processes and scientific knowledge as they use scientific reasoning and critical thinking to develop their understanding of science. Process skills should not be taught discretely but learners should be involved in scientific inquiries that integrate the use of process skills. While Taylor et al (1975), focused on prospective elementary science teachers, this study focused on analysing the extent to which such opportunities are offered by Chemistry prospective secondary school teachers during their teaching practice session.

2.6 Constructivist view and Teacher Preparation

Children learning in science ought to be based on a constructivist’s view. The view acknowledges that children construct their own knowledge through personal interaction with adults, peers and materials that they encounter (Vygotsky, 1978; Peter, 1987). As a result, children already hold beliefs about how the world operates before they come to formal science classrooms. Learning is regarded as an active process whereby learners construct personal meaning of the subject matter through their interactions with the physical and social world. The learner is the one who must make sense out of experience. A teacher who therefore engages students in thinking, asking questions, testing ideas, representing thoughts and explaining phenomena can facilitate learning. Effective science teaching must take into account what students know, then modify this knowledge so that it reflects scientific views. Moving from constructivist philosophy, psychology and epistemology to the characterization of
constructivist teaching and learning environments presents a challenge. Constructivist philosophy does not dictate how one should teach, but makes it incumbent upon the teacher to deal with each learner as an individual, to value the diversity of perspective and to recognize that a learner’s behaviour is a reflection of his or her life experiences. Since the genesis of deep change in the educational system resides within the individual teacher, his or her beliefs and ambitions to act may be cultivated or inhibited during his or her early experiences as a prospective teacher.

There are at least two sources for knowledge construction, personal experience with the physical world and interaction with the social world. Piaget’s theory of mental structures and logical mathematical operations has underscored the significance of concrete experience in developing cognitive structures. Interaction with objects and events stimulates the construction of knowledge, as opposed to passive listening. According to Piaget (1972), it’s the learner who brings to bear mental operations in reaction to the environment, engaging in learning and furthering cognitive development. Science teaching has to promote more experiences with concrete material emphasizing manipulation of objects, testing ideas and organising data, thus motivating learners to wonder why and find out how as learning takes place. Piaget identifies four stages of cognitive development as; sensorimotor stage or infancy, pre-operational stage or early childhood, concrete operational stage or childhood/adolescence and formal operational stage or adolescence/adulthood. The last stage is where most high school students fall and it’s the stage, where intelligence is demonstrated through logical use of symbols as they relate to abstract concepts. Not all learners however, may get to the formal operation stage, as many people do not think formally during adulthood. It’s therefore important for teachers to use a wide variety of concrete experiences to help their students to learn, while emphasizing the
critical role that experiences or interactions with the surrounding environment play in student’s learning. Educators on the other hand ought to plan a developmentally appropriate curriculum that enhances the learners’ logical and conceptual growth. Whereas Piaget’s work focussed on physical interaction, Vygotsky (1998), focussed more attention on social interaction and the importance of communication as a process of learning. He believed that peers and adults greatly influence learning and acquisition of science concepts. For him, direct instruction and importance of language in the mediation of ideas has a more influential role on assimilation of ideas and advances learning and development. The second aspect of his theory is the idea that the potential for cognition development depends upon the zone of proximal development (ZPD). This is a level of development attained when children engage in social behaviour. The range of skills that can be developed with adult guidance or peer collaboration far exceeds what can be attained alone. Respecting the zone of proximal development involves assigning manageable tasks to learners. Discovery learning is therefore more meaningful than didactic theoretical rote learning.

Students learn about science from others. Similarly scientists learn about their enterprise by interacting with other scientists and examining the ideas that they have contributed to the discipline. Knowledge is therefore a product of culture that has been constructed over time, growing and changing as a result of human interaction with ideas that have been socially constructed.

According to Ausubel (1963), students must relate the materials under study to their existing cognitive structures of organised information. When students learn in a meaningful manner, they form mental connections between new ideas and the relevant elements within their existing cognitive structures. Ausubel’s work has stressed the importance of logical organisation of science content and the use of
concept maps. His idea of the comparative organizers serves to illustrate how we can show similarities between what students know and what they are expected to learn. This approach uses analogies to facilitate assimilation of new materials into existing cognitive structures. Ausubel’s view, which provides a theory of learning that explains cognitive development in terms of the acquisition of concepts and their integration into the cognitive structure in a hierarchically organised way during the active life of the individual, adds a practical dimension to Piaget’s theory of cognitive development.

According to some self efficacy researchers, (Bandura, 1997; Fullan, 1993), the catalyst for educational reform is the individual teacher and that a teacher’s behaviour, values, beliefs and ambition to act may be enhanced or suppressed during student teaching. Fullan (1993), further argues that the moral purpose or making a difference, concerns bringing about improvements. Research on efficacy of teachers suggest that behaviour such as persistence at a task, risk taking and use of innovation are related to degrees of efficacy (Ashton & Webb, 1986). Highly efficacious teachers have been found to be more likely to use inquiry and student centred constructivist teaching strategies, while teachers with a low sense of efficacy are more likely to use teacher directed strategies such as lecture and reading from the textbook.

Theoretical perspective for teaching and learning has shifted from behavioural approaches, where teaching is viewed as a well defined, structured activity that can be taught as a set of skills to cognitive constructivism approaches which are based on the assumption that learning is fundamentally a socially mediated activity Molly (2005).
This study attempted to determine the readiness of university prospective teachers to use these new approaches of cognitive constructivism in their Chemistry classroom instruction.

2.7 Experiential Learning and Chemistry Instruction

Experiential learning is learning through reflection. It requires no teacher and relates meaning making process of the individual learners’ experience. Kolb (1984), posits that knowledge is created through the transformation of experience. Kolb points out that in order to gain genuine knowledge from experience, the learner must; be willing to be actively involved in the experience, be able to reflect on the experience, posses and use analytical skills to conceptualise the experience and should posses decision making and problem solving skills in order to use the new ideas gained from experience. Experiential learning can however lead to miss-educative experiences as all experiences do not automatically equate to learning. The Kolb model of learning requires four kinds of abilities or understanding if learning is to be successful, this include; concrete experience or doing, reflective observation or observing, abstract conceptualisation or thinking and active experimentation or planning. Learners should first be fully and freely involved in the new experience. Secondly they must make or have time and space to be able to reflect on their experience from different perspectives which is influenced greatly by feedback from others. Lastly, learners must be able to form reform and process their ideas, own them and be able to integrate the new ideas into sound logical theories. The learner should be able to apply the new ideas in making decisions, solve problems and test implications in new situations. An effective experiential facilitator is therefore one who is passionate about his or her work and is able to immerse participants totally in the learning
situation, allowing them to gain new knowledge from their peers and the environment created.

The essence of teaching is to bring about desirable change in learner’s behaviour in terms of knowledge, skills and attitudes. Brown, Oke & Brown (1982), define teaching and learning as an attempt to help someone acquire or change some knowledge, skills and attitudes. In this process the learner is expected to receive information, understand it and use it later when need arises. To achieve effective teaching and learning, deliberate effort is needed on the part of the teacher in the use of appropriate approaches that best convey skills and concepts to the learner, as students do not become active learners by accident, but by design. This implies that the teacher has to design individual or group tasks, assignments, demonstration or learner experimental activities, projects among other teaching and learning strategies that will stimulate thinking processes that are likely to result in construction of meaning. This study attempted to establish the extent to which experiential learning is practiced in Chemistry classroom instruction by university prospective teachers.

2.8.0 Laboratory Work and Science Education

Laboratory work is an instructional strategy that involves firsthand experience that permits learners to participate in science education as a way of thinking and investigation, as well as developing a better understanding of science concepts, principles and theories. It provides concrete and authentic experiences that aid students in comprehending phenomena that is under study in the curriculum and discussed in classrooms. This type of activity involves learners in scientific inquiry by allowing them to ask questions, propose solutions, design experiments, make predictions, observations, organise data, and explain patterns, giving generalisations
from information. Laboratory work allows students to plan and participate in investigations, helping them to improve on their laboratory and cooperative skills.

The science laboratory is central to science teaching. It has the potential to engage students in authentic investigations in which they can identify and carry out various investigations discussed in class by following prescribed procedures and drawing conclusions. According to Freedman, (2002), laboratory work can be used to help students acquire a better understanding of concepts and principles as a result of concrete experiences. Science laboratory work seems to leave a lasting impression on students. Many of them enjoy laboratory work and prefer it to other modes of instruction as most learners like engaging in active learning experiences. It also breaks up the instructional lecture monotony, limiting the amount of straight jacket lectures and adds variety to instruction. Generally, laboratory work can be used to promote the following learning outcomes; Attitude towards science, which learners develop after instruction, scientific inquiry, conceptual development and technical skills.

Science teachers need to make explicit how each aspect of laboratory inquiry activity reflects scientific investigation and how this relates to the course objectives under study. A great deal of laboratory work that takes place in schools is aimless, trivial and badly planned (Hodson, 1985). Laboratory periods are often too short and students do not complete their laboratory work, Gardner and Gauld, (as cited in Hegarty-Hazel, 1990). Materials and equipment are a problem in many schools where resources are limited for this type of instruction. According to the American laboratory report on investigations in high school science (2005), the following suggestions can be employed to enhance student learning from laboratory experiences with regard to instructional design perspective. Teachers should be able to;
i) Specify the learning outcomes in measurable terms,
ii) Thoughtfully sequence laboratory work with other type of instruction
iii) Integrate the process of finding out with learning the content under study and
iv) Incorporate student reflection and discussion through laboratory work

Science laboratory experimental work can be used to achieve many different learning outcomes. Some laboratory exercises may be employed to verify concepts previously discussed in classrooms. Others may be used to develop particular manipulative skills that are needed in subsequent laboratory work, while other laboratory exercises facilitate the attainment of various concepts. The desired outcomes will dictate the type of laboratory work needed. Each type of laboratory approach has unique characteristics differentiating it from other approaches. Generally, most approaches can be classified into one of five categories that are listed;

2.8.1 Deductive or verification laboratory

The deduction or verification laboratory is the most common approach to laboratory work in science instruction. The purpose of this type of activity is to confirm concepts, principles and laws that have been addressed during classroom discussion. Most science teachers present major scientific concepts, ideas, and principles in class, through lecture method and discussions, followed by laboratory experiments to illustrate examples and try to verify various attributes and relationships. Many of the laws in Chemistry that are represented by chemical formulae can be illustrated in the laboratory by the deductive approach. Greater meaning of formulae of compounds in class is acquired when students gather data and use it to verify laws or principles under investigations. Verification laboratory activities have the advantage of providing learners with an idea of what they expect to find out in advance, about an abstract idea. This learning approach helps to reinforce subject matter content taught in classrooms.
2.8.2 Inductive laboratory

Inductive laboratory provides students with the opportunity to develop scientific, concepts principles and laws, through first hand experiences before these ideas are discussed in the classrooms. These activities expose learners to experiences that enable them to search for patterns and identify relationships from experimental results. Ideas and theories are thereafter discussed in class under the guidance of the teacher and applications of the concepts provided to reinforce learning.

Science teachers frequently use deductive laboratory work but they should be encouraged to apply inductive laboratory approach as well. This is because meaningful learning takes place when learners are able to discover or find out by themselves.

2.8.3 Technical Skills Laboratory

Good laboratory techniques are essential for conducting successful laboratory activities and collecting accurate data. They require manipulative skills that involve hand-eye coordination. Such skills as cutting glass, setting up apparatus and equipment for experimental work, are essential for laboratory science instruction. Science educators have placed little emphasis on developing proficiency in laboratory skills and techniques (Hegarty- Hezel, 1990), yet all science teachers and students require gradual development of basic process skills for laboratory experimental science teaching and learning. Psychomotor and mental skills practice is necessary in order to improve students’ abilities to make accurate and precise laboratory experiments. Physical practice with laboratory equipment provides concrete experience with the apparatus and procedures during class time and discussion sessions. Mental practice of the skills and procedures can then ensure.
2.8.4 Science Process Skills

One of the purposes for conducting laboratory work is for students to develop science process skills, used for data collection, performing various scientific investigations and producing evidence to answer scientific questions. The basic science process skills which science teachers have to pay special attention to because these are the skills that high school learners require for use in the laboratory practical activities include the following:

- Observation, which involves one or more of the senses that are used to gather information about objects and/or events. When making observations, learners often look for similarities and differences as they try to compare and contrast their observations.

- Classifying, this process skill begins with observing similarities and differences among objects and/or events in order to categorise them according to a predetermined set of properties or schemes.

- Measuring, as a process skill involves using quantitative observations, standardized measuring tools or non standardized objects, to collect and record scientific data.

- Communicating is a process skill that has to do with giving or exchanging information. It involves using words and/or graphic symbols to describe an action, an object or an event either orally or in writing.

- Inferring as a process skill involves explaining observations as well as drawing conclusions based on information or knowledge of cause and effect or past experiences, from which one can recognise patterns and identify relationships among data and make generalisations. Applications of concepts are thus provided to reinforce learning.

- Predicting is the sixth process skill that involves stating the expected outcomes of a future event based on a pattern of evidence. Predictions are based on prior knowledge gained through experiences or data collected. Patterns or general trends in the information collected allow us to make predictions about something beyond actual observations or measurements.

It was therefore the purpose of this study to analyse the trainee teacher’s proficiency in handling practical activities during laboratory classroom instruction.
2.8.5 Small-Group Problem-Solving Laboratory Work.

Science teachers should engage their learners in problem solving laboratory work. This is where students are given opportunities to identify a problem, design procedures, collect information, organise data and report their findings. This type of laboratory investigations can involve authentic inquiry experience for their learners. This approach is recommended because psychologically, when learners are involved in organising their own learning, they are inclined to better understand what they are doing. Students take more interest in their own learning, when they take part in organizing it.

Science teachers have to therefore, carefully plan and organise their laboratory activities in order for learners to attain important learning outcomes. Teachers must give attention to the relevance and the degree of structure of laboratory activities, methods by which student’s record and report their findings, classroom management and evaluation of learners work. Failure to which may undermine the value of laboratory work.

The use of familiar and/or local objects and materials in laboratory activities demonstrates the applicability of science concepts and principles in daily life. Local materials are not expensive and are easy to obtain and improvise for laboratory practical instruction. If instruction begins with things that are familiar to learners, it’s most likely to be related to the knowledge that they posses. Consequently instruction that begins with what students know facilitates their conceptual development as the instruction scaffolds their learning.

Evaluation of laboratory work as part of the total science course is essential. There are several techniques employed in this process that include, paper and pencil tests,
laboratory reports, practical examinations and direct observation by the teacher to assess learner’s behaviour in the laboratory. The efforts demonstrated by students in the laboratory, should be rewarded. Giving credit for demonstrated effort can reinforce the process of learning science.

Science teachers should incorporate fieldwork into their instruction because it offers a variety of learning experiences to learners, by exposing them to a natural and technological world. Field trips are the most memorable academic experiences enjoyed by students which should be well utilized by teachers and students to improve on their scientific literacy.

2.8.6 Laboratory safety

Safety during laboratory work must be well addressed during practical instruction. Science teachers ought to discuss the safety and any potential hazards associated with a given laboratory activity, before learners are permitted to engage in any practical activity. Appropriate protection gear must be provided to all learners including the teachers. The study attempted to investigate laboratory processes and the safety precautions taken during the learning process.

2.9 Learning Resources and Chemistry Learning

Resources in education play a very important role in facilitating learning (MacAlney, 2009). Effective learning in science cannot be possible without access to educational resources. These resources include both print and non print materials, coupled with an enabling learning environment that provides appropriate learning experiences to learners. A resource can therefore be viewed in Chemistry as a medium, which assists a learner in clarifying or simplifying some concepts in the learning process (Twoli, 2006).
Such resources include; the syllabus, schemes of work, lesson plans, teachers handbooks, text books, reference books, laboratory manuals or instruction handouts, charts, audio visual aids, models, CDs, Chemistry Kits (mini-Labs) as well as equipped science laboratories, Information Communication and Technology (ICT) integration in learning, chemicals and glassware as well as realia or actual exposure to real life situations are among the many educational learning resources used in schools. Education resources are selected and used to stimulate interest and motivate learning. Walton & Rock (1975), argue that education resources should complement but not replace the teacher. Teacher’s skills to structure the resources into meaningful learning experiences to achieve curriculum objectives are very important. This requires that teachers be equipped with sufficient pedagogical and organisational skills on how to use resources effectively and efficiently. It is usually expected that science teachers learn how to construct and improvise some science apparatus and materials during their course of training. This improvisation should be encouraged as one effective mechanism for the renewal of ideas and introduction of new designs in science equipment. Walton et al (1975), recommends that the science teacher needs to have the following information about the existence of commercially prepared resources; Ready access to the resources, the opportunity to use them, advice and training in all aspects of resource based learning, including the specifications, selection, application and management of resources on a systematic basis. Some of the main instructional uses of resources include the following:

i. Resources inspire one to learn using a variety of senses such as provision of stimulus variation, which allows for multi-variant sense responses.

ii. They increase learning activities hence improving on the manipulative skills and employing the use of cognitive skills.
iii. They provide opportunities for learners to ask and find answers to arising questions where, such questions and answers can clarify concepts and add knowledge.

iv. They simplify and make certain concepts real, especially when using models.

v. Resources make learning dynamic and can lead to thrilling discoveries, which are likely to make Chemistry learning effective and interesting for learners to understand and get motivated.

Resources therefore play an important role in Chemistry instruction. They mediate conceptualisation through the process of visualisation (Twoli, 2006). Resources should therefore relate well with the lesson objectives and content. Teachers should be able to make simple resources, especially charts and models for Chemistry instruction. This study analysed the utilisation and use of various teaching and learning resources in achieving the set lesson objectives for Chemistry instruction at secondary school level.

2.10 Assessment and Chemistry Learning

Assessment is a means of determining the extent to which students achieve the learning goals specified in the syllabus objectives. Assessment is therefore an important consideration in planning for teaching. Assessments must thus closely resemble meaningful learning tasks and assess the acquisition of high level thinking and reasoning abilities as integral to subject matter knowledge.

New conceptual frameworks for designing of assessments require new psychometric theories that reflect current advances in research on cognition and human learning. Traditional achievement assessment that measure long term educational outcomes and growth, cannot adequately describe complex processes of thought, reasoning and problem solving. Tests were generally designed to be administered following instruction, rather than being integrated in learning. Techniques for measuring achievement have relied on the psychometric technology that are used for selection,
promotion and placement testing which focuses primarily on the amount of declarative knowledge that students have acquired. According to Kenya. Institute of Education, research findings on summative evaluation (2010), most schools use traditional written tests, whereas observation and projects are rarely used. This view is at odds with current theories of cognition that emphasizes meaningful learning which entails reasoning, problem solving and active construction of knowledge. Assessments that are integral to instruction and allow students to display the thinking, reasoning and strategic processes that underlie their competences can ensure more valid inferences regarding the nature and level of students understanding (Snow & Hohman, 1989). Assessment should be capable of determining the nature and depth of students understanding by reflecting on the organisation and coherence of their knowledge structures. To promote students acquisition of coherent knowledge structures, instruction and assessment should emphasize knowledge construction and possibilities of learning in collaborative settings. This is because meaningful knowledge is constructed through collaborative efforts between teachers and learners in classrooms.

The World Bank report (2005) indicates that all over the world, the role of national examinations is arguably the main characteristic and peculiar feature of secondary education. The report argues that in many developing countries, secondary education is ‘guarded’ by examinations at both entry and exit. Teachers in Kenya, often fall back to rote learning in order to make their students pass national examinations. The practitioners’ intents and desires become overtaken by the evaluator’s stance and theoretical frameworks. This has resulted in our education system failing to provide learners with creative and innovative minds capable of critical thinking and development of requisite skills in problem solving.
According to Lambert (1985), teachers must provide robust instruction, engaging in the continuous generation and application of complex judgements to manage classroom dilemmas, identify student’s instructional needs, learner characteristics and individual differences. They should also decide what to teach and how much time to allocate to instruction, identify appropriate instructional levels and materials. He further argues that teachers have to group learners and decide on how to measure the effects of instruction. Lambert stresses that teachers should monitor the lesson as it is being taught, interact with learners and make decisions about providing additional instruction as they provide students with feedback. Lastly, teachers should analyse and reflect on the results and effectiveness of instruction.

Generally learning objectives, for science courses are derived from the national goals of education. Learning objectives are linked to assessment by indicating what students should do at the end of instruction. Instructional objectives guide teachers’ decisions on what students should learn. Planning provides guidance for the design and selection of assessment and learning experiences. At the beginning of instruction, early assessment may facilitate differentiated instruction to meet the needs of diverse learners. Learners could be introduced to a topic or unit through an engaging activity that will invoke learner’s responses and questions. A problem based dilemma that highlights important ideas from the topic could also be used to reveal learner’s held assumptions and misconceptions. Alternatively, learners could be given a brief pre-test that addresses key concepts and major ideas from the topic to be taught. These assessments serve a diagnostic purpose, by revealing the learners’ understanding in order to better meet group and individual needs through instruction.

During instruction, assessment should be woven into science learning experiences. A lot of information about student learning and the quality of teaching can be gathered
during instruction. A key feature of during instruction assessment is its seamlessness (Abele & Volkmann, 2006). Instruction should thus flow naturally into assessment, while assessment can take many forms that include asking learners questions, or learners can be required to draw diagrams, write equations or formulae among many other forms of showing their thinking. Learners oral responses to questions as well as writing down answers, tell a lot about what understanding they are constructing. Learners will often tell teachers if they require further clarification or assistance. In addition, learners’ in attentiveness or off task behaviour can indicate whether the lesson is boring, difficult, or too easy. Teachers must be aware of such signals and be prepared to modify their teaching accordingly.

Assessment during instruction is considered formative because its primary purpose is to provide teachers with information that will enable them make desired or necessary adjustments to their instruction.

At the conclusion of an instructional sequence, it’s important to determine what students have learned. When considered in the context of a single or multi day lesson, end of instruction assessment could be done in as little as five minutes, by giving short quizzes, but when thought of as the concluding experience of a unit or topic, the assessment may take longer. End of unit assessment should reflect the desired learning goals and guide the selection and development of unit learning experiences. This form of assessment is summative because it is applied at the conclusion of instructional sequence and is used to indicate accomplishment in form of a grade. End of instruction assessment should allow students to show how scientific knowledge can be utilized and information reorganized to generate new understanding and not for examination competitions. Ideally, assessment will also enhance the ability of students to monitor, evaluate and regulate their own learning. The study attempted to
identify the different modes of assessment utilized by prospective teachers and how the assessment results are used to improve teaching and learning of Chemistry.

2.11 Related Studies done in Kenya.

Studies done in Kenya concerning teacher preparedness to facilitate of Chemistry instruction are quite scanty. However, a few related relevant studies have been carried out. Orado (2009), in a study on factors influencing performance in Chemistry practical work among secondary schools, indicated that although laboratories in secondary schools are equipped with basic apparatus and materials to carry out a variety of activities, teachers taught and stressed skills mainly assessed by the Kenya National Examinations Council, leaving out key scientific skills such as experimental design and hypothesis formulation. What is taught thus appears to be dictated by the demands of the national examinations. Majani (1989) in a study on factors that contribute to poor performance in Kenya Certificate of Education Chemistry examinations showed that; inadequacy of teaching and learning resources/facilities was part of the reasons for the poor performance. Maleche, Khaemba, Kadenyi & Barasa (2006) in a paper, “Bachelor of Education programme on the cross, a case for a fresh testament,” suggest that Bachelor of Education degree programme needs a review of curriculum to meet new challenges in society. Mse, (1998) in a study of the pre-service training of primary school teachers for vocational education in Kenya showed that graduate tutors in teacher training colleges are severely handicapped as their university education courses do not prepare them for teaching in primary teachers colleges. According to Mse, the pre-service teachers lack the ability to translate theory into practice as they are too theoretical in approach and rarely demonstrate to the pupils what is expected of them. Most of them adopted the lecture method in teaching with little attempt to meaningfully involve their pupils in the
lesson. The trainee teachers have inadequate content in various topics, are unable to make and use various items for teaching. In addition, he attributes this poor performance to various factors that include; lack of knowledge and skills in their subjects and inadequacy of teaching and learning materials and facilities in schools where they were carrying out their teaching practice. In his suggestions for further research, Mse points out the need for researchers to critically examine the teaching and training in each subject to see how they are designed to produce a well trained teacher in the subject(s) they teach. This gave the gap for this study

From the reviewed literature, it is evident that no study has been carried out specifically in the area of pre-service teacher preparedness to facilitate quality Chemistry instruction in Kenya. Most of the studies done are foreign based, hence a gap that requires researching on.

2.12 Summary

This study showed that teaching and learning theories have an effect on the classroom learning processes. In this study, university prospective teachers were observed in their natural environment, which included existing challenges that teachers face during classroom instruction. Efforts on how prospective teachers facilitate classroom instruction will provide home-grown solutions in re-aligning teacher education preparation programs offered at the universities and other teacher training colleges to meet the challenges of changing dynamic knowledge based economy. The study identified the limiting factors to effective Chemistry content facilitation and specific practices that contribute to the poor learner achievement at classroom level. This chapter therefore was an extension of the existing literature as it was aimed at helping teacher educators make informed decisions in designing a curriculum that can
enhance achievement in Chemistry education at both university and basic education levels.
CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter describes the procedures and strategies used in the study, focusing on the study design, sample size, target population, sources of data, sampling procedures, research instruments and their administration. An outline of the methods used for data collection, analyses and presentation as well as description of study variables.

3.2 Study Design

The aim of this study was to establish the preparedness of prospective teachers to deliver Chemistry instruction at secondary school level. As a result, a descriptive cross-sectional survey design was adopted, where a selected representative sample of prospective teachers responded to questionnaires and lesson observation protocols were scored during classroom instruction on the same at one point in time. Data was collected using a mixed methods approach, where both qualitative and quantitative approaches were used. Surveys are unique in that, they allow for gathering of information not available from other sources. They also provide for unbiased representation of the population of interest as well as standardization of measurement, where the same information is collected from all the respondents. According to Owen, (2002), data from survey studies can be used to compliment existing data from secondary sources. The design used descriptive statistics to analyse all variables so as to appropriately describe and summarise the data sample. This was because, the data gathered was used to describe the existing status of prospective teachers in Chemistry instruction and how the patterns and procedures in practical and theory lessons influence the learner’s achievement and attitude towards Chemistry learning.
3.3 Location of study

The sample population for both the pilot and final study was drawn from the Kenyatta University Chemistry prospective teachers, during their teaching practice exercise in Nairobi Teaching Practice Zone. Nairobi Teaching Practice Zone was found suitable as it had sufficient number of secondary schools required for the sampled number of the prospective Chemistry teachers.

3.4 Target Population

The study population consisted of Kenyatta University Chemistry prospective teachers and the secondary school Form two learners in the respective teaching practice schools in Nairobi teaching practice zone. A total of forty six prospective teachers and two hundred and fifty nine form two learners formed the study sample. Information from Kenyatta university Teaching Practice office had indicated that for the teaching practice period May-August 2011, there were one hundred and eighty eight (188) teaching practice secondary schools in Nairobi teaching practice zone. The TP schools are divided into smaller sub-zones for ease of administration and supervision. From a total of (188) secondary schools in Nairobi’s teaching practice zone, thirty nine teaching practice schools which had student teachers with a Chemistry subject combination formed the sampling frame, from which the sample population was selected.

3.5 Sampling procedure

Stratified random sampling, random sampling and purposive sampling techniques were used to come up with a representative sample for the study. The prospective teachers in the T.P schools were purposively sampled with their respective Form Two learners for the study. The learner attitude questionnaires were administered to Form
two learners. Where there was more than one stream of the Form Two classes, only one of them was randomly selected for the administration of the leaner questionnaires. Form Two learners were preferred in this study because, at this level, they all take Chemistry as a compulsory subject and they are also less inclined towards selected subjects of study as compared to Form Threes and Fours.

A list of prospective teachers who taught Chemistry in Nairobi TP Zone was obtained from Kenyatta University Teaching Practice office from which the Chemistry prospective teachers for Nairobi Teaching Practice zone were sampled to respond to the Teacher Questionnaire Guide. A further twenty three TP schools were randomly sampled for the administration of the Lesson Observation protocol. In each of the sampled schools, Form Two Chemistry learners were randomly sampled to respond to the Chemistry Learner Attitude Questionnaire. According to Wiesma (1995), a sampling fraction of at least (20%) of the total population of less than (100) is an acceptable sample in descriptive research. Twenty three schools for the Lesson Observation Schedule represented about (59%) of the total population. Table 3.1 summarises the number of selected schools by subzone, the number of prospective teachers and the learners sampled.
Table 3.1 Sample size grid of schools by type and category

<table>
<thead>
<tr>
<th>TP Zone</th>
<th>School with TP Chem. Students</th>
<th>No of schools sampled</th>
<th>No of teachers sampled</th>
<th>No. of learners sampled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nairobi East A; TP students(109)</td>
<td>13</td>
<td>12</td>
<td>12</td>
<td>120</td>
</tr>
<tr>
<td>Nairobi East B; TP students(70)</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>Nairobi East C; TP students(66)</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>69</td>
</tr>
<tr>
<td>Nairobi West TP students(39)</td>
<td>9</td>
<td>6</td>
<td>7</td>
<td>40</td>
</tr>
<tr>
<td>Nairobi Central A:TP students(29)</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Nairobi Central B TP students(58)</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Others outside Nairobi TP zone</td>
<td>-</td>
<td>-</td>
<td>9</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>39</strong></td>
<td><strong>33</strong></td>
<td><strong>46</strong></td>
<td><strong>259</strong></td>
</tr>
</tbody>
</table>

3.6.0 Instruments for data collection

The objectives of the study formed the basis from which the instruments were designed. In this study, three instruments were used for data collection. Both qualitative and quantitative approaches were used for data gathering because data collected was in both numerical measures and verbal descriptions. Data was gathered using the following research instruments;

3.6.1 Teachers Questionnaire Guide.

A teachers’ Questionnaire guide (TQG) was developed by the researcher. The questionnaire took the form of multiple-choice questions of both the closed and open
ended type. Most of the questions measured a single variable or opinion. Effort was taken to enhance clarity by making the questions clear and unambiguous. This was in order to eliminate chances of the questions having different meanings to different respondents. The questionnaire was administered to the prospective teachers in order to solicit for information on the prospective teacher’s background as regards their preparedness for Chemistry instruction, teacher training and instructional practices. This instrument (Appendix-1) was chosen because of its objectivity. Responses from the prospective teachers were noted and kept for analyses and interpretation.

3.6.2 Lesson Observation Schedule

This instrument was adapted from a combination of two instruments; the Reformed Teaching Observation Protocol (RTOP), developed by Sawada & Piburn (2000), and the Practical Teaching Assessment Scheme for Diploma Teachers College Examinations, developed by the Ministry of Education Kenya (2009). This instrument was used to measure both theory and practical classroom processes and interactions, attainment of set objectives, experiences offered in classrooms, use of instructional resources, modes of assessment, class organisation and planning (Appendix III). The behaviour and skills emphasised during teaching were also sought from prospective teachers.

3.6.3 Chemistry Learners Attitude Questionnaire.

The Chemistry Learners Attitude Questionnaire (CLAQ) was developed by the researcher and is composed of five closed format type of questions and nineteen likert type of items. Most of the questions measured learner’s opinions towards Chemistry instruction (Appendix II). The Likert types of items were used to make an attitude scale. The items consisted of an equal number of both positive and negative
statements regarding Chemistry instruction, which the learners responded to using a five point rating scale; {strongly agree (1), agree (2) undecided (3), disagree (4) and strongly disagree (5)}

3.7 Pilot study

To ascertain the validity and reliability of the instruments, the three instruments CLAQ, TQG and LOS were pilot tested using four schools in Nairobi TP Zone which did not form part of the study schools, but had prospective teachers on teaching practice posting. Piloting the instruments helped to identify and rectify any mistakes in the questions, procedures and time required for administration of research instruments.

Reliability is the degree to which the indicator or test is a consistent measure over time or simply a test to determine whether the respondents will give similar responses if asked to do so at a different time. To determine the reliability of the measurement tool, a test-retest method was used where the respondents in pilot schools were asked similar questions in different pilot schools. The two questionnaires and the lesson observation protocol were subjected to a spearman’s correlation test using SPSS computer software package. A strong positive Spearman’s correlation of $r = 0.84$ was found when the test questions were correlated on two successive administrations. A correlation coefficient of $r = 0.8$ or higher is taken as an indicator that the question is reliable (David & Sutton, 2004). According to Wiersma (1995), analysis of item content, criterion and construct related evidence through pre-testing of study instruments validates the tools. Several measures were taken to ensure validity which included use of several instruments in the study. Content validation was carried out to establish the representativeness of the size of the items with respect to the sample
from which the findings were to be derived and the different dimensions of the research questions.

Following the results of the pilot study, the items that were found to be repetitive in the instruments were deleted. Some items in the lesson observation protocol were fused together for example schemes of work and lesson plan designs, thus reducing the number of proficiency areas from six to five. Ambiguous statements were refined, improving the question tools. After incorporating issues emerging from the pilot study, the instruments were finally re-designed and produced for administration to the sample study population. The instruments are therefore accurate and can be used for generalisation of the findings.

3.8 **Data collection procedures.**

The main purpose of the data collection phase was to administer the questionnaires and carry out the lesson observation protocols on the sampled respondents. Both the LOS and TQG were administered by the researcher, who helped in clarifying any of the questions that the respondents sought for more clarification. After filling the questionnaires under the researcher’s guidance there were informal sessions between the researcher and the prospective teacher(s). The guided questionnaire was meant to prompt and explore further issues that were not captured in the questionnaire through group discussion sessions. The researcher personally observed the prospective teachers using lesson observation schedules (LOS) during the seven single theory lessons and twenty double laboratory experimental lessons in the respective teaching practice schools. The lessons were based on five classroom observation protocols. The researcher examined the prospective teachers’ ability to establish a positive learning climate and classroom management, to their ability to explain concepts and
provide useful feedback to the learners. The researcher conducted and obtained time tables from the prospective teachers through the University sub-zone co-ordinators, before visiting the schools. The researcher was therefore guided by the prospective teacher’s timetables. The researcher got to the respective schools on the assigned date(s) in time and went straight to the Heat/Teachers’ office for a courtesy call and to inform the Heads of respective TP schools about the purpose of the study. The Head/Teachers would in most cases invite the prospective teacher(s) to their offices for a formal introduction and familiarisation. The prospective teacher and the researcher would then walk together to the classroom. The researcher would sit quietly behind the class, following through the lesson while filling the LOS checklists, without interfering with the progress of the lesson. After the lesson the researcher held a conferencing session with the prospective teacher(s). Each trainee teacher was observed twice over a period of one month. The classroom observations ranged from forty minutes in single lessons to eighty minutes in double lessons. The observations focused on the instructional strategies applied, use of teaching/learning resources, methods of assessment, classroom management and the laboratory experimental activities that the prospective teachers engaged their learners in during the teaching and learning process. The Chemistry Learner Attitude Questionnaire (CLAQ) was administered to the Form two learners with the help of the prospective teachers, who guided the learners in responding to the items in the questionnaire in the respective classes that they taught. Before embarking on data collection a permit for research was obtained from the Ministry of Higher Education

3.9 Data analysis procedure

The data collected was, coded and processed using the SPSS version 14 software in order to build a database of statistics that was used to describe, analyse and present
the data using descriptive and inferential statistics. Data from this study included responses from teacher questionnaires, Lesson Observation scores, preparation for facilitation of Chemistry instruction and the Chemistry learner’s questionnaire scores that were used to capture learner’s attitude towards Chemistry instruction. The statistical tests that were used to report the findings included frequency counts of behaviour for observed prospective teacher’s classroom lessons, which were tallied and expressed as means and standard deviations, frequency counts for prospective teachers responses were tallied and reported as means, percentages and in frequency tables. A Chi-Square test was run to compare if there was a significant relationship between the male and female prospective teachers in some of their responses. Quantitative data was analysed and is presented in distributive tables while qualitative data is presented in narrative form.

3.10 Logical and Ethical Consideration

The confidentiality, anonymity and privacy of those involved in the study were guaranteed by making sure that the instruments used did not ask for the respondent’s identity so as to remain anonymous. Informed consent was sought from relevant authorities to carry out the study by first seeking a research permit from the Ministry of Higher Education, followed by informing the Kenyatta University’s TP office, who provided the researcher with the names of the Nairobi teaching practice sub- zone coordinators. The sub-zone co-ordinators were conducted personally and made aware of the intended study. The sub-zone coordinators provided the researcher with the required details of all the prospective teachers in their sub- zones, which included their subject combinations and mobile phone numbers. The prospective teachers were informed about the purpose of the study before the visits were made to their respective teaching practice schools through their mobile phone contacts.
Head/Teachers of selected schools were informed about the intended study and the participation of the prospective teachers in the study. Data collected was held confidential and was not used for any other purpose other than for the study. Finally, the researcher made all possible efforts to adjust his timeframe according to the research participants’ convenience and willingness.
CHAPTER FOUR
DATA ANALYSIS, PRESENTATION AND DISCUSSION

4.0 Introduction

This study was aimed at analysing the Prospective teacher preparedness to facilitate Chemistry instruction at secondary school level. Five factors; Relevance of course content taught at the universities, prospective teachers’ Planning and Preparation for instruction, Instructional strategies applied, proficiency of handling practical experimental activities and learner’s attitudes towards Chemistry instruction were measured. The prospective teacher was the unit of analysis. Data collected was coded for computer use. A spearman’s correlation coefficient of \( r = .84 \) was found when the scores on successive administration were correlated. The scores for this study are therefore both reliable and valid.

There were a total of forty six (46) Kenyatta University prospective student teacher cases. In addition, there were two hundred and fifty nine (259) learner cases that were analysed in the study. The gender distribution of those involved in the study revealed a ratio of 2:1, male to female prospective teachers of the total sample; (69.7%) were male and 32.6% were female teachers. The study was also aimed at providing empirical evidence to test the validity of the ratings of other classroom factors proposed as significant in influencing quality classroom instruction. For these findings, a descriptive approach was used to analyse the results. The findings of the analyses are presented in this chapter in accordance with the research objectives and research questions presented in chapter one.
4.1.0 Characteristics of the respondents

A total of forty six (46) Kenyatta University prospective teachers on teaching practice were sampled; 31 male (67.4%) and 15 female (32.6%). This gender imbalance may imply a situation of lack of role models for female learners in pursuing Chemistry and other science related subjects at secondary school level.

4.1.1 First choice of University courses by TP Students

The respondents were asked to name their first choice course of study before joining the university. The findings are depicted in figure 4.1

**Figure 4.1 First Choice courses at University (N=46)**

From the findings in figure 4.1, it can be shown that the highest number of respondents (30.5 percent) chose medicine as their first choice course of study, while (21.7 percent) chose Education. This is an indication that education is becoming a career of choice for many students joining university education. The study also sought to find out the second teaching subject among the prospective teachers. Figure 4.2 summarises these findings.
Majority of the respondents (45.7 percent) had Mathematics as their second teaching subject, while (32.6 percent) had Biology and a small percent (4.4 percent) had Physical Education and Geography. In this case, it appears that the prospective teachers have a good mathematical background to enable them carry out effective facilitation in Chemistry. These finding partially agree with Phelps (2006), whose findings on a study of the nature of science shows that specific orientation are aligned with distinct sub-disciplines and significantly influence the teaching carried out in classrooms. Phelps further posits that for instance, teachers trained in Biology teach Physics courses differently from those trained in Physics and Chemistry.

4.2.0 Intention of Prospective Teachers to stay in the teaching profession

The prospective teachers were asked if they intended to stay on in the teaching profession for the rest of their working life. About fifty four percent of the respondents indicated that they intended to stay on in the teaching profession, which works out to only about half of the total sampled prospective teachers. The rest
(45.7%) stating that, they would wish to leave the profession at whatever opportunity that may arise. This can have serious implications on the quality of teaching as the prospective teachers may lack the commitment towards teaching. From the findings, it can be concluded that many of the prospective teachers are in the teaching profession not by choice, but by chance. Many excellent teachers already work in schools, but their work often goes unrecognised and un-rewarded as a consequence, many good teachers and many who would be exceptional teachers do not consider teaching as a lifelong profession. According to the Organisation for Economic Co-operation and Development (OECD), drawing qualified teachers to the profession and helping those qualified to stay in the profession requires that education systems prepare and support a high quality teaching force and effective teaching through appraisal and feedback (as cited in Schleicher, 2010). Table 4.2 shows a Chi-Square test that was run to determine the statistical significance of gender differences on the wish of prospective teachers to leave the profession upon graduation

Table 4.1 Gender-Intend to stay in teaching Cross tabulation (N=46)

<table>
<thead>
<tr>
<th>GENDER</th>
<th>Intent to stay in teaching</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Males</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>% of Total</td>
<td>37.0</td>
<td>30.4</td>
</tr>
<tr>
<td>Female</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>% of Total</td>
<td>17.4</td>
<td>15.2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>25</td>
<td>21</td>
</tr>
<tr>
<td>%</td>
<td>54.3%</td>
<td>45.7%</td>
</tr>
</tbody>
</table>

From the findings in Table 4.1, it can be observed that (37%) of the male prospective teachers felt they would wish to stay on in the teaching profession compared to (17%)
of their female counterparts. A chi-square test was performed to assess whether these observed differences were significant.

**Table 4.2 Chi-Square Tests (N=46)**

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig (2-sided)</th>
<th>Exact Sig (2-sided)</th>
<th>Exact Sig. (1-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>.009</td>
<td>1</td>
<td>.923</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuity Correction</td>
<td>.000</td>
<td>1</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>.009</td>
<td>1</td>
<td>.923</td>
<td>1.000</td>
<td>.585</td>
</tr>
<tr>
<td>Fisher’s Exact Test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Two hypotheses were established. The research hypothesis was that there is a significance difference in gender on the wish of prospective teachers to leave the teaching profession upon graduation. The null hypothesis was that there is no significance difference in gender on the wish of prospective teachers to leave the teaching profession upon graduation. The chi-square statistic value was .009, the degrees of freedom are 1 and the reported confidence level is .923. At the 5 percent significant level of (P= 0.05), for 1 df, the calculated chi-square test statistic value is higher than the significant level. We therefore reject the null hypothesis that there is no significance difference in gender on the wish of the prospective teachers to leave the teaching profession upon graduation. In which case, it can be concluded that there is a significant difference in gender on the wish of the prospective teachers to leave the teaching profession. The male teachers are likely to leave the teaching profession more often as compared to their female counterparts. This negative attitude towards teaching as a profession may impact negatively on the performance and commitment
of the prospective teachers which may affect the quality of Chemistry instruction at secondary school level.

4.3.0 Relevance of Chemistry content taught at University to school curriculum

From the literature review, it was established that there exists a mismatch between the Chemistry course content taught at the university and the expectations of the secondary school syllabus. The research question sought to find out the relevance of the university course outlines to the expectations of the secondary chemistry school syllabus.

Figure 4.3 shows the responses on relevance of the university Chemistry course content to the secondary school syllabus and the sufficiency of the duration provided for the teaching practice session for the course.

**Figure 4.3 Content Relevance and TP period sufficiency. (N=46)**

Majority (67.4%) of the sampled prospective teachers felt that the Chemistry course content taught at the university was not related to the secondary school Chemistry syllabus course content. A paltry (32.6%) felt that the content was related to the Chemistry syllabus taught at secondary school level. This implies that the university
curriculum might be at a higher level and may not be directly applied to the school situation. This finding is consistent with Phelps argument that teachers who complete university based programmes do not leave with the appropriate knowledge and practices to be effective in contemporary classrooms (as cited in Deborah, Mark & Phelps, 2008), Some critics have outlined the following weaknesses; low admission standards, curriculum fragmentation, excessive requirements, disconnection with classroom worlds and inadequate quality control mechanisms as the cause of the poor classroom practices by teachers (Levine, 2006). This finding reflects Maleche et. al. (2006) argument that, like other processes of education and training, the Bachelor of Education programme needs a review of curriculum to meet new challenges in society. There is therefore an urgent need to link teacher education and school reform programmes as classroom teachers may be finding it difficult to make a connection between the two syllabi. The advanced course programmes can however give confidence and flexibility in classroom instruction as the trainee teachers are equipped with higher subject matter content and pedagogical skills to manage any challenges in classroom instruction compared to their learner’s expectations.

The study findings in figure 4.3 further indicates that over two thirds (64.5%) of the prospective teachers felt that the teaching practice (TP) period of one term was not sufficient for the course. When probed further, (66%) of the respondents were of the opinion that two terms or six months duration would be better, while (34%) felt the period given for teaching practice was sufficient. This indicates that majority of the prospective teachers would like the TP period session doubled, which implies that the period provided for teaching practice may not be exposing the trainee teachers to sufficient teaching practice field experience. This might be one of the causes for lack of confidence in managing challenges in classroom practice among trainee teachers.
Grossman & McDonald argue that teacher educators should move away from a curriculum focused on what teachers need to know to a curriculum focussed on core practices where the development of pedagogical skills in interaction aspects of teaching is addressed by university based teacher educators as well as field experiences, (as cited in Borko, Whitcomb & Liston, 2009). There is an urgent need to re-align the university Chemistry teacher education programs to school curricular in order to have a positive impact on teacher training and secondary school classroom Chemistry instruction. The programmes ought to be sufficiently flexible to respond to teacher, students, curricular and contexts differences, while maintaining consistency with the intended design features and core principles. These findings support Teaching and learning International Survey study (TALIS), conducted by the Organisation for Economic Co-operation and Development (OECD, 2007-2008) which suggests that, equipping teachers for effective learning in the twentieth century will require the rethinking of initial teacher education programmes, redesigning and strengthening investment in professional development and providing ongoing support and feedback for teachers in every aspect of their work. Standa (2011), recommends that all universities, whether private or public, should continuously review their training programmes to meet changing job market needs (as cited in The Standard Newspaper Oct. 26th 2011).

4.3.1 Topics not well addressed at University with respect to TP Teachers
The respondents were asked to name the topics/concepts they felt were not well addressed at the university which are important for Chemistry instruction at secondary school. Figure 4.4 summarises the responses from the findings.
Figure 4.4 Topics not well addressed at the University with respect to Prospective Teachers (N=29)

From the analysis in figure 4.4, it can be observed that, there are topics respondents felt were not well addressed at the university yet they are important for secondary school Chemistry instruction. Electrochemistry (17.4%) had the highest frequency counts, followed by Organic Chemistry (13%). Majority of the prospective teachers did not seem to have challenges with the teaching of practical skills at the university, as only 4.2% of the respondents felt that Chemistry practical activities were not well addressed. The university programs may not be addressing some of the important topics for secondary school curriculum and could be dwelling on topics that may not be directly addressing the secondary school Chemistry syllabus requirements. One of the prospective teachers was quoted saying “topics taught in year one at the university appear to be related to the secondary school Chemistry syllabus subject content but the rest of the Chemistry course is too advanced for secondary school level”. The teacher named spectroscopy as one of topics that cannot be applied at secondary school level. There is need therefore for the university to carry out a Chemistry syllabus review to identify suitable Chemistry content for education
students that can address the needs and expectations of high school Chemistry learning.

### 4.3.2 Topics found challenging to teach in secondary schools.

The prospective teachers were asked if there were any topics/concepts that they found challenging to teach. Forty five pre-cent (45%) of them responded in the affirmative while (55%) disagreed. When asked to name the challenging topics, the information in figure 4.5 was captured.

**Figure 4.5 Topics TP teachers Found challenging to teach in secondary schools (N=23)**

<table>
<thead>
<tr>
<th>Topics found challenging to teach</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodic Table</td>
<td>4.3</td>
</tr>
<tr>
<td>The mole concept</td>
<td>4.3</td>
</tr>
<tr>
<td>Enthalpy changes</td>
<td>6.5</td>
</tr>
<tr>
<td>Organic Chemistry</td>
<td>8.7</td>
</tr>
<tr>
<td>Metals</td>
<td>15.2</td>
</tr>
<tr>
<td>Structure and Bonding</td>
<td>8.7</td>
</tr>
<tr>
<td>Electrochemistry</td>
<td>8.7</td>
</tr>
<tr>
<td>Radioactivity</td>
<td></td>
</tr>
</tbody>
</table>

From the findings, in figure 4.5, the topics/concepts that were found to be challenging to teach included; Electrochemistry (15.2 %), which was indicated as the most challenging topic to teach, followed by structure and bonding, radioactivity and metals all with (8.7%). Enthalpy changes were rated at (6.5%). These may imply that the poor performance of Chemistry at secondary school level might be emanating from the inconsistency between the university course content and the Chemistry school syllabus. The findings further depict that it’s probable the university course programmes offered for teacher training may not be adequately preparing teachers for what is expected of them at the classroom level. These findings corroborate with a
study carried out by Dindar, Bektas & Celik (2010), whose findings showed that pre-service Chemistry teachers had some misconceptions or difficulties in explaining some Chemistry concepts. The study revealed that the most challenging topics for pre-service Chemistry teachers were some of the basic Chemistry topics for example, particulate nature of matter, chemical equilibrium and acids and bases. The study concluded that, with difficulties in understanding matter and particles, the pre-service teachers could not meaningfully explain other topics such as gases and electrochemistry.

The study also sought to find out from the prospective teachers, the topics/concepts that learners found difficult to comprehend. Figure 4.6 shows the findings

**Figure 4.6 Topics/concepts learners find difficult to comprehend (N=46)**

From the findings, it can be observed that almost all the prospective teachers (93.9%) felt that there were topics/concepts learners find difficult to comprehend. Only (6.1%) of the respondents felt that their learners had no difficulties in comprehending Chemistry concepts/skills. Most of the prospective teachers indicated, the Mole concept (65.2%), Electrochemistry (45.7%) and Organic Chemistry (32.6%) respectively as the topics learners find most challenging to comprehend during class instruction. The Periodic table (4.3%), Chemical Families (6.5%) and Metal
extraction (6.5%) were rated low which may imply that these topics do not pose a major challenge to the learners. Results from figures 4.4, 4.5 and 4.6 suggest an interesting relationship between topics/concepts prospective teachers felt were not well addressed at the university, the ones they find difficult to address and those learners find difficult to comprehend. The findings show no corroboration at all. For example, apart from electrochemistry, the other topics like organic Chemistry and the mole concept, were found not challenging to teach and yet learners found them difficult to comprehend, which may indicate the lack of pedagogical preparation on the part of prospective to transform content knowledge into teaching. The findings further indicate that the topics that learners seem to have no difficulties in comprehending happen not to involve basic mathematical computations. This finding therefore seems to suggest that the problem of the prospective teachers may be lack of sufficient pedagogical strategies and comprehension of basic mathematical skills. There is need therefore for teacher educators to infuse correct pedagogical strategies and core mathematical skills in science teacher training programs. This finding is in line with the research findings that student learning should ascertain core mathematical ideas and skills which learners find difficult (Slylianide & Back, 2004).

When asked to suggest reasons why learners find the said topics difficult, the prospective teachers ranked the reasons as shown in figure 4.7
From the findings in figure 4.7, learner’s negative attitude (37.0%) was ranked the highest, followed by difficult calculations (23.9%) and abstract topics (19.6%), as reasons why learners find some topics difficult to comprehend. This also points to lack of basic mathematical concepts inherent in Chemistry as the course of the negative attitude towards Chemistry by both the teachers and their learners. Resources (8.7%) and time allocation (8.7%) appear not to affect conceptualisation of Chemistry subject matter.

Besides the factors mentioned above, prospective teachers were asked to rank other factors they believed hinder delivery of quality Chemistry instruction. Table 4.3 shows the weighted mean scores for these categorised factors.
Table 4.3 Weighted means and respective ranking for the categorised factors that hinder quality instruction (N=46)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Weighted Mean score (Maximum=5)</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficult content</td>
<td>3.4</td>
<td>4</td>
</tr>
<tr>
<td>Adequacy of materials</td>
<td>4.2</td>
<td>2</td>
</tr>
<tr>
<td>Individual differences</td>
<td>4.2</td>
<td>2</td>
</tr>
<tr>
<td>Negative attitude by learners</td>
<td>4.78</td>
<td>1</td>
</tr>
<tr>
<td>Lack of text books</td>
<td>3.98</td>
<td>3</td>
</tr>
</tbody>
</table>

From Table 4.3 it can be observed that learner’s negative attitude (M=4.78) remains the highest factor that hinder Chemistry instruction. This is despite the joint Kenya/Japan government project SMASSE that is meant to address this challenge. Adequacy of teaching and learning materials still rank very high (M=4.2) as a hindrance despite the school assistance program by the government in the purchase of teaching and learning materials, which can be explained by other factors that may include poor supervision and management of resources by individual schools. On further probing however, majority (78%) of the respondents indicated that lack of teaching/learning resources was hampering efforts for quality Chemistry instruction. The said government assistance program may not be sufficient for acquiring the requisite resources for effective instruction.

4.4.0 Planning and preparations for instruction

4.4.1 Proficiencies for Classroom activities

To decode the level of prospective teacher’s classroom experiences, the study analysed the general quality of instruction, learning resources used or alluded to,
actual modes of assessment applied in class, schemes of work, lesson plan details and level of prospective teacher/learner interaction.

The focus for this knowledge category was to establish whether the prospective teachers were committed to their learners and demonstrated responsibility in managing and motivating student learning. In this study, effort was made to identify factors influencing quality instruction through observation schedules.

Five items on a likert scale frequency continuum were used to discern this information. The items were categorised into the five proficiencies. The results of mean scores and standard deviations used to measure the extent of lesson design proficiencies are shown in table 4.4

**Table 4.4 Proficiencies for lesson design and implementation (N=27)**

<table>
<thead>
<tr>
<th>Proficiencies</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proficiency 1.1 The instructional strategies and activities in the lesson plan designs respected learners prior knowledge and pre conceptions</td>
<td>4.00</td>
<td>0.75</td>
</tr>
<tr>
<td>Proficiency 1.2 The lesson was designed to engage learners as members of a community</td>
<td>3.88</td>
<td>0.90</td>
</tr>
<tr>
<td>Proficiency 1.3 Student explorations preceded formal presentation.</td>
<td>2.37</td>
<td>0.83</td>
</tr>
<tr>
<td>Proficiency 1.4 The lesson encouraged to seek and value alternative modes of investigation and or problem solving</td>
<td>2.66</td>
<td>0.69</td>
</tr>
<tr>
<td>Proficiency 1.5 The focus and direction of the lesson was often determined by ideas originating with learners and followed systematically</td>
<td>1.30</td>
<td>1.38</td>
</tr>
</tbody>
</table>

*Adopted from the reformed teaching observation protocol (RTOP, 2000)*
Table 4.5 Benchmarks for interpretation

<table>
<thead>
<tr>
<th>Standard</th>
<th>Interpretation</th>
<th>Coding scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5 ≥ M ≤ 5.0</td>
<td>Very descriptive</td>
<td>5-V. good</td>
</tr>
<tr>
<td></td>
<td>Optimum</td>
<td>4-Good</td>
</tr>
<tr>
<td>2.5 ≤ M ≤ 3.0</td>
<td>Average effort</td>
<td>3- Average</td>
</tr>
<tr>
<td></td>
<td>Minimum effort</td>
<td>2-Weak</td>
</tr>
<tr>
<td>1.0 ≤ M ≥ 1.5</td>
<td>Never occurred</td>
<td>1-V. Weak</td>
</tr>
</tbody>
</table>

The interpretations are based on consolidation of results from observations of the twenty seven (27) classroom lessons. From Table 4.5, the highest expected mean score is M=5. A mean score in the range of 4.5 and 5.0 represent a very high frequency and describes very descriptive effort. Optimum effort is described by a mean score of between 3.0 and 4.5, representing moderate frequency. A mean score in the range of between 2.5 and 3.0 indicates average frequency and describes average effort and a mean score range between 1.5 and below 2.5 describe low frequency and describes minimum effort. A mean score below 1.5 describes no effort or the activity never occurred at all.

Results were analysed using frequency mean scores and weighted standard deviations as shown in table 4.4. The highest frequency reflected by the highest mean score (M=4.0), corresponds to Lesson Plan or lesson design while the lowest frequency mean score (M=1.3) corresponds to the focus and direction of the lesson. These analyses reveal that the lesson design was in the optimum range, indicating good prevalence by all prospective teachers. The lesson plans however, failed to define learner outcomes, as the remarks column was missing for all the observed cases. The instructional strategies and activities were dominated by question and answer method and learner
note taking. (Appendix; 1V; 1, 2, 3 and 4). Student exploration, alternative modes of investigations like problem solving were minimal (M=2.37). The focus and direction of the lesson was fully determined by the TP teachers. Learners were not given any chance to express their views. Most of the prospective teachers did not however follow their prepared lesson plans. Majority of them depended on prepared lesson notes and/or class text books for information which they dictated to the learners.

Majority of the prospective teachers however did a formal introduction by linking their lessons to previous lessons, using question and answer method, which was commendable. Poor planning and lack of innovativeness was however noted with some lessons lasting as short as twenty five minutes instead of forty minutes for a theory single lesson and thirty to forty minutes instead of eighty minutes for a double lesson respectively. It was further noted that though the teaching/learning resources were well indicated in the schemes of work and lesson plans, they were rarely prepared and utilised for instruction. Lack of adequate time management leads to a lot of time wastage. Poor classroom management and control was evident in a number of observed cases. This finding agrees with Schleicher (2010), survey finding that; lost learning time is closely associated with classroom disciplinary climate, which in turn is closely associated with individual job satisfaction.

Schemes of work and lesson plans are guidelines designed to make teaching and learning more manageable. Schemes of work and lesson plans are usually the starting point in preparing to teach. They help teachers to budget for time so that delivery of instruction remains on target. They also help teachers to prepare for the required resources in good time, guide in planning for continuous assessments, field trips, visits and other school calendar programs. Learners should be regularly referred to the schemes of work, to be able to link them to the way the course is progressing. The
findings however revealed that these documents remained in the prospective teacher’s files. Meaningful schemes of work and lesson plans should contain some key information that has some formative value which include definition of learning objectives, which is about describing in a logical order, the steps necessary to build up the knowledge and understanding of a subject or topic, Teaching activities, which help in the acquisition of knowledge and understanding and learner outcomes, which defines the knowledge and understanding that a learner should have acquired at the end of the lesson. Learner outcomes were however, found to be missing in all the lesson formats observed. Lesson outcomes or remarks column is necessary to ensure that learning objectives have been achieved and that the teaching methods are effective, which enables the teacher to determine whether the learner is ready to move on.

4.5 **Frequency of use of a variety of instructional methods in Chemistry**

The research question addressed the type of methods commonly applied by prospective teachers in facilitating Chemistry classroom instruction. Figure 4.8 shows the findings of the study.
Figure 4.8 reveals that most prospective teachers indicated that the most common method of instruction they applied for teaching was teacher demonstration (95.7%), followed by question and answer (91.3%) and class experiment (82.6%). Group work (73.9%) and lecture method (52.2%) were also rated high respectively. The rarest modes of instruction were e-learning (95.7%), field work (93.5%) and project work (93.5%). Most teachers and school administrators consider field work and class projects as time wasting, expensive and as methods that disrupt learning. These policies by individual schools may explain why these methods of instruction are hardly used in teaching, thus affecting quality instruction.

For the lecture method, the findings can be considered in order for chemistry and other science subjects, as this is the common method for introducing and explaining scientific principles, theories and laws. The interactive methods were however observed as minimum or below average when compared to direct methods of
instruction. Chemistry is supposed to be taught practically in a laboratory through experiments, with hands on experiences. Research reveals that use of technology in the classroom is beneficial to learners and teachers, as it prepares learners for the real world by simulating real environments as well as improving skills that might not otherwise be fully cultivated in a traditional learning setting. In addition, learners acquire numerous ways of solving problems. Studies further demonstrate that Information Communication and Technology (ICT) tools stimulate learner’s sensory and cognitive curiosity, develop life skills, boost self confidence and facilitate the learning of abstract ideas and theories. Use of applications like power point with relevant images can serve to make a class lively and attractive to learners at different levels. With the help of ICT, teachers can creatively design programmes that are learner centred and promote quality learning. The only way to improve learner’s outcome is therefore the improvement of instructional practice through variation of instructional methods. ICT should be integrated in the teaching and learning process to help enhance acquisition of key skills in Information Technology, (IT) among teachers.
Table 4.6 Proficiencies for procedural knowledge (lesson Development) N=27

<table>
<thead>
<tr>
<th>Proficiencies</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proficiency 3.1 Learners used a variety of means (models drawings, graphs, multi media elements, concrete materials, manipulations, etc) to represent phenomena( use of resource materials)</td>
<td>2.48</td>
<td>1.15</td>
</tr>
<tr>
<td>Proficiency3.2 Learners made predictions, estimations and were actively involved in devising and performing lesson activities.</td>
<td>2.52</td>
<td>1.14</td>
</tr>
<tr>
<td>Proficiency 33 Learners were actively engaged in thought provoking activities that often involved the critical assessment of procedures.</td>
<td>2.30</td>
<td>0.82</td>
</tr>
<tr>
<td>Proficiency 3.4 Learners were exposed to a variety of suitable methods of instruction.</td>
<td>2.41</td>
<td>0.844</td>
</tr>
<tr>
<td>Proficiency 3.5 Intellectual rigor, constructive criticism and the challenging of ideas were valued</td>
<td>1.94</td>
<td>0.92</td>
</tr>
</tbody>
</table>

From the analysis in table 4.6, it can be shown that, prospective teachers seem to have failed to seize the opportunity to transform learners misconceptions into comprehensible knowledge by not involving them in devising lesson activities, (M=2.52), as well as not engaging them in thought provoking activities (2.30) that involve critical assessment procedures. Teachers should not only be regarded as implementers of curriculum but as designers of learning opportunities and environments as well. Use of a variety of resources was observed to be minimal (M=2.48). The common resource that was used in most of the observed cases apart from the chalkboard was the Manila paper. There was no evidence of improvisation of locally available materials for classroom instruction in any of the observed lessons. Multimedia elements such as text, graphics, audio videos and animations delivered on a computer or other electronic device, increase learners interactivity with knowledge and resources which enhances improved conceptualisation and skill acquisition. Most of the prospective teachers did not vary the modes of instructional methods applied, (M=2.41). The use of one way formal lecture mode of instruction was quite evident.
Intellectual rigor and constructive criticism (M= 1.94) were curtailed as the trainee teachers formed the source of information with learners copying class notes and remaining passive listeners throughout entire lessons. This finding indicates that most of the prospective teachers rely on the traditional didactic rather than the heuristic methods of instruction. These approaches make science concepts abstract to learners and therefore difficult to comprehend. This finding reveals lack of sufficient pedagogical preparation in teacher education programs. The finding partially agree with that of a survey done by TALIS, (OECD) ,that cites lack of pedagogical preparation of teachers as one of the factors hindering their work (as cited in Schleicher, 2010)

Table 4.7 shows proficiencies for content knowledge where, the researcher observed prospective teachers content knowledge mastery, symbolic representations, and theory building. Prospective teacher’s commitment to promote coherent conceptual understanding and connections with other content disciplines were also observed.

**Table 4.7 Proficiencies for content knowledge (N=27)**

<table>
<thead>
<tr>
<th>Proficiencies</th>
<th>Mean</th>
<th>S D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proficiency 2.1 The lesson involved fundamental concepts of the subject</td>
<td>2.58</td>
<td>1.84</td>
</tr>
<tr>
<td>Proficiency 2.2 The lesson promoted strongly coherent conceptual understanding through clear and concise explanations</td>
<td>2.60</td>
<td>1.22</td>
</tr>
<tr>
<td>Proficiency 2.3 The teacher had a solid grasp of subject matter content inherent in the lesson</td>
<td>3.52</td>
<td>0.57</td>
</tr>
<tr>
<td>Proficiency 2.4 Elements of abstraction (i.e. symbolic representation, theory building) were encouraged when it was important to do so</td>
<td>3.00</td>
<td>1.44</td>
</tr>
<tr>
<td>Proficiency 2.5 Connections with other content discipline were explored and valued</td>
<td>2.00</td>
<td>1.18</td>
</tr>
</tbody>
</table>
Majority of the prospective teachers showed subject content mastery (M=3.52). Others however, seemed to lack solid grasp of the subject content and were not coherent in their presentation (M=2.60). One case was noted where a form one student asked a question during a lesson on states of matter. The question asked was; “what is naphthalene” the trainee teacher’s response was, “a solid substance”. This showed lack of subject content mastery on the part of the prospective teacher’s coherent concept development.

4.5.1 Proficiency for prospective teachers practical activities

The prospective teachers were asked if the laboratory practical experiences they are exposed to at the University were sufficient. Majority of the respondents (72.8%) felt that the practical experiences they are exposed to are sufficient in preparing them to teach secondary school chemistry, with only (9.1%) disagreeing.

On further discussions the prospective teachers indicated that the laboratory practical skills learnt at the university were acquired during the experimental Chemistry class work in the Chemistry department. They further indicated that preparations of chemical solutions and reagents for class experiments are always done for them in advance by laboratory technicians, thus denying them the opportunity to learn how to prepare chemical solutions and reagents for laboratory experiments. The Educational Communication and Technology Department does not expose prospective teachers to any form of laboratory skills and experiences on how to prepare for practical laboratory experimental work. The department does not have a laboratory of its own for science laboratory experimental activities/exercises. The prospective teachers appear to acquire practical skills during their Chemistry subject class lessons, which may not be sufficient as the content, concepts and skills taught at the university may
not be related to the practical competences required at secondary school level. One of the prospective teachers was quoted saying “some of us go without performing any practical experiment for the whole semester because of the big numbers of our working groups which on average consists of six members for each group”. These big groups often result into, “most students simply copying experimental reports from past student experimental work since the experiments are recipe experiments repeated over years”. This may imply the un-preparedness by prospective teachers for the secondary Chemistry laboratory learner experimental work, which might be one of the reasons why the classroom practical activities were observed as minimum. Table 4.8 shows observed prospective teachers classroom experimental acts.

Table 4.8 Prevalence of prospective teacher’s practical classroom acts (N=20)

<table>
<thead>
<tr>
<th>Review of lessons</th>
<th>Learner Experiment</th>
<th>Group Discussion</th>
<th>Use of worksheets</th>
<th>Teacher Demonstration</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 (100%)</td>
<td>6 (30%)</td>
<td>4 (20%)</td>
<td>0%</td>
<td>14(70%)</td>
</tr>
</tbody>
</table>

Table 4.8 reveals an overreliance on the traditional direct strategies of instruction, compared to the interactive approaches required during laboratory learner experimental lessons. The findings from the prospective teacher’s questionnaire do not correlate with the classroom observation findings. The prospective teacher’s responses might have been as a result of what they felt should be the ideal situation rather than the actual classroom experience. This is because majority (82.6%) of the sampled prospective teachers (Figure 4.8) indicated learner experiments as one of the methods often used in classroom laboratory instruction compared to (30%) in the observed cases. The high prevalence for teacher demonstration method (70%) was however expected because practical activities at junior secondary school level rely
heavily on teacher demonstration experiments because of safety precautions. All the observed teacher demonstration experiments were however, teacher centred where learners were placed in a passive role. Most trainee teachers did not prepare procedures for the demonstration experiments. The practical worksheets were missing altogether. The prospective teachers either read procedures directly from the textbooks or from prepared class notes, yet the learners had the same textbooks as their class course books, which lead to a lot of time wasting and passive learning in a number of observed cases. Most of the practical lessons took about half of the allocated time, with some taking as little as twenty minutes to completion. This showed lack of proper lesson planning. Aspects like preparing indicators from flower extracts, that should take a few minutes were in one case extended to eighty minutes, a whole double lesson. This may indicate lack of sufficient preparation. Teacher centred laboratory demonstrations rarely involve the learners, denying them acquisition of important practical manipulative skills. Majority of the prospective teachers pre-empted the experimental results, instead of allowing learners to carryout experiments, make observations and inquiries to discover and verify scientific concepts for themselves. Although use of deductive laboratory experiments helps to reinforce subject matter content taught in classrooms, it lowers the curiosity and interest of the learners. The most important feature of effective science education is to support theoretical explanations with actual learner practices through learner experiments. Learners should be able to use practice as a context to advance the development of theoretical knowledge. Although most prospective teachers did not involve their learners in actual practical activities, because of poor lesson planning and scarcity of resources in the TP schools. However, about thirty per cent (30%) of them had learner experiments carried out in groups as the trainee teachers moved
round the groups correcting and encouraging learners. The learners followed given procedures, practised various science process skills, through inquiry, which enhanced teamwork and development of concepts through observations and inferences.

These research findings support Teaching and Learning Survey study (TALIS), whose findings indicated that teachers tend to show similar beliefs about how to teach where actual teaching practices often do not match their intentions (as cited in Schleicher (2010). Teachers in most cases use traditional practices aimed at transmitting knowledge in structured settings much more often than they use student oriented practices such as adapting teaching to individual needs.

From the analysis of lesson observations, the study established that prospective teachers were not sufficiently proficient in handling practical laboratory lessons as enhanced learning activities that require deeper and sustained cognitive learner activities were minimal.

**Table 4.9 Proficiencies for Learner/Teacher Relationship (N=27)**

<table>
<thead>
<tr>
<th>Proficiencies</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proficiency 5.1 Active Participation of learners was encouraged and valued,</td>
<td>4.93</td>
<td>1.29</td>
</tr>
<tr>
<td>teacher kept class registers, progress records for individual learners.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proficiency 5.2 learners were encouraged to generate alternative solution</td>
<td>2.48</td>
<td>1.18</td>
</tr>
<tr>
<td>strategies and ways of interpreting evidence.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proficiency 5.3 The teacher had follow up activates like check correct, and</td>
<td>1.74</td>
<td>0.85</td>
</tr>
<tr>
<td>mark learners work, as well as giving additional work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proficiency 5.4 The teacher acted as a resource person, working to support</td>
<td>2.93</td>
<td>1.13</td>
</tr>
<tr>
<td>and enhance learner investigation. Organise the classroom to stimulate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>interest, full participation and good behaviour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proficiency 5.5 The teacher appeared confident cheerful and firm to inspire.</td>
<td>3.00</td>
<td>1.96</td>
</tr>
</tbody>
</table>
Table 4.9, shows that most of the prospective teachers had up to date class registers and record of work covered books (4.93) and appeared to encourage learner participation as well as valuing their responses. However the trainee teachers seemed to lack sufficient confidence (M=3.00) in encouraging learners to generate alternative solutions. They were rather seen as authorities of knowledge (M=2.93) and not as resource persons guiding learner investigations.

On average, majority of the prospective teachers failed to carry out follow up activities such as checking, correcting and marking learners work, giving additional work and having time for individual learners (M=1.74), to ascertain achievement of the set instructional objectives. In a number of cases, wrong diagrams, formulae and equations were noted in the learner’s notebooks during classroom teaching. Chorus responses were noted in a number of cases, indicating lack of classroom control. Prospective teacher’s inability to sustain learner’s attention often resulted into indiscipline in a few observed cases. These findings are in conformity with TALIS (2009), finding, which indicate that classroom climate has been shown to affect students’ outcome and attainment. The survey further notes that structuring and student oriented practices tend to be associated with a pleasant, orderly classroom climate which in turn tends to go with teacher-efficacy and job satisfaction

4.5.2 Assessment Methods

The study sought to investigate the importance the prospective teachers placed on different modes of assessment and how they utilized the assessment results obtained during classroom instruction. Figure 4.9 illustrates the percentages of the different modes of assessment applied by the prospective teachers during their classroom instruction
Findings from figure 4.9 indicate that the highest mode of assessment applied by the prospective teachers was class observations (90.9%), followed by oral questioning (75.7%). This was expected as this mode of assessment is common because it’s done on the spot informative assessment classroom lessons. Assignments (90.9%) and written questions (69.7%) were rare and this was also expected as the prospective teachers had been in their TP classes for only a short time when the study was conducted. Written questions are common during summative assessment at the end of term or year and not in formative assessments. Project work as an assessment mode (0%) was nonexistent. This may be expected based of the fact that despite being in their TP classes for a short time, this mode of assessment is not used at the Kenya Certificate of Secondary Education Examinations (KCSE). Modes of assessment in schools often follow the same pattern as those used at KCSE national examinations; this is because most schools begin preparing their students for national examinations.
from as early as lower secondary school, in order to compete favourably in our high stakes examination oriented education system. These findings differ with those of Morgul & Secken (2009), whose findings indicated that project-oriented Chemistry laboratory practice does in fact have an impact on improving student’s scientific process skills.

Table 4.10 Proficiencies for communication Interaction (Classroom Culture) N=27

<table>
<thead>
<tr>
<th>Proficiencies</th>
<th>Mean</th>
<th>S D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proficiency 4.1 Learners were involved in the communication of their ideas to others using a variety of means and media.</td>
<td>3.00</td>
<td>1.62</td>
</tr>
<tr>
<td>Proficiency 4.2 The teacher’s questions triggered divergent modes of thinking, using varied and appropriate questioning techniques</td>
<td>2.52</td>
<td>0.89</td>
</tr>
<tr>
<td>Proficiency 4.3 There was a high proportion of learner talk and questions were well distributed among learners.</td>
<td>2.63</td>
<td>1.00</td>
</tr>
<tr>
<td>Proficiency 4.4 Learners’ questions and comments often determined the focus and direction of classroom discourse</td>
<td>1.50</td>
<td>1.84</td>
</tr>
<tr>
<td>Proficiency 4.5 Pupils responses were used to further their understanding</td>
<td>2.60</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Adapted from the reformed teaching observation protocol (RTOP, 2000)

The mean score of (M=3.00) and below across the items as shown in table 4.10 suggests that there was minimal classroom communication interaction to further learner understanding. There was however a good attempt in using the question and answer method in the lesson development although, the questions asked were few and not thought provoking. Most of the prospective teachers however, lacked the initiative, creativity and confidence to motivate learners. About thirty per cent of the trainee teachers were however fluent and effective in their classroom communication. Lack of proper questioning techniques (M=2.52) and selected responses from bright learners was evident in a number of cases observed. This made majority of the other learners passive thus affecting their attention to instruction. The focus and direction of
the lesson was fully dependent on the prospective teachers (M=1.50). Learners were not involved in determining the direction of what they learned in class. There was therefore no democracy in the classes observed as all the teaching and learning activities were determined by the teacher.

4.6.0 Learners Attitudes towards Chemistry Instruction

To solicit for information on learner’s attitude towards Chemistry instruction, the study used a series of questions on the utility, importance and enjoyability of Chemistry as a subject by the learners. Learners perception about the value of learning Chemistry may be considered as both an input and output variable because their attitude towards Chemistry as a subject can be related to educational achievement in ways that reinforce higher or lower performance. Learners who do well in Chemistry will generally have a positive attitude towards the subject. Those learners with a high positive attitude thus tend to perform better.

Table 4.11 Learners frequency Cross tabulation on their liking for Chemistry (N=259)

<table>
<thead>
<tr>
<th></th>
<th>I like Chemistry</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Male percentage</td>
<td>80.6%</td>
<td>19.4%</td>
</tr>
<tr>
<td>Total percentage</td>
<td>84.1%</td>
<td>15.9%</td>
</tr>
<tr>
<td>Female percentage</td>
<td>86.7%</td>
<td>13.3%</td>
</tr>
<tr>
<td>Total percentage</td>
<td>86.7%</td>
<td>13.3%</td>
</tr>
<tr>
<td></td>
<td>84.1%</td>
<td>15.9%</td>
</tr>
</tbody>
</table>

From table 4.11, it’s evident that majority of learners sampled (84.1%) like Chemistry as a subject. Only a small percentage (15.9%) indicated a dislike of the subject. This implies that most learners have a positive attitude towards learning Chemistry. The poor performance in Chemistry at secondary school level may not be as a result of the
negative attitude by learners as alluded to by the prospective teachers. The poor learner attitude may be created at school by the persistent poor teaching methods and lack of teaching and learning resources, among other factors. Research should thus be carried out to establish factors responsible for the certain change in attitude by learners during the process of learning.

4.7.0 Summary

The findings in this study have shown that factors such as the teaching and learning methods, modes of assessment and learners attitude can directly influence classroom instruction, while other classroom factors such as the course programs offered, i.e. topics not well addressed, those found challenging to teach and the ones learners find difficult to comprehend may indirectly influence performance.

The critical finding was the mismatch between the course content taught at the universities and the expectations of the basic education sector.
CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This study aimed at establishing the preparedness of Kenyatta University prospective teachers to facilitate Chemistry instruction at secondary school level. Five factors;

(i) Relevance of university Chemistry course content to the expectations of secondary school Chemistry curriculum,

(ii) Planning and Preparations for instruction,

(iii) Capacity of prospective teachers to provide instruction opportunities for achievement of the set learning objectives,

(iv) Proficiency of the prospective teachers to handle practical lessons and

(v) The learner’s attitude towards Chemistry instruction was investigated in the study. The findings were analyzed using both descriptive and inferential statistics. This chapter discusses the conclusions and recommendations from the findings of the study and suggests some recommendations.

5.2 Relevance of Chemistry course content to the secondary school syllabus

The research analyzed the extent to which Kenyatta university Chemistry teacher training course outlines are relevant to the secondary school Chemistry curriculum expectations. The study used data from prospective teacher’s questionnaire on whether the course outlines they are exposed to help them to effectively facilitate secondary school Chemistry instruction. The research findings indicated that there exists a mismatch between the university Chemistry course content and the secondary
school Chemistry syllabus requirements. Majority of the respondents (67.4%) felt that the Chemistry course content taught at the university was not related to the secondary Chemistry curriculum. Over half (56 %) of the respondents felt that there were topics/concepts that were not well addressed at the university, while (45%) of the respondents confessed that there were Topics/Concepts at secondary school level which they found challenging to teach. Most of the prospective (93.9%) felt that there were topics/concepts that learners found difficult to comprehend during class instruction, while (64.5%) felt that the teaching practice period provided is not sufficient. This implies that there is a mismatch between what is taught at the university and the expectations of the secondary school Chemistry course content and similarly, the course duration in not sufficient. The findings partially agree with the World Bank (2005), and the sessional paper No. 1 of 2005-Kenya reports, which points out that, there is a mismatch between the radically new key competencies demanded of students in the knowledge based society and the teaching skills acquired from teacher training colleges.

5.3.0 Planning and preparations for effective classroom management and teaching

5.3.1 Schemes of work and Lesson Plans;

From the findings, it was revealed that schemes of work and lesson plans prepared by the prospective teachers contained most of the relevant details required for effective instruction apart from the learner outcomes or remarks column which was missing and yet is important in evaluating lesson achievement. The findings further indicated that although most prospective teachers had on average well organized lesson plans with relevant information, the lesson plans were not appropriately followed during
class instruction. Majority of the prospective teachers use prepared lesson notes and/or copied notes from the class course textbook.

5.3.2 Instructional procedures and strategies

The research question under investigation was to establish the different types of instructional procedures and strategies used by prospective teachers during their classroom and laboratory lessons. The study used data from the prospective teacher’s questionnaire and an observation protocol to compare what the prospective teachers said they did or alluded to and what they practiced in class. From the findings, majority of the prospective teachers in their questionnaire responses claimed to employ heuristic methods or approaches in their classroom teaching including; class experiment (82.6%), teacher demonstration (95.7%) and group work (73.9%). From the class observation schedules however, it was evident that the most common methods of instruction applied were lecture and teacher demonstration for practical lesson experiments. Twoli (2006), argues that the teacher demonstration method has the disadvantage of making learners passive and is likely to lose out on the chance to practice important manipulative skills. The rarest method of instruction was e-learning. Technology is revolutionizing the way people communicate and conduct business, yet it has been slow to penetrate the school curriculum.

5.4 Proficiency for Practical activities

The finding revealed that, prospective teachers’ proficiency in handling practical learning interactions during laboratory investigations was observed as minimum. Laboratories were non-existent in most schools especially private schools. Classrooms in many of this category of schools are too small and congested for effective teaching and learning processes. Provision of physical facilities in schools ought to be given
priority as they appear to be seriously affecting learning in many schools especially the private schools. Learning of chemistry and other basic science subjects cannot be effective without a laboratory or a science room as was evident in many schools visited.

5.5 Learner’s attitude towards Chemistry instruction

The findings indicated that Chemistry learners had a positive attitude towards Chemistry learning. The poor performance in Chemistry may not be emanating from the negative attitude on the part of the learners as was indicated by the prospective teachers (Table 4.10). Teachers should take advantage of this positive attitude towards Chemistry instruction to engage and capture the interest of the learners by utilizing all the instructional techniques in their repertoire for improved learner outcomes.

5.6 Implications of the Study

The findings of the study are important for teacher trainers at the universities and other teacher training colleges. Universities can use the findings in this study to re-assess the course programs offered for education students in re-aligning the syllabi or course programmes to the expectations of the secondary school Chemistry syllabus course content and in addressing the dictates of Kenya’s vision 2030.

University prospective teachers may find the data useful in expanding their opportunities by applying interactive methods of instruction to improve their performance as proficient teachers. The trainee teachers may also utilize the findings in motivating their learners by enhancing classroom teacher/learner interaction.
Policy makers and school administrators can use the findings in making informed decisions about the state of learning and teaching facilities in schools. This is especially the conditions of school laboratories and the general learning environment for science education. Researchers in education can strengthen these findings by expanding the study on the relevance of university course programs in other subject areas in line with the requirements of the job market.

5.7.0 Recommendations

Following the findings in this study that the Chemistry course content programs offered at the university may not be relevant to the secondary school Chemistry syllabus, the following recommendations need to be taken into consideration by the universities, teachers, curriculum developers and education policy makers, for quality learning and improved performance in Chemistry and other science subjects at both the university and school levels.

(a) To improve on the quality of Chemistry learning and teaching at secondary school level, there is need to re-align the Chemistry teacher course programs taught at the university to the secondary Chemistry school curriculum. Subject content standards should be established for teacher training and be evaluated periodically with a global orientation in terms of competition for opportunities and international collaborations based on research.

(b) Chemistry and Science Education programs at the university should be tailored to the expectations of secondary school and diploma colleges syllabi requirements and avoid lumping them together with the general science Chemistry course programs as may be the case. Universities should carry out a curriculum reform to identify suitable Chemistry content for education students that will address the
needs and expectations of high school learners, majority of whom have KCSE as their terminal course. The teaching practice period should be increased from the current three months to at least six months duration in order to give trainee teacher’s sufficient time to master the requisite pedagogical skills and gain confidence in teaching.

(c) Kenya Institute of Education (KIE) should liaise with schools of education at the universities’ as well as other research institutes for professional guidance and harmonious corroboration during the school curriculum reviews and reforms in individual subject areas.

5.7.1 Preparation for instruction

The results of this study indicate that preparations for instruction and the teaching strategies used by prospective teachers are not effective. This calls for new approaches to managing classroom instruction such that;

i) Chemistry and science prospective teachers are exposed to interactive teaching approaches at their teacher training colleges, where they are able to develop and use experimental design in scientific inquiry and use the language of science to communicate and apply scientific concepts skills and processes in their classroom and everyday life. To be able to do this, key resources should be availed in all secondary schools.

ii) There is need for a paradigm shift from the content based curriculum to a competency based curriculum (CBC), which emphasises development of learner’s skills and competencies for everyday life, making the learner the main actor and the teacher the facilitator during classroom instruction. To be
able to do this will however require that, key resources and facilities are provided schools.

iii) Schemes of work and lesson plans are vital tools in preparation for instruction. From the findings of this study, it has been revealed that lesson plans may not be adding any value to improve classroom instruction because it appears they are not followed in the teaching/learning process. It is therefore, recommended that the current lesson plans be done away with and instead, new lesson or work plans be re-formatted to include summary lesson notes and learner outcomes.

iv) There is need for ICT Integration in teacher training programs at the university to ensure e-confidence for improved ICT integration in Chemistry instruction in order to strengthen the teaching techniques of student teachers.

5.7.2 Proficiency in handling practical activities

Laboratory work provides learners with concrete and authentic first hand experiences that help them develop a better understanding of scientific concepts, principles and theories discussed in classrooms. Policies should be put in place such that;

a) Universities should set up active and well equipped science laboratories and/or resource centres for teacher training in science education pedagogical skills specifically for the department of Educational Communication and Technology.

b) Each secondary school should have an active standard and a well stocked science laboratory with the required Chemistry equipments, facilities and chemicals before it is registered.
5.7.3 Recommendations for further Research

The study has identified gaps that could be researched on to support its findings. The study identified a mismatch between the university Chemistry education course curriculum and the expectations of secondary school Chemistry syllabus. This implies that there is need for a study to examine and harmonize the Chemistry syllabi at both school and university levels for improved student achievement and other market demands.

Research in effective classroom practice need to be carried out to assist teachers in their pedagogical content knowledge for improved teaching strategies and confidence among prospective teachers. This is because, the learner’s high expectations from teachers require meaningful engagement in science process skills in classrooms and laboratory management.

There is little doubt that a more thorough study in teacher preparation-teacher practices-student outcomes relationship in other teaching subjects would be beneficial in knowing much about what prospective teachers are learning in teacher training programmes that they then implement in the classrooms to further student learning. Such research would provide empirical evidence on the specific practices or types of practices that contribute most to learner success. With evidence on what teachers learn in their training programs, what they subsequently do in their classrooms and what their learners learn as a result, we may have the information we need to work towards creating better teachers, better teaching and better classroom outcomes.

Generally prospective teachers, possess the required basic Chemistry subject content matter mastery and skills for teaching at secondary school level, but are not yet to the required standard. This is supported by observed lack of confidence among
prospective teachers. Most prospective teachers introduced their lessons by relating to what had previously been taught in class, using the question and answer technique and tried to capture learner’s attention and maintain it throughout the lesson. They are however yet to integrate constructivism in their teaching and learning processes.
REFERENCES


**International Association for the Evaluation of Educational Achievement.** (1998). TIMSS International Study Center: Boston College Chestnut Hill, MA, USA.


Kenya Institute of education .Nairobi


**Kennedy, M.M. (2008).** *Sorting out Teacher Quality.* Phi Delta Kappan, 90 (1), 59-63


Lambert, L. (1985). *How Teachers Manage to Teach, Perspectives on problems in practice*; Harvard education review, 55(2) 178.194


**Schleicher, A. (2010).** Lessons from the world on effective Teaching and learning Environments. *Journal for Teacher education* 62(2) 202-221 @ American Association of colleges for teacher education, http://www.sagepub.com/journal permission


APPENDIX: I

TEACHERS’ QUESTIONNAIRE GUIDE TO BE ADMINISTERED TO THE CHEMISTRY T.P STUDENTS TEACHERS IN SELECTED SCHOOLS.

INTRODUCTION

The purpose of this questionnaire was to solicit for information concerning teacher preparedness for quality Chemistry instruction at secondary school level from Kenyatta University teaching practice student teachers in Nairobi Teaching Practice zone.

You are kindly requested to honestly respond to the questions that follow. Your cooperation will assist this study to achieve its objectives of determining the quality of Chemistry instruction offered at secondary school level.

The information you give will be used for the purpose of this study only and it will be treated as confidential information.

SECTION A

1. Gender: Male [ ] Female [ ]

2. What was your first choice career course of study before joining the university?

3. Do you intend to stay on in teaching as a professional teacher or what are your future plans as regards career choice?

4. What is your second teaching subject specify whether you are a major, regular or minor Second teaching subject?

5. Comment on the following modalities as put in place for the following,

   (a) Is the teaching practice (TP) duration given sufficient for the course?

      Yes [ ] No [ ]

   (b) Give reasons and any suggestions (for yes or no)..............................
      What would be the best duration......................................................
6. (a). In your own assessment, do you think the Chemistry course content taught at your college is related to secondary school chemistry course content outline?

   Yes [ ]    No [ ]

(b) If your answer in (a). Above is No, which subject topics/concepts are not well addressed in the college syllabi that are important for Chemistry instruction at secondary school? (Name (3) of the topics/concepts) ………………………………….

……………………………………………………………………………………

……………………………………………………………………………………

7 i) In your evaluation of the Chemistry course content taught at secondary school, are there any topics/concepts that learners find difficult to comprehend?

   Yes [ ]    No [ ]

 ii) If your response in 7 (i).above is no, name (3) the topics/concepts ………………………………….

……………………………………………………………………………………

……………………………………………………………………………………

 iii) What could be the reason(s) why learners find the said topics difficult or challenging?

……………………………………………………………………………………

……………………………………………………………………………………

8. (i) Are there any Chemistry topics or concepts which you find challenging to teach at secondary school level?

   Yes [ ]    No [ ]

(ii) If your answer in 8. (i) Above is yes, name them.

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………
9. To what extent do you agree that the Chemistry subject content taught at university helps in achievement of the set Chemistry syllabus objectives/content taught at secondary school?

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Undecided</th>
<th>disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. To what extent do you agree that the Chemistry practical experiences you are exposed to during your coursework are sufficient in preparing you to teach secondary school Chemistry practical lessons?

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SECTION B

11. To what extent do you agree that the following factors hinder delivery of quality Chemistry instruction at secondary school level.

<table>
<thead>
<tr>
<th>Factor</th>
<th>S. A</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Difficult content</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Adequacy of instructional material</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Individual differences among learners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) Negative attitude by learners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) Lack of appropriate materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
12. How often do you use the following methods of teaching? (Indicate the frequency of use in the table)

<table>
<thead>
<tr>
<th>Teacher Method</th>
<th>Very often</th>
<th>Often</th>
<th>rarely</th>
<th>never</th>
<th>Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question &amp; answer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class Experiments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher Demonstration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lecture method</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field trips</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e-learning (IT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

13. Indicate the frequency of use of the following assessment methods in your Chemistry class.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Daily</th>
<th>Once a week</th>
<th>Twice a week</th>
<th>Once a term</th>
<th>Not at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Written question</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>b) Observation</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>c) Oral questioning</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>d) Projects</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>e) Assignment</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>
14. Rate the extent to which the following are ways of utilizing test results to enhance learning in Chemistry.

<table>
<thead>
<tr>
<th></th>
<th>S A</th>
<th>A</th>
<th>UD</th>
<th>D</th>
<th>S D</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Promotion of learners to the next class</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Find out weak learners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) assess achievement of learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>objecties</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) results used to motivate learners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) Assess ability of different learners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f) Provide feedback to teachers and</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>learners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g) Utilize results to improve performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

15. Are the required facilities and resources for quality Chemistry curriculum implementation sufficient?

   Yes [   ]         N0 [   ]

If No, specify how you go about teaching without resources and facilities to achieve your instructional objectives in Chemistry………………………………………………………………………………………….
APPENDIX: II

CHEMISTRY LEARNERS' ATTITUDE QUESTIONNAIRE

The purpose of this questionnaire was to solicit for information concerning Form Two learner’s attitude towards Chemistry instruction in Nairobi Teaching Practice zone.

You are requested to kindly respond to the questions below. Your responses will be used for the purpose of this study only. The questionnaire consists of two sections A and B. Respond to all the questions in both sections.

SECTION A

1. Sex      Male [ ]    Female [ ]

2. What would you like to become (career) when you finish school...........................................

SECTION B

Below are statements regarding chemistry instruction with letters SA (Strongly Agree), A (Agree), UD (Un-decided), D (disagree), SD (Strongly Disagree) against each statement. This study is interested in sharing your feeling about each statement. Respond by ticking in the column with the most appropriate letter(s) depending on how you feel about each statement.

3. Do you like Chemistry as a subject?

Yes [ ]    No [ ]

If yes, go to question (4) and if No, move to question (5)

4. I like Chemistry because:

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) It is interesting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) It is well taught</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) It is applicable in daily life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) It is easy to understand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) It has many practical experiments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f) It gives new knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g) It has good career prospects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.) I do not like Chemistry because

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(h)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(j)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(k)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(l)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## APPENDIX: III

### CHEMISTRY TEACHERS OBSERVATION SCHEDULE.

### 1. SCHEME OF WORK

<table>
<thead>
<tr>
<th>PROFIENCY</th>
<th>RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never Occurred</td>
<td>Highly Descriptive</td>
</tr>
<tr>
<td>Very Weak</td>
<td>Weak</td>
</tr>
<tr>
<td>Average</td>
<td>Good V, Good</td>
</tr>
</tbody>
</table>

### i) Did the scheme have the relevant details like Week, Lesson, Topic, Sub-topic/content. | 1 | 2 | 3 | 4 | 5 |

### ii) Objectives: Were they well stated? Specific, Measurable, attainable, | 1 | 2 | 3 | 4 | 5 |

### iii) Teaching/learning methods, | 1 | 2 | 3 | 4 | 5 |

### iv) Teaching/learning resources | 1 | 2 | 3 | 4 | 5 |

### v) Learning aids: were they varied? | 1 | 2 | 3 | 4 | 5 |

### vi) Remarks: Were the remarks comprehensive and informative? | 1 | 2 | 3 | 4 | 5 |

### vii) Was the scheme followed appropriately? | 1 | 2 | 3 | 4 | 5 |

### 2. LESSON PLAN

<table>
<thead>
<tr>
<th>PROFIENCY</th>
<th>RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never Occurred</td>
<td>Highly Descriptive</td>
</tr>
<tr>
<td>V. Weak</td>
<td>Weak</td>
</tr>
<tr>
<td>Average</td>
<td>Good V, Good</td>
</tr>
</tbody>
</table>

### a) Was the lesson suitably organized? (Layout) | 1 | 2 | 3 | 4 | 5 |

### b) Were the lesson objective clearly defined? | 1 | 2 | 3 | 4 | 5 |

### c) Was the introduction, available and suitable? | 1 | 2 | 3 | 4 | 5 |

### d) Was the content well organized and timed? | 1 | 2 | 3 | 4 | 5 |

### e) Was the conclusion available? Was it suitable? | 1 | 2 | 3 | 4 | 5 |

### f) Was it followed throughout the instruction? | 1 | 2 | 3 | 4 | 5 |
3. LESSON PRESENTATION

<table>
<thead>
<tr>
<th>PROFICIENCY</th>
<th>RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>Highly</td>
</tr>
<tr>
<td>Occurred</td>
<td>Descriptive</td>
</tr>
<tr>
<td>V. Weak</td>
<td>Weak</td>
</tr>
<tr>
<td>Weak</td>
<td>Average</td>
</tr>
<tr>
<td>Good</td>
<td>V. Good</td>
</tr>
</tbody>
</table>

|       | V. Weak | Weak | Average | V. Good |

i) Introduction

Did the introduction:

a) Arrest learner’s attention and interest? 1 2 3 4 5
b) Link new material with old? 1 2 3 4 5
c) Relate to the lesson? 1 2 3 4 5
d) Was it well timed? 1 2 3 4 5

ii) Lesson Development

<table>
<thead>
<tr>
<th>PROFICIENCY</th>
<th>RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>Highly</td>
</tr>
<tr>
<td>Occurred</td>
<td>Descriptive</td>
</tr>
<tr>
<td>V. Weak</td>
<td>Weak</td>
</tr>
<tr>
<td>Weak</td>
<td>Average</td>
</tr>
<tr>
<td>Good</td>
<td>V. Good</td>
</tr>
</tbody>
</table>

Did the teacher:

a) Involve learners in the lesson? 1 2 3 4 5
b) Sustain learners’ interest? 1 2 3 4 5
c) Use language appropriate for the learners? 1 2 3 4 5
d) Use clear and concise explanations? 1 2 3 4 5
e) Have sufficient Chemistry subject mastery? 1 2 3 4 5
f) Use varied and suitable instruction methods? 1 2 3 4 5
h) Use varied and appropriate questioning techniques? 1 2 3 4 5
i) Distribute questions appropriately? 1 2 3 4 5
i) Make use of pupil’s responses to further their understanding?  
   1 2 3 4 5

j) Continuously assess the learner’s mastery of the topic/content?  
   1 2 3 4 5

k) Use resource materials effective?  
(Charts, maps, diagrams, models, etc.)  
   1 2 3 4 5

### iii) Conclusion

<table>
<thead>
<tr>
<th>PROFICIENCY</th>
<th>RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>Highly Descriptive</td>
</tr>
<tr>
<td>V.Weak</td>
<td></td>
</tr>
<tr>
<td>Weak</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>V.Good</td>
<td></td>
</tr>
</tbody>
</table>

**Did the teacher:**

a) Consolidate/revise/recapitulate the work covered?  
   1 2 3 4 5

b) Achieve the lesson objectives?  
   1 2 3 4 5

### i v). Prevalence of teacher practical classroom activities

<table>
<thead>
<tr>
<th>Review of lessons</th>
<th>Class experiments</th>
<th>Group discussion</th>
<th>Use of worksheets</th>
<th>Teacher demos</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. CLASSROOM MANAGEMENT AND CONTROL

<table>
<thead>
<tr>
<th>PROFICIENCY</th>
<th>RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>Highly</td>
</tr>
<tr>
<td>Occurred</td>
<td>Descriptive</td>
</tr>
<tr>
<td>V.Weak</td>
<td>Weak</td>
</tr>
<tr>
<td>Weak</td>
<td>Average</td>
</tr>
<tr>
<td>Average</td>
<td>Good</td>
</tr>
<tr>
<td>Good</td>
<td>V.Good</td>
</tr>
</tbody>
</table>

Did the teacher:-

a) Relate well with learners (Good rapport).
   - 1 2 3 4 5

b) Sustain learners ‘attention
   - 1 2 3 4 5

c) Deal with undesirable behaviour promptly and effectively
   - 1 2 3 4 5

d) Organize the classroom so as to stimulate interest, ensure full participation and good behaviour?
   - 1 2 3 4 5

e) Show initiative such as imagination and readiness to use ideas like, handling learners of different abilities.
   - 1 2 3 4 5

5. TEACHERS MANNER

<table>
<thead>
<tr>
<th>PROFICIENCY</th>
<th>RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>Highly</td>
</tr>
<tr>
<td>Occurred</td>
<td>Descriptive</td>
</tr>
<tr>
<td>V.Weak</td>
<td>Weak</td>
</tr>
<tr>
<td>Weak</td>
<td>Average</td>
</tr>
<tr>
<td>Average</td>
<td>Good</td>
</tr>
<tr>
<td>Good</td>
<td>V.Good</td>
</tr>
</tbody>
</table>

Did the teacher:-

a) Appear well dressed and groomed?
   - 1 2 3 4 5

b) Appear confident, cheerful and firm to inspire respect?
   - 1 2 3 4 5

c) Have a good teacher/learner relationship
   - 1 2 3 4 5

d) Communicate clearly and effectively?
   - 1 2 3 4 5
### 6. PUPILS’ WORK AND TEACHERS RECORDS

<table>
<thead>
<tr>
<th>PROFICIENCY</th>
<th>RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never Occurred</td>
<td></td>
</tr>
<tr>
<td>V. Weak</td>
<td>Weak</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Does the teacher: -</th>
<th>Never Occurred</th>
<th>Highly Descriptive</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Give learners varied, sufficient and relevant exercise?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For example; written work, Projects</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>b) Check correct and mark learners’ Work regularly?</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>c) Have follow up activities like Corrections, additional work etc.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>d) Keep appropriate and up to date Progress records for each learner?</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>e) Keep class register, records of Work covered, etc.</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
APPENDIX: IV SAMPLE LESSON PLANS

SAMPLE LESSON PLAN (1)

KENYATTA UNIVERSITY LESSON PLAN

NAME: LUCY ACKERING                                     REG. NO: E311004101
SCHOOL/INST: KAMISI HIGH SCHOOL                        FORM/LEVEL: TWO
SUBJECT: CHEMISTRY                                     TOPIC: Chemical Equations
SUB-TOPIC: Balancing of Chemical Equations
WEEK: TWO                                               LESSON NO.: 2
DATE:                                                  TIME: 10-20-10:00
OBJECTIVE (S): By the end of the lesson, the learner should be able to: 1. Define a chemical equation by writing the correct and well-balanced chemical equation.

<table>
<thead>
<tr>
<th>TIME</th>
<th>CONTENT</th>
<th>LEARNING ACTIVITIES</th>
<th>RESOURCES/MATERIALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 MINUTES</td>
<td>INTRODUCTION</td>
<td>Asking questions</td>
<td>Chalkboard illustrations, Teacher's notes</td>
</tr>
<tr>
<td></td>
<td>Preview of the previous lesson: Chemical formulae</td>
<td>Answering questions</td>
<td></td>
</tr>
<tr>
<td>20 MINUTES</td>
<td>LESSON DEVELOPMENT</td>
<td>Asking questions</td>
<td>Chalkboard showing some chemical equations</td>
</tr>
<tr>
<td></td>
<td>Definition of chemical equation</td>
<td>Answering questions</td>
<td>Pennion High Secondary Chemistry Bk1 13-2 by Sarah Nyoni</td>
</tr>
<tr>
<td></td>
<td>Risks of balancing chemical equations</td>
<td>Solving problems individually</td>
<td>Secondary chemistry Bk 2 by Kenya Literature bureau</td>
</tr>
<tr>
<td></td>
<td>Balancing chemical equations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 MINUTES</td>
<td>CONCLUSION</td>
<td>Asking questions</td>
<td>Secondary chemistry Bk 2 by Kenya Literature bureau</td>
</tr>
<tr>
<td></td>
<td>Summary of the lesson</td>
<td>Answering questions</td>
<td>Chalkboard illustrations</td>
</tr>
<tr>
<td></td>
<td>Assignment</td>
<td>Note making</td>
<td></td>
</tr>
</tbody>
</table>
## SAMPLE LESSON PLAN (2)

**KENYATTA UNIVERSITY LESSON PLAN**

**NAME:** Simon M. Orangi  
**REG. NO:** F373/6443/2008

**SCHOOL/INST:** Kahawa Garrison  
**FORM/LEVEL:** 1 EAST

**SUBJECT:** Chemistry  
**TOPIC:** Acids and Bases

**SUB-TOPIC:** Simple Acid-Base Indicators

**WEEK:** 4  
**LESSON NO:** 2 and 3  
**DATE:** 24/05/11  
**TIME:** 08.25 - 11.45

**OBJECTIVE:** By the end of the lesson, the learner should be able to define an indicator to differentiate between an acid and a base.

<table>
<thead>
<tr>
<th>TIME</th>
<th>CONTENT</th>
<th>LEARNING ACTIVITIES</th>
<th>RESOURCES/ MATERIALS</th>
</tr>
</thead>
</table>
| 5 minutes | **INTRODUCTION**  
Review the previous lesson’s content | Asking and answering of questions. | Teacher’s Notes |
| 70 minutes | **LESSON DEVELOPMENT**  
- Class experiment on simple-acid indicators.  
- Give the procedure  
- Group the students  
- Define a base  
- Define an acid  
- Define an indicator |  
- Forming groups  
- Discussion  
- Going through the procedure  
- Performing the experiment  
- Recording results  
- Note taking |  
Longhorn pg 109-110  
KLB pg 54 - 58  
- Orange acid  
- HCl  
- Bicarbonate and meter  
- Flowers  
- Propanone |
| 5 minutes | **CONCLUSION**  
Review the key points | Asking and answering of questions | Teacher’s Notes  
- Experiment results |
# KENYATTA UNIVERSITY LESSON PLAN

**NAME:** Mahinda O Josephat  
**REG. NO:** E74/1121/2007

**SCHOOL/INST:** BOOKSHIRE HIGH SCHOOL  
**FORM/LEVEL:** Form II

**SUBJECT:** Chemistry  
**TOPIC:** Chemical family: properties of halogens

**SUB-TOPIC:** Halogen

**WEEK:** 4  
**LESSON NO:** 4  
**DATE:** 13/05/2011  
**TIME:** 8:00 - 10:00 AM

**OBJECTIVE (S)**
- State physical properties of halogens.

<table>
<thead>
<tr>
<th>TIME</th>
<th>CONTENT</th>
<th>LEARNING ACTIVITIES</th>
<th>RESOURCES/ MATERIALS</th>
</tr>
</thead>
</table>
| 5 Min | **Introduction**  
Review on reduction in the size of atoms and ion in groups | Teacher explaining  
gradation in the size  
of atoms and ion in  
halogen learners copying summary notes. | Kenya Literature Bureau (2009), Secondary Chemistry  
Student Guide Book 2, Kenya Literature Bureau Nairobi  
Page 43 - 45 |
| 30 Min | **Main Body**  
Physical properties of halogens  
Fluorine gas yellow  
Chlorine greenish  
Bromine brownish  
Iodine shiny dark  
Solid. | Teacher giving  
Physical properties  
of halogen learners copying summary notes. | Kenya Literature Bureau (2009), Secondary Chemistry  
Student Guide Book 2, Kenya Literature Bureau Nairobi  
Page 43 - 45 |
| 5 Min | **Review on the lesson.**  
Learners answering  
questions learners copying summary notes. | Teacher answering  
questions learners copying summary notes. | Kenya Literature Bureau (2009), Secondary Chemistry  
Student Guide Book 2, Kenya Literature Bureau Nairobi  
Page 43 - 45 |
APPENDIX V:

RESEARCH PERMIT

THIS IS TO CERTIFY THAT:
Prof./Dr./Mr./Mrs./Miss. JOSEPHAT MACHINA

of (Address) KENYATTA UNIVERSITY
P.O BOX 43844, NAIROBI

has been permitted to conduct research in
Location, ALL

District, NAIROBI, RIET VALLEY, CENTRAL Province,
on the topic: PRE- SERVICE TEACHERS’ PREPAREDNESS TO DELIVER QUALITY CHEMISTRY INSTRUCTION AT SECONDARY LEVEL IN NAIROBI TEACHING PRACTICE ZONE - KENYA.

for a period ending 30th DECEMBER 2011.

Research Permit No. NCST/RRI/12/1/SS011/1463
Date of issue 21st OCTOBER 2011
Fee received KSHS.1000

Applicant’s Signature

Secretary National Council for Science and Technology

CONDITIONS

1. You must report to the District Commissioner and the District Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit.
2. Government Officers will not be interviewed without prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. You are required to submit at least two(2)/four(4) bound copies of your final report for Kenyans and non-Kenyans respectively.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice.

CONDITIONS (see back page)