

**EFFECT OF COMPUTER ASSISTED LEARNING ON SECONDARY
SCHOOL STUDENTS' ACHIEVEMENT IN CHEMISTRY IN
MURANG'A SOUTH SUB – COUNTY, MURANG'A COUNTY,
KENYA.**

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E55/CE/13928/2009

**A THESIS SUBMITTED IN PARTIAL FULFILMENT FOR THE
AWARD OF THE DEGREE OF MASTER OF EDUCATION IN THE
SCHOOL OF EDUCATION OF KENYATTA UNIVERSITY.**

JUNE, 2015.

DECLARATION

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

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DEDICATION

I dedicate this work to my family for the immense support and encouragement they accorded me during the trying times as I endeavored to make meaning of this work. To my dear wife Grace, children Cynthia and Brian those lonely moments spent in solitude due to my absence did not all go in vain. Your support and understanding were priceless. Thank you very much for the sacrifice.

ACKNOWLEDGEMENT

I would like to give thanks to the Almighty God for giving me the strength, time, ability and good health to embark on writing this thesis.

To my supervisors, Dr. Waweru and Dr. Khatete for their professional guidance in helping me acquire the desired knowledge and skills in area of research. I am also sincerely indebted to all the scholars and members of Educational Communication and Technology department of Kenyatta University who directly or indirectly contributed to this study.

My gratitude goes to the school principals, science HODs and chemistry teachers of the sample schools for their assistance during the data collection process. Chemistry teachers were particularly supportive and had even to change their teaching approaches to facilitate the study. My appreciation also goes to the students who participated in the study.

Lastly I am indebted to my family for their moral support and encouragement all through while doing this work.

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ABBREVIATIONS AND ACCRONYMNS

ANOVA	Analysis of Variance
CAL	Computer Assisted Learning
CAL	Computer Assisted Instructions
FDSE	Free Day Secondary Education
Ho	Null Hypothesis
ICT	Information Communication and Technology
K.C.S.E	Kenya Certificate of Secondary Education
K.I.E	Kenya Institute of Education.
Max	Maximum Possible
MOEST	Ministry Of Education Science and Technology
SPSS	Statistical Package for Social Sciences
UNESCO	United Nations Educational, Scientific and Cultural Organization
WWW	World Wide Web

ABSTRACT

The study sought to investigate effect of integration of Computer Assisted Learning (CAL) on students' mastery of chemistry in secondary schools in Murang'a South Sub - County, Kenya. Documentary evidence indicate students' persistent poor performance in the subject in the Kenya Certificate of Secondary Education (KCSE) not only for Murang'a Sub – County students' but for the country at large. The poor performance has been attributed to among other factors poor teaching methodologies adopted by classroom teachers in teaching the subject. Literature shows that integration of CAL in the teaching and learning of the subject enhances classroom pedagogical approach leading to improved performance. However, limited empirical data exist on the efficacy of use of the method in secondary school in Kenya. Therefore, an experimental study was designed to determine the effect use of CAL on students' mastery and achievement in chemistry. The objectives of the study were to compare effects of use of CAL and traditional methods on the academic achievement in chemistry, to investigate the effect of use of CAL on students' achievement based on gender and effect of use of CAL on students achievement in chemistry based on age. The study sample consisted of 297 form two secondary school students drawn from six (6) secondary schools using purposive and simple random sampling. The sample was divided into an experimental and control group with each consisting of 138 and 159 respectively. A pre-test instrument prepared by the researcher was administered to each of the two groups at the beginning of the study, the experimental group was exposed to CAL method of instruction developed by the Kenya Institute of Education (K.I.E) consisting of drills, tutorials and simulations while the control group was exposed to traditional methods in teaching of carbon (IV) oxide. At the end of the treatment, a post-test instrument which had been developed by the researcher was administered to each of the groups. Data obtained from the instruments were analysed descriptively using frequency and percentages and inferentially using Analysis of Variance (ANOVA) with the aid of Statistical Package for Social Sciences version 17 computer software. The ANOVA results showed that students in the experimental group had higher level of mastery as compared to those in the control group ($P=0.01$) indicating that it is a better method of instruction. Similarly, the results showed that use of CAL promoted mastery of chemistry for boys as compared to girls ($P=0.023$) though its impact on students mastery based on age was found to be insignificant ($P=0.154$). It is therefore recommended that schools be adequately equipped with ICT infrastructure to enable use of CAL, relevant policy guidelines for integration of CAL in the teaching and learning process be formulated and implemented and teachers empowered to integrate CAL in teaching and learning of chemistry.

CHAPTER ONE

1.1 Introduction

This chapter describes the background of the study. It also gives a highlight on performance of sciences in Murang'a South, a Sub -County of Murang'a County for the last six years. The chapter ventures on statement of the problem and consequently the objectives of the research. Being an experimental study, some research hypothesis was formulated to guide the study. Other subtitles under this chapter included, significance of the research, assumption of the research, and delimitation of the research, theoretical frame work and conceptual frame work. Lastly some of the terms used were defined as used in the study.

1.2 Background of the Study.

Educational technology is the effective use of technological tools in learning and incorporates numerous types of media that deliver e.g. text books, audio CDs, photographs and animated information in the teaching and learning process. Similarly, it encompasses technological applications and processes such as audio or video tape, satellite TV, CD-ROM, and web-based learning as well as computer assisted learning, (Garrison, (2011)). A computer is a general purpose device that can be programmed to carry out a set of logical operations. Computers as technological tools have been used to teach, manage, show and communicate information which makes them unique compared the other learning devices (Georges, (2001)). Computer assisted learning (CAL) is a method, which uses a computer in the teaching and learning, thereby strengthening students' motivation and education in the process. In other words, use of CAL creates a learning environment where a computer program, or its application is used to assist in teaching and learning of a particular subject. This is because the use of CAL gives

opportunities to both students and teachers to learn at their speed and combine active learning with CAL. (Daintith, (2004)).

According to Daintith and Wright (2008), over the last two decades, the use of CAL has become more and more widespread and important especially in difficult subjects, more specifically in the sciences. Several reasons have been advanced by researchers for the use of CAL to support educational programs, chemistry education included. Among these is the capability to provide information in form of text, graph, audio, video, picture, animation and simulation which aids in strengthening student's mastery level. There is a form of one-to-one instruction and the opportunity for the students to proceed at their own pace, repeating parts of the exercise as they wish, none of which are available in a didactic classroom situation. In addition, there is the added variety and, perhaps, novelty in CAL, along with the potential to use vivid and animated graphics, enabling three dimensional aspects, and other features to be viewed more realistically (Sanger and Greenbowe, (2000)).

In the United States of America, CAL has long been considered as a method for addressing school improvement since it offers advantages over traditional instruction. CAL involves a one-on-one interaction, multimedia capabilities that enrich the lesson presentations, self-pacing and instantaneous feedback. (Zhao and Lei, (2012)). The report illustrates that CAL has positive effects on students' achievements and attitudes. In addition, Fraser, Walberg, Welch and Hattie (1987) noted that the use of computers for instruction resulted in increased student interest, cooperation, achievement in science, and coverage of science curriculum. According to Bangert, and Kulik (1987), students receiving CAL learn better and faster, and students' scores on delayed tests indicate that

the retention of content learned using CAL is superior to retention following traditional instruction.

Similar studies in Europe supports the fact that CAL is an effective tool in enhancing student's level of mastery in chemistry. In a study on the overall effectiveness of CAL in teaching chemistry, biology and physics in Turkey, the results indicated that CAL has a positive effect on the academic achievement of students. Pontecorvo et al (1997) in a study to assess the effects of CAL on attitudes, motivation or learning, and the possible advantages of computer-assisted learning programs among secondary school students also reported a higher achievement rate for the experimental group that received CAL than those in the control group who were exposed to traditional methods of instruction. Likewise, Levine and Donitsa (1997) compared the effects of traditional learning strategies to CAL in applications and the assessment using chemistry Achievement Test on students and the results of the evaluations showed that students in the experimental group were more successful at answering questions than those in the control group.

Similar results were reported by Yalcinalp, Geban and Ozkan, (1995) among 6th grade chemistry students (Park, Lee and Kim, (2009)) among secondary school level learners. Similarly, in a study where the traditional and the computer assisted learning methods were used in teaching acids and bases in secondary chemistry ,a 52% improvement was observed in the post-instruction test results of the students of the experimental group whereas the control group only improved by 31%. The independent two-sample t-test was applied for the evaluation of the results and they were significantly different (Morgil, (2005)). The significant positive influence of CAL on the student's achievement in chemistry has also been supported by Ranade (2006) and Bollinger (1986) whose conclusion was that CAL provides greater opportunities to the students to learn and brings

a new kind of experiences for the students in secondary schools thus it is better than the traditional method of learning chemistry.

In Africa, studies on use of CAL in teaching and learning of chemistry are few. The few documented research findings however tend to corroborate the observations by researchers globally. For instance, Etukudo (2003), in a study on effects of computer assisted learning (CAL) on Nigerian secondary school students' performance in Mathematics, showed that performance of students exposed to CAL was better than that of their counterparts exposed to the traditional methods.

In Kenya, few studies document the impacts of CAL on classroom practice. In a study on enhancement of science performance through computer-assisted instruction among selected secondary school learners in Kenya, Samuel (2012) noted that the improvement in science performance by the experimental group resulted from the application of CAL in science lessons and that the instructional methods used by teachers influence the performance of the learners. Wambugu and Changeiywo (2008) also noted that the teaching approach that a teacher adopts is one factor that may affect students' achievement, and therefore use of an appropriate teaching approach is critical to the successful teaching and learning of science. The studies however were not specific to chemistry.

Although numerous research findings on CAL globally attest to its positive impact on students' learning outcome, Omwenga (2005) noted that Kenyan high school teachers, chemistry teachers included have done very little to introduce this modern teaching

approach in their classroom practice . This is in spite of the government sponsored day secondary education provided by the Kenya Government that is making it possible for schools to increasingly acquire computers thereby ensuring that the infrastructure is put in place awaiting implementation by teachers (Ministry Of Education Science And Technology Sessional Paper, (2012)). The integration of CAL could have helped schools in checking the persistent poor performance witnessed from the year 2005 to 2012 in science subjects such as chemistry both national in Kenya and in Murang'a South Sub – County. Table 1.1 compares students' performance in three science subjects (Chemistry, Biology and Physics) in the Kenya Certificate of Secondary Examination (KCSE).

Table 1.1 Students' Performance in Sciences at KCSE Level (2005 – 2012)

Year	Chemistry			Biology			Physics		
	Entry	Mean score.	Max score	Entry	Mean score	Max Score	Entry	Mean score	Max score
2005	5187	3.7735	12	4267	4.4267	12	1452	4.8912	12
2006	4630	3.4281	12	3974	3.6691	12	1505	4.7934	12
2007	5626	3.5437	12	4252	4.8252	12	1709	4.7415	12
2008	5993	3.5253	12	4758	4.2518	12	1970	4.2716	12
2009	2109	3.3952	12	1695	4.2838	12	702	4.1490	12
2010	2153	3.5678	12	1723	4.087	12	733	4.4501	12
2011	2541	3.440	12	1902	4.867	12	852	4.5273	12
2012	2639	3.9211	12	2071	4.4598	12	929	4.5087	12

Source: Murang'a South Sub County K.C.S.E. subject analysis 2005-2012.

Table 1.1 shows that between 2005 and 2012, students' performance in science subjects had persistently been low (lower than 6 out of 12). The poor performance was found to be

more noticeable in chemistry which registered the least mean score for all the science subjects within the same period. A similar trend in performance in the subject is observed for Murang'a South Sub – County students over the same period as is illustrated in Table 1.2.

Table 1.2 Murang'a South Sub County Students Performance in Chemistry

YEAR	Murang'a South Sub County Chemistry Mean Score	National Chemistry Mean Score	Maximum
2005	3.774	2.024	12
2006	3.428	2.990	12
2007	3.544	3.047	12
2008	3.525	2.729	12
2009	3.395	2.294	12
2010	3.568	2.711	12
2011	3.440	2.839	12
2012	3.921	3.352	12

Source: Murang'a South Sub County K.C.S.E. subject analysis 2005-2012.

From Table 1.2, it is evident that for the period of 2005 to 2012, Murang'a South Sub County chemistry mean score was equally below average though slightly higher than the national averages for the same period. Ogembo (2012) attribute the students' poor achievement in chemistry to a number of factors including student's attitude towards chemistry, teacher's attitude towards student ability in the subject, availability and use of resources, poor learning environment, and poor method of instruction. Research by Chiriswa (2002) and Kwaka (2003) commenting on the deplorable levels of performance

by students in the sciences maintain that sciences subjects (Biology, Chemistry and Physics) are poorly performed by most high school students in Kenya.

1.3 Statement of the Problem.

Chemistry is one of the science subjects studied in the secondary school. It is central to many science related courses such as medicine, pharmacy amongst others. In spite of this fact, students' achievement in chemistry both at national level and Murang'a South Sub – County is poor. Available research findings attribute the students' poor achievement to a number of factors including student's attitude towards chemistry, teacher's attitude towards student ability in the subject, availability and use of resources, poor learning environment, and poor method of instruction. Integration of CAL in teaching and learning of chemistry has been proposed as one of the modern approaches which could lead to improved achievement. However, there is limited research on the extent and effect of use of CAL on students' mastery and achievement in chemistry in Kenya and Murang'a South Sub - County. The existing gap in research in Kenya and Murang'a South Sub – County demands that studies be carried out to ascertain the impact of integration of CAL students' mastery of chemistry concepts and achievement. The research therefore sought to investigate the effects of CAL on students' mastery and achievement in chemistry.

1.4 Research Objectives.

The study was intended to compare computer assisted learning and traditional learning methods in teaching chemistry. Specifically the study sought to:

- a) Establish the difference in performance in chemistry in Murang'a South Sub- County secondary school students exposed to computer assisted learning compared to those exposed to traditional learning methods.
- b) Determine the gender difference in performance in Murang'a South Sub- County secondary school students exposed to computer assisted learning.
- c) Determine the age difference in performance in Murang'a South-Sub County secondary school students exposed to computer assisted learning.

1.5 Research Hypotheses

The following research hypothesis were tested:

H₀₁: There is no significant difference in performance in chemistry of students exposed to computer assisted learning compared to those exposed to traditional methods of learning.

H₀₂: There is no significant difference in performance in chemistry for students exposed to computer assisted learning based on gender.

H₀₃: There is no significant difference in performance in chemistry for students exposed to computer assisted learning based on age.

1.6 Significance of the Research.

The study draws its importance from the fact that achieving a country scientific and technological development targets depends on the quality of human resource it prepares. Educational institutions, secondary schools included are charged with the responsibility of preparing a country's human resource by implementing the agreed curriculum. Thus poor implementation of curricula directly hampers development of the human resource. The study findings will therefore be beneficial to:-

Ministry of Education – help in coming up with policies that would promote formulation and dissemination of ICT integration in to school curricular.

School Administrators – enable them adopt best practices for implement ICT integration in classroom teaching and learning.

Chemistry Teachers – benefit from information on best practices on integration of CAL in teaching and learning for improvement of students’ achievement in chemistry.

1.7 Assumption of the Research.

The study assumes that teachers implementing the CAL lessons are of same competence motivation and have a positive attitude towards integration of CAL in the teaching and learning of chemistry. It also presupposes that the students undertaking the CAL lessons are of the same ability motivation and attitude towards use of CAL in chemistry.

1.8 Delimitation of the Research.

The study delimit itself to issues of integration of CAL in the teaching and learning of chemistry so as to enable an assessment of its impact on students’ mastery of the subject. This is in spite of the fact that integration of ICT tools such as CAL in the teaching and learning is anticipated in the entire secondary school curricula subject

1.9 Theoretical Frame Work

This research was based on the Constructivism Theory. Constructivism is a term used to represent a collection of theories, such as generative learning (Wittrock (1990)), discovery learning (Bruner, (1961)), and situated learning (Brown, Collins, and Duguid, (1989)). The fundamental insight of constructivist theory is that knowledge is actively constructed and not simply acquired by the learner. According to Roblyer and Edwards

(2006), learners construct knowledge themselves rather than simply receiving it from knowledgeable teachers. Computer assisted learning programs have been related to constructivism in that students are at the centre of the learning process. Rather than being passive recipients of instruction, they are actively involved in constructing knowledge (Hogan, (2005)). Constructivism Theory argues that humans beings generate knowledge and meaning from an interaction between their experiences and their ideas. Learners learn by experimentation, and not by being told what will happen. They are left to make their own inferences, discoveries and conclusions. It also emphasizes that learning is not a haphazard process but that students learn the new information that is presented to them by building upon knowledge that they already possess. This theory suggests that the teacher's role is not only to observe and assess but to also engage with the students while they are completing activities, suggesting solutions and posing questions to the students for promotion of reasoning (DeVries, et al (2002)).

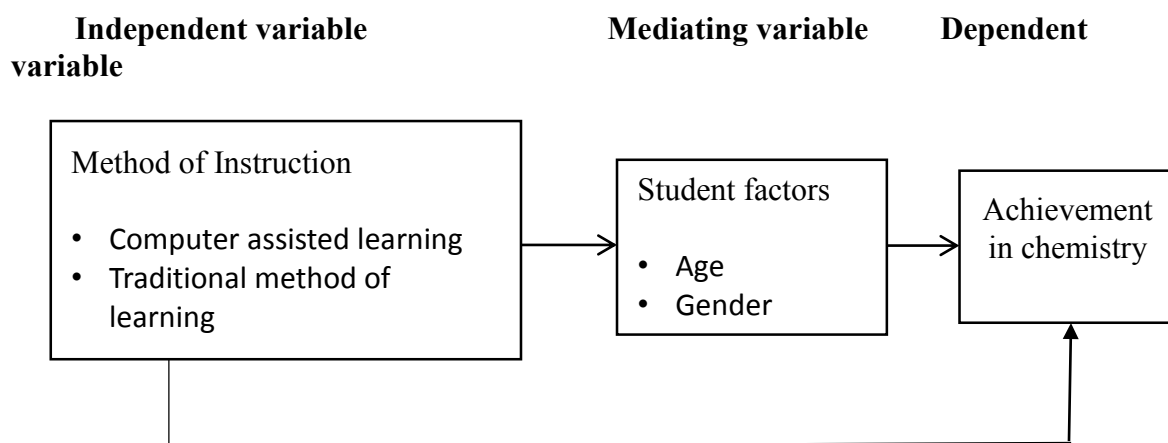
Computer assisted learning programs are interactive and enable students to control the pace and sequence of their learning (Driscoll, (2000), Silverman and Casazza, (2000)). During the learning process, a student is presented with specific tasks and must master them before going to the next level. In the drill and practice of computer assisted learning, the pace and number of trials to reach mastery varies from student to student.

1.10 Conceptual Frame Work.

Figure 1.1 conceptualizes the relationship between the elements identified as important in integration of CAL in the teaching and learning for mastery of chemistry. The achievement in chemistry which is the dependent variable is effected by mastery of chemistry content as is dictated to by the method of instruction (independent variable)

adopted in teaching and learning of the subject. The process is mediated by student factors which include gender and age.

Figure1.1 Conceptual Frame Work



Source: Samuel, N. J. (2012).

1.12 Definition of Terms

Computer assisted learning	The use of computers to present drills, practice exercises and tutorial sequence to students during the teaching and learning process.
Curriculum	The set of courses and their content offered at an institution of learning
Drill	Something done over and over in order to develop skills
Simulation	An attempt to model a real-life or hypothetical situation on a computer so that it can be studied to see how the system works.
Traditional method	Teacher centered teaching and learning approaches that are commonly adopted in the classroom in the delivery of curricula.
Tutorial	As used here to mean a computer program whose purpose it is to assist users in learning how to use a software product e.g. where the user follows on-screen where upon they do the tutorial exercises and receives feedback depending on their action.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviewed related literature to the study .In particular; it surveys the use of computer assisted instruction in education. It also compares traditional teaching methods and computer instructional method. The issue on gender and computer is also looked into. Besides this a research gap is sighted which the study attempted to investigate.

2.2 Use of Computer Assisted Instructions in Education

A computer is an electronic device that has the capacity to store, retrieve and process both qualitative for example, dictionary of terms and quantitative information for example, the formulae. It can accommodate instructional program which include drills, tutorials and simulations. Computer assisted learning can have great potential as instructional tools in the classroom (Moore, (1997)). The challenge is how to optimize usage. Gonzalez and Birch (2000) ascertain that computer assisted learning has the ability to promote active learning in a wide variety of disciplines from literature to the social sciences and beyond.

Although traditional teaching methods can be used with some success, they do not prepare our students for the challenges of today society as observed by Ivers (2002). Over the years the role of teacher in the classroom has gradually but drastically and steadily evolved. New teaching and learning methods have emerged, many of which favour individual or small group learning. As a result the teacher's role has evolved from being the source of knowledge to being a director and facilitator of instruction. For this reason the teacher has resorted to the use of various resources and organizes learning in varying ways. (Gerlach (1971)). Jonassen (2000) describes computer assisted learning as a way

that support learning by allowing students to construct knowledge, explore and assess information with other students and represent what they know.

Computers were never developed for improving the quality of teaching and learning process, but researchers started using computers for teaching. (Sansanwal, (2000)). Computer Based Instructions (CBI) thus was developed and people gradually started developing computer assisted learning (CAL) for teaching. The developed CAL was found to be effective in terms of achievement of science process skills. (Vensel, (1988)). CAL are valuable tools in diverse field of applications. CAL are now used in diverse fields of education. In the field of teaching in particular, the wide use of CAL are evident in diverse school in elementary, high-schools, colleges and universities. CAL are advantageous in the sense that these machines teach much more effectively in technical sense, they can attain and teach far more students and kept students more focus with the subject.

The World Wide Web access will also enable students to get various educational sources from all above the planet, hence making the globe like a classroom of studying. It enables him or her to access different ideas. In teaching kids or young learners, the use of CAL in the teaching processes is extremely considerably beneficial. The use of CAL could catch the focus of the kids, generating them attentive as well as participative in teaching and studying activities. Creating use with these technologies will allow the teachers to increase his/her teaching style that could possibly boost the learning of the students. CAL are advantageous in the sense that these machines educate more effectively .They can attain and teach far more students and kept students much more concentrate with the subject. With the access of the internet, it is also feasible to educate these students or

learners that are situated in the remote or far places provided these areas have internet signals (Owston, (1997)).

These technological capabilities make the teacher to reach as well as to educate a lot more learners. The web access will also allow the students to get different educational sources from all more than the globe, thus creating the globe like a classroom of learning. (Bayraktar, (2001)). It enables him or her to access different concepts as properly as learning and information coming from abroad. CAL can be utilized in education to make it possible for the learners to find out modern day tools and information that will make him or her prepared for the probable technological modifications in the future. This study used computer assisted learnings with an aim of establishing its impact on academic achievement in teaching and learning of secondary school chemistry.

2.3 Traditional Teaching Methods versus Computer assisted learnings

As quoted above, the use of CAL as a supplement to traditional instructions can have the potential to produce higher achievement than the use of traditional instructions alone. Besides this, students can learn instructional contents faster with CAL than with traditional methods and the level of retention may be better with CAL. CAL can improve student motivation (Marr, (2000)). Research has found that student using computers have increased self-confidence , self-esteem and are more successful and motivated to learn which is not the case with some conventional methods (Wishart, (2002)). There are many research studies supporting the use of computer instructions in classroom to supplement traditional teaching methods. Miller (1999) indicated that one of the benefits of CAL over traditional teaching methods is the immediate feedback received by the student. Unlike the traditional methods, CAL is effective for teaching and learning with all levels of students including those with special needs.

Researchers have found that one major advantage in using CAL over traditional methods is that they are used across a variety of subject areas, including Mathematics (Christmann, (1999)) and also in Science and Social studies, which not the case with traditional methods is Isernhagen (1999). Students perceive computers assisted instructions as having a positive effect on their learning (Lin, (1998)). They are more likely to be more involved and active participants during instructional process when technology is involved which is also a significant factor over traditional methods (Sivin, (2000)). Computer assisted learning can have many positive benefits depending on how they are used as observed by Archer (1998). Many researchers recommend using computer assisted learnings over traditional methods to support higher order thinking and problem- solving skills. Herrington (1999) describes CAL as intellectual partner that can supports learning by allowing students to use them as tools to construct knowledge, explore and assess information with others and articulate and represent what they know. Other researchers note that using computer instructions can provide students an opportunity to learn and apply real world skills which is a provision not offered by the traditional methods (Ivers, (2002)).

The international society for technology in education (2005) suggests that teachers who move away from traditional learning environment to new learning environment promote active learning, higher level thinking, collaborative and multisensory stimulation. These environments support multiple intelligence, constructivism and cooperative learning. According to Sansanwal (2000) the teaching learning objectives are multi-dimensional in nature and their achievement to be realized calls for integration of multiple methods. At present computer assisted learnings may be of some use. It is a well-known fact that not a

single teacher is capable of giving up to date and complete information in his own subject which is a dominant feature with tradition methods. Computer assisted learnings can fill this gap because it can provide access to different sources of information which is not the case with the traditional process and method. It may provide accurate information as comprehensive as possible in different formats with different examples. Computer assisted learnings can provide online interaction facility. It helps learners to broaden the information base. It provides variety in the presentation of context which helps learners in concentration. (Becker,(2000)).

Computer assisted learnings provide flexibility to learners which are sometimes denied by the traditional process and method. Computer assisted learning could be of great help because it includes the drill-and-practice, tutorial, or simulation activities. Cotton found that computer software provides many instructional benefits and CAL can have a much greater impact on student learning when compared to traditional methods. Researchers have also found that CAL enhances learning rate, that is, students learned the same amount of material in less time than the traditionally instructed students or learned more material given the same amount of time. Moreover, students receiving CAL also retain their learning better (Cotton, (2001)). Most researchers concluded that the use of CAL can leads to more positive student attitudes than the use of traditional methods. This finding has emerged from studies of the effects of CAL on student attitudes as cited by Cotton (2001).The use of a CD-ROM tutorial is ideal to support traditional methods.

One advantage of CAL over traditional methods in teaching is self-paced learning. According to Lawson (1999), a learner may review specific topics on which he/she needs clarification and if familiar with the topic, may quickly progress at a faster rate to other

topics. This is in stark contrast to conventional methods, in which learning is based on a predetermined time where learners are individually expected to master the topic during that time. Another advantage of self-paced learning is the flexibility of schedules it provides. Learning is accessible almost anywhere a computer can be located (Congram, (1995)). Also, the self-pacing learning concept eliminates the need for group instruction and scheduling (Dhanjal, (1999)). Along with flexibility of schedules comes the cost-effectiveness of using CAL over traditional methods. Since learners can study at home avoiding the need to travel to training facilities, this results in savings in costs on travel and accommodation costs (Dhanjal, (1999)).

Another advantage of CAL over traditional methods is the increased knowledge retention it affords to students. Content retention is increased by engaging multiple senses i.e. auditory, visual, and kinaesthetic during the learning process (Dhanjal, (1999)). Well-designed CAL may incorporate full-colour animation, product simulation and supportive narration to create a professional, yet inviting tone CAL offers realistic, on-the-job scenarios to simulate hazardous situations which test a student's skills and responses. Its detailed, high-resolution graphics and animations enhance learning and promote a better understanding and knowledge of the content (Congram, (1995)). Other advantages include consistency of message, which cannot be assumed with a live instructor (Dhanjal, (1999)), measurability, which can be accomplished using self-check questions, pre-tests and post-tests (Lawson, (1999)), and customization. Through customization features, curriculum developers can tailor a genetic program to match with the government policies and procedures (Lawson, (1999)). CAL clearly has many advantages over traditional methods.

2.4 Gender and Use of CAL

Gender bias is a reference to preference for or favoring of one sex over the other in computer use and access (The American Heritage Dictionary, (2013)). The educational system is believed to influence the gender gap in computer use. One argument states that the gender separation in the use of the computer education begins as far back as kindergarten. (Wilder, Marchie and Cooper, (1985)).

All students should have equal accessibility regardless of sex, race, socioeconomic background, or disability. It is important for teachers to be informed of innovations in classroom management plans and teaching strategies which are fair and equitable to all students. Sitting in the same classroom and listening to the same teacher is received differently by boys and girls which is the case with computers education (Sadker, (1994)). In the 1980s, research in Europe and North America identified boys' greater access to computers in schools also noted boys' dominance in computer related tasks and discussions. This research commonly found boys to be more active in computer-related classroom discussions, to make more spontaneous comments, and to be asked more questions by teachers (Volman (2002)). Girls, on the other hand, more often lacked confidence in computing, tended to underestimate their computer-related competence. Initial explanations of these findings in Europe and North America focused on boys far greater hands- on experience of computers at home, their greater enthusiasm to use computers, their greater confidence in using computers, and their tendency to rate themselves better than girls.

Important contributing factors to boys' greater computer confidence can be the attitudes and behavior of their teachers. Research shows that some teachers assume a certain

expertise in boys, turn to boys for expert assistance when technical difficulties arise. ICTs have the potential to alleviate or remove some of the barriers or constraints that prevent girls from accessing educational opportunities, such as illiteracy, poverty, time scarcity, mobility, and relevancy. But there are additional factors that prohibit girls from ICT usage such as restricted access to the technology, high costs and lack of skills and information. However, the lack of participation of girls in the use of ICTs can primarily be attributed to social behavior, culture, and religious traditions (UNESCO Asia and Pacific regional bureau for education).

Girls are deprived of any opportunity to gain ICT related knowledge and skills in school. This may inhibit their acquisition of the levels of literacy and confidence that might enable them to access and use ICTs in school context. Because of the critical role that education has to play in opening up ICT-related opportunities, access to education is consistently identified by gender equality advocates as one of the most important factors involved in enabling girls and women of all ages to benefit from new information technologies (Rathgeber (2001), (Hafkin (2001))). ICTs should be equally accessible to boys and girls. As girls enter adolescence; large numbers of them tend to lose interest in science, math, and computer technology. (Closing the gender gap: Gender Gaps Fact Sheet, (1997)). This is attributed to the different treatments by educators which divert girls from science and technology (Robinson and Lubienski, (2011)).

There is considerable evidence to suggest that boys use computers more than girls; this difference, like computer attitude, only emerges in middle school. In one study of 6,800 students, computer use by boys and girls in the fourth grade was about equal, but by the eighth grade, boys reported significantly higher use (Barker, (2006)). According to

Whitley (1997), boys use computers more frequently than girls at their homes, their friends' homes, and after-school clubs. They use computers to play games, use educational software, and access the Internet, whereas girls use computers for email, instant messaging, and homework. Boys tend to be more assertive and dominant about computer use and girls tend to be more passive. Teachers let girls give up more easily than boys when solving computer-related problems. Girls appear to prefer to use computers for goal-oriented activities with meaningful contexts. Girls like co-operative learning based on inquiry and diversity of topics. There are a number of strategies that teachers can use to address gender differences in computer attitude and use. The following has been suggested by American Association of University Women (2002).
Develop a positive computer culture: It is important for teachers to establish a clear set of rules and behaviors for using computers. A co-operative, supportive atmosphere needs to be emphasized. In addition, computer time must be monitored closely. Finally, girls should be encouraged not to give up too quickly; teachers should offer thoughtful support and hints instead of doing the task for them (American Association of University Women, (2002)).

One way to limit aggressive, dominating behavior by boys is to create same-sex computer study groups (Kay, (2006)). Kay is of the opinion that teachers should be sensitive to differentiated learning since boys and girls may have different learning styles when it comes to computers. Rather than looking for a gender-neutral solution, Kay suggests that we should seek ways to validate different views of technology. This means that a variety of needs to be encouraged: working in pairs to address a problem; using in a wide range of contexts; and allowing for creativity in projects, so that boys and girls can pursue tasks that interest them (Kay, (2006)).

The American Association of University Women (2000) adds that girls are often more interested in using computers to complete personally meaningful tasks. For example, a Web Quest (<http://www.webquest.org/>) is an ideal activity that encourages collaboration to solve authentic, real-world problems. Activities that encourage students to be resourceful and construct their own knowledge should be promoted. In addition; computers should be integrated into a variety of contexts and subject areas.

Focusing on a curriculum that emphasizes learning specific computer skills out of context may discourage girls from using computers. The common practice of using computers as a reward should probably be discouraged, because it tends to promote more aggressive and assertive behavior from boys. Some girls may back off and defer to more self-confident boys. (Butler, (2000)). Well-planned activities are essential to address gender differences effectively. According to Butler (2000), it is important to improve teachers' computer skills: It is important that teachers become capable enough to design effective computer-based lessons. Without the confidence and ability to use computers in an educational setting, it will be hard for teachers to design effective computer-based lessons or to guide meaningful computer use. In addition, gender perceptions will never change unless female teachers demonstrate that they are capable users of technology (Jenson, (2003)).

2.5 Age and Use of CAL

Age is considered as one of the independent variables that may likely affect the academic performance of learners'. The Cognitive development and maturity are associated with age and are necessary on learners academic performance. Age of the individual, as it increases, usually affects the various developmental changes. It also affects every area of

human performance (Ukueze, (2007)). Therefore, it has become necessary to examine the extent to which age affects the academic performance of learners. Pianta and La Paro (2008) presented evidence that older children fare better academically than their younger peers. On the other hand, Gilmore (1985) researched on the relationship between age and academic achievement and argued that the older students in a class fare better than younger classmates. In contrast DeMeis and Stearns (1992); Dietz and Wilson (1985) found no significant relationship between age and academic achievement. They found significantly higher achievement of the oldest as compared to the youngest students at age nine but this difference disappeared by age seventeen. Academic performance is a product of personal determination, cognitive development and motivation as well as several other positive correlates (Emina (1986)). Other researches such as Aghadiuns (1992) found that age does not significantly influence academic performance even if other variables such as method of instruction and level of motivation do.

According to Ugoji (2008) the younger students tend to be more focused on their academic work than the older ones. This could be because the older ones are encumbered with other non-academic issues that divide their attention. The younger students, though concentrate on their academic work may not have experience to effectively meet the challenges required for enhanced academic work. The research finding were that there is no significant difference in academic performance based on age. In a study on the influence of relative age on learner attainment and development carried out in Australia, Chile, the United Kingdom and the USA , all of the studies found evidence of statistically significant effects for relative age Pupils who are younger in the year group performed poorly in attainment tests. Relative age effects for attainment was quite large for young learners. There was a smaller relative age difference among older primary learners but the

difference remained significant throughout primary school. At secondary stage, the difference was still apparent but was not statistically significant. (Sharp et al (2009))

In other studies on the effect of age on academic achievement are mixed. Anthony, Drumright, Whites, and Seikel (1995) found that as students become older, the correlation between age and school achievement diminishes. The study findings asserts that schools provide equalizing experiences, and thus the longer students stay in the schooling process, the more the impact of age on student achievement is diminished. In addition, as the students move up the age there would more students drop out of school, thus reducing the magnitude of the correlation. On the other hand, results from other studies have contradicted these results, by demonstrating that there is a gap in student achievements as students get older (Crosser, (1998)).

During the past decade, a great number of studies have investigated various age groups of people regarding their attitudes and beliefs toward computers. According to Jimoyiannis, (2013), most of the investigations revealed four correlated dimensions. These includes fear or caution regarding computer use, self-efficacy and confidence in the ability to use ICT, liking use of computers and ICT tools and perceptions about the value and the usefulness of ICT use in personal life. The development of students' ICT expertise has a basis in strong internal motivation and in intensive use of ICT but not their age. However exposure to ICT tools gives confidence to the learners. It was observed that young people who have grown up with computers, mobile phones, and the Internet were not fearful of technology and they were willing and opened to experimentation with new ICT

applications and facilities which was in contrast with adult learners (Isopahkala et al (2011)).

2.5 Research Gap

Most of the research done dealt with students' attitude towards use of computer technology. They have also cited a number of benefits when computer technology is used. Others have studied gender imbalances with computer technology. However, use of computer instructions in teaching chemistry at high school level in African countries is not extensive. Furthermore a comparison of traditional teaching methods and computer instructions in teaching secondary school chemistry in Kenya so far is not intensive. Nothing much has been done in Murang'a County and specifically in Murang'a South Sub County on use of computer assisted learning in teaching and learning of secondary school chemistry. This study thus attempted to fill these existing research gaps by assessing the effect of CAL on teaching and learning of chemistry. .

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter deals with the research design. It has also dealt with the location of the study, the target population and population sampling size and procedure. It highlights on pre-test and post-test. Besides this it also deals with the data collection, data analysis and ethical considerations.

3.2 Research Design

The design of this research was experimental. The aim of an experimental research is to investigate the possible cause and effect relationship by manipulating one independent variable to influence the dependent variable in the experimental group and measuring the effects of the manipulation by some statistical means. By manipulating the independent variable, it can be established if the treatment makes a difference on the subjects. If the average scores of the two groups prove to be significantly different then it can be concluded that the effect of the treatment caused this difference. (Mason, Gunst and Hess (2003)). True experimental design is regarded as the most accurate form of experimental research, in that it tries to confirm or reject a hypothesis. For an experiment to be classified as a true experimental design, it must fit some criteria. The sample groups must be assigned randomly and there must be a viable control group and only one variable can be manipulated and tested. The tested subjects must also be randomly assigned to either control or experimental groups. The advantage here is the randomization, so that any differences that appear in the post-test should be the result of the experimental variable rather than possible difference between the two groups. Some of the advantages when true experimental design is used is that the results of a true experimental design can be statistically analysed. It is also much easier for other researchers to replicate the

experiment and validate the results (Martyn, (2008)). In this study the experimental and the control groups were randomly selected .A pre-test and post -test was administered to the two groups .This design was deemed appropriate for this study since the study intended to assess the effect of use of CAL on student mastery and achievement in chemistry without controlling for factors such as school related factors, teacher related factors and students attitudinal factors.

Figure 3.1 Research Design.

Group	Pre-test	Treatment	Post-test
Experimental group	O ₁	X	O ₃
Control Group	O ₂	X	O ₄

Where: O₁ and O₂ is pre-test

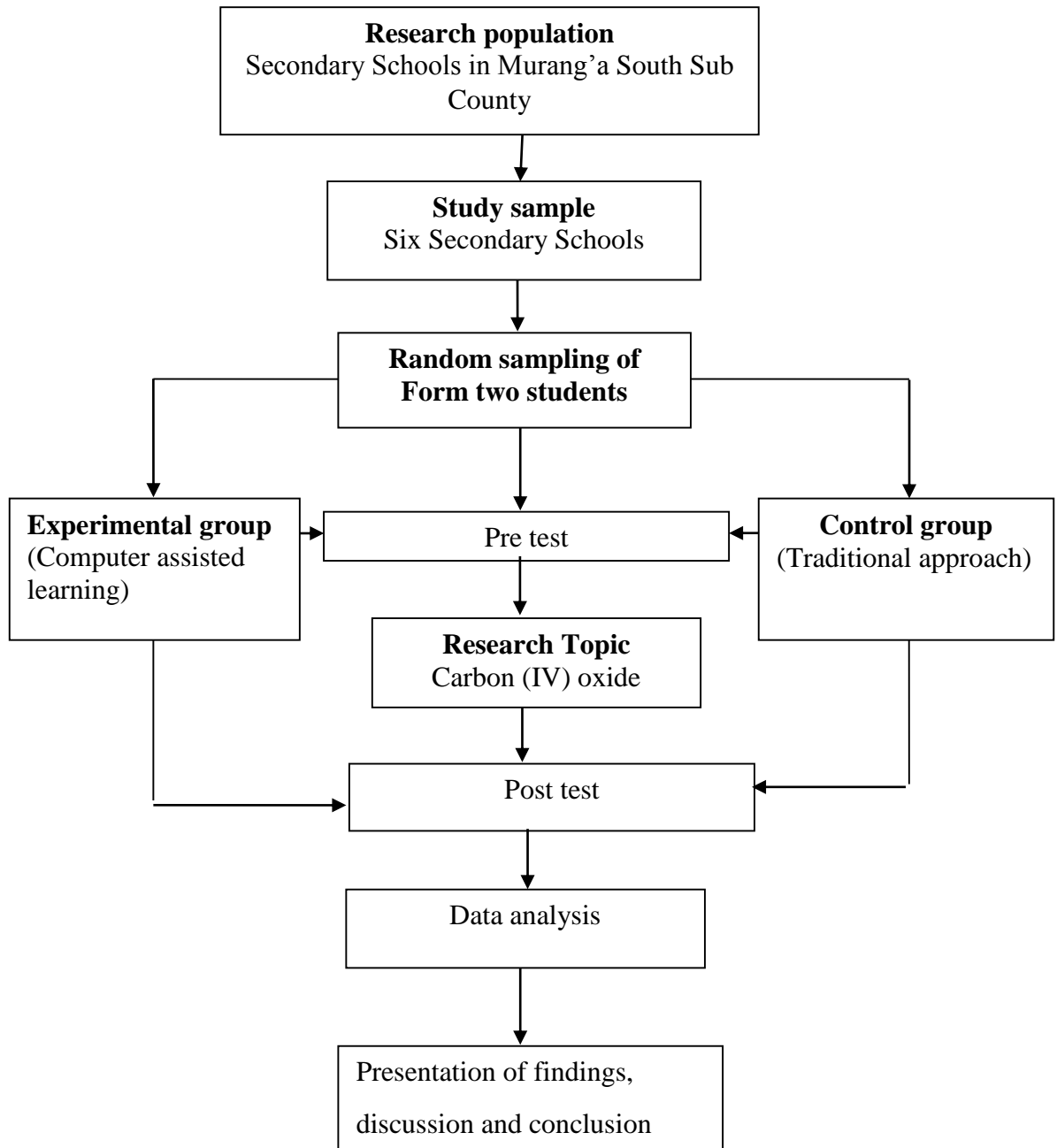
X is intervention or treatment

X is no intervention or treatment

O₃ and O₄ is post-test

The following study design and process was used in this research.

Figure 3.2: Study Design



Source: Samuel, N. J. (2012).

3.3 Location of the Study

The study was conducted in Murang'a South, a Sub -County of the Murang'a County in Kenya. Murang'a County is in the Central part of Kenya, about 70 kilometers East of Nairobi. (See appendix 1) .The County posts poor results in chemistry and is also familiar to the researcher which makes collection of data effective

3.4 Target Population

The study targeted form two students in ten secondary schools in Murang'a South Sub-County with ICT infrastructure for integration of CAL in the teaching and learning of chemistry. There were 912 form two students in the ten schools with ICT infrastructure for integration of CAL who constituted the target population.

3.5 Sampling Procedure and Sample Size

3.5.1 Sampling Procedure

A sample is any number of cases less than the total number of cases in the population from which it is drawn (Ingule and Gatumu, (1996)). Sampling saves time and expenses of studying the entire population (Gall and Borg, (1999)). Sampling was achieved at three different phases. The first phase involved the use of purposive sampling to select secondary schools in Murang'a South Sub – County with ICT infrastructure for integration of CAL in classroom teaching and learning process. Also referred to as judgmental sampling, purposive sampling is the deliberate choice of an informant due to the qualities that the informant possesses (Tongco, (2007)). Secondly, stratified random sampling was used to pick out proportionate population of students from different categories of schools i.e. boys only, girls only and mixed schools. Lastly, Simple random sampling was used to select respondents among the selected schools.

3.5.2 Sample Size

Sample size is the actual population picked out from the entire population that takes part in a study (Bartlett, Kotrlik and Higgins (2001)). From a target population of 912 form two students, 297 respondents were selected. Information in Table 3.1 shows that the ten schools with ICT infrastructure were stratified into boys only, girls only and mixed schools and proportionate sample of six schools drawn. Then simple random sampling was used to designate a stream either as control or experimental group from schools selected.

Table 3.1 Sampling Grid

Type of school	Schools		Students			
	Total	Sample	Total population	Sample		
				Experimental	Control	Total
Boys only	2	1	190	18	19	37
Girls only	2	1	187	39	34	73
Mixed	6	4	535	102	85	187
Total	10	6	912	159	138	297

Source: Sub County Secondary Schools Form II Students (2011).

3.6 Research Instruments

The research instruments for this study included:

3.6.1 Pre -Test

A pre-test was given to the control and the experimental groups. The pre-test was based on form one and part of the form two chemistry syllabus but did not test on the sub-topic carbon (IV) oxide. The pre-test questions were set using Blooms taxonomy which

includes; remember, understand, apply, analyze, evaluate and create. (Anderson, et al. (2001)). The set questions were also made in such a way that they assess the stated learning outcomes and were properly structured and clearly expressed. The questions were made appropriate in length and difficulty besides the marks allocated to the questions were ensured that they added up correctly. Other principles considered when setting the test were reliability, validity and fairness. It was composed of 10 open ended questions. The pre- test was given in all the sampled schools to help ascertain the general knowledge in chemistry on the selected students as at form two. (See appendix II).

3.6.2 Post -Test

A post-test was given to the two groups. The test was set by the researcher based on the sub-topic carbon (IV) oxide. The post-test questions were set using Blooms taxonomy as well which includes; remember, understand, apply, analyze, evaluate and create. (Anderson et al (2001)). The set questions were also made in such a way that they assessed the stated learning outcomes and were properly structured and clearly expressed. The questions were made appropriate in length and difficulty. The marks allocated to the questions were ensured that they added up correctly. Other principles considered when setting the test were reliability, validity. It comprised 10 open ended questions. (See appendix III).

3.7 Pilot Study

The pre-test items and post-test items were piloted. Pilot, or feasibility study, is a small experiment designed to test logistics and gather information prior to a larger study, in order to improve the quality and efficiency. A pilot study reveals deficiencies in the design of a proposed experiment or procedure. A pilot study is normally small in

comparison with the main experiment. It provides vital information on the proposed procedures or treatments. (Teijlingen, Rennie, Hundley and Graham (2001)). Purposive sampling was used to identify two secondary schools in Murang'a South Sub County where piloting of test items was carried out. The pilot study was used to establish reliability and validity.

3.7.1 Reliability

Reliability is the consistency of measurement over time, whether it provides the same results on repeated trials. (Christine, (2013)). The split-half method was used to test the reliability of the pre- test and post- test items. In the split-half method, the total number of items is divided into halves, and a correlation calculated between the two halves. This correlation estimated the reliability of each half of the test. Table 3.3 contains the reliability index obtained from an analysis of the reliability of the instruments that were used in the study. The results show that each instrument had a reliability index greater than 0.7000 (0.7563 and 0.7876 for the pretest and post test instruments respectively). Any reliability of 0.7000 and above is taken to depict an agreeable level of reliability for the instruments, thus the items of the instruments were deemed reliable (Kothari, (2004)). The reliability index for each of the instruments were as is shown in Table 3.3.

Table 3.3 Reliability Index

Instrument	Reliability index
Pre test	0.7563
Post test	0.7876

3.7.2 Validity

Validity can be defined as the degree to which a test measures what it is supposed to measure (Christine, (2013)). To achieve validity on the test items, the researcher

constructed these test items using form one and two chemistry syllabus .The researcher sought the opinion of the supervisors on the validity of the items included in the pre and post test instruments. Similarly, the opinion of three senior chemistry examiners with the Kenya national examination council were sought on the validity of the items of the instruments.

3.8 Data Collection Method and Procedure

At the beginning of the study face the research visited sampled schools to seek permission, and to be introduced to the students and their teachers. The researcher took time to explain to the respondents the importance of the study and to seek their permission to be involved in the study. The researcher also consulted with chemistry class teacher on their role in the course of the study. For those classes sampled as experimental centres, class teacher were familiarised with the CAL simulations and drills. The respondents were also informed to prepare for a pre-test instrument that was then administered one week later.

After administration of the pre-test instrument, the respondents were given treatment which included use of traditional methods of instruction for the control groups and CAL simulations of the topic carbon (IV) oxide for the experimental group. Then, a post test instrument which was prepared by the researcher in consultation with the teachers who were involved in administering the treatments was given to the respondents to assess the impact of the treatment on their achievement levels in carbon (IV) oxide. Finally, the instruments were marked by the researcher and respondents achievements in the two tests compared.

3.9 Data Analysis

Data obtained from the pre- test and a post- test scores were analyzed using descriptive statistics in the form of frequency and percentage with the aid of Statistical Package for Social Sciences (SPSS) version 17 computer software. The various hypothesis were tested using a one way Analysis of Variance (ANOVA) test.

3.10 Ethical Considerations

The researcher sought for a research permit. The researcher also visited the sampled school to seek permission and create a good rapport with the schools administration and teachers as well. The respondents were informed of their right of choice to take part in the study and the option to withdraw at any stage. Lastly, all the respondents were assured of the confidentiality with which data collected data would be treated.

CHAPTER FOUR: FINDINGS, INTERPRETATION AND DISCUSSION

4.1 Introduction

This chapter presents the analysis of data collected and discusses the findings of the relationship between performances of chemistry students exposed to computer assisted learning method as compared to those exposed to traditional learning methods, in Murang'a South Sub-County, Kenya. The data were obtained from a sample of 297 form two chemistry students through tests given out to the selected respondents. The data obtained was analyzed using frequency, percentage and Analysis of Variance with the aid of Statistical Package for Social Sciences version 17 computer software.

4.2 Demographics

The study comprised of 297 respondents drawn from six sampled schools which were divided into control group constituting 159 (53.5%) students and experimental group constituting 138 (46.5%) students. The findings are discussed under two themes; age and gender.

4.2.1 Age of Respondents

Analyses of the students' age were as summarized in Table 4.1.

Table 4.1 Age of Respondents

			Group		Total
			Control	Experimental	
Age	14-16		114	104	218
		% of Total	38.4%	35.0%	73.4%
	Above 16		45	34	79
		% of Total	15.2%	11.4%	26.6%
Total			159	138	297
		% of Total	53.5%	46.5%	100.0%

From Table 4.1 which contains information on the respondents' age shows that a majority

of the students, 218 (73.4%) were aged between 14 and 16 years as compared to 79 (26.6%) who were over 16 years old with an a comparable distribution across control and experimental groups..

4.2.2 Gender

Similarly, the respondents analysis based on gender were as summarized in Table 4.2.

Table 4.2 Sample by Gender

			Group		Total
			Control	Experimental	
Gender	Boy		74	64	138
		% of Total	24.9%	21.5%	46.5%
	Girl		85	74	159
		% of Total	28.6%	24.9%	53.5%
Total			159	138	297
		% of Total	53.5%	46.5%	100.0%

With regard to the respondents gender, there were slightly less boys (138 – 46.5%) as compared to the number of girls (159 – 53.5%) with each of them almost evenly distributed across the control and experimental groups.

4.3 Effect of CAL on Students Performance in Chemistry

The study sought to establish the effect of CAL on performance of students in chemistry by comparing the performance of students exposed to CAL method and those exposed to traditional modes of learning. The respondents were first given a pre- test. They were then divided into control and experimental groups and taught the topic carbon (iv) oxide using CAL for the experimental group and traditional method for the control groups. Finally, their mastery of the topic was assessed using a post- test. An analysis of the research findings were as is illustrated in Tables 4.3, 4.4, 4.5 and 4.6.

Table 4.3 Pre-test Performance

			Pretest					Total
			0-20	21-40	41-60	61-80	81-100	
Group	Control		141	11	4	2	1	159
		% of Total	47.5%	3.7%	1.3%	0.7%	0.3%	53.5%
	Experimental		123	13	1	1	0	138
		% of Total	41.4%	4.4%	0.3%	0.3%	0.0%	46.5%
Total			264	24	5	3	1	297
		% of Total	88.9%	8.1%	1.7%	1.0%	0.3%	100.0%

Results presented in Table 4.3 show that the respondents' general performance in the pre-test was poor (Mean= 19.5%; SD= 10.05). A 40% mark was used in this research to interpret the performance. Globally a 40% minimum subject pass mark is used in many countries at high school level which includes Afghanistan, Egypt, Honduras and Japan. Other countries such as Bangladesh have used a less than 40% minimum subject pass mark of 33% while Nepal has a minimum subject pass mark of 35%. (Grading System by Country (2015)) .From this study, more students in the control group scored less than 40% (152 representing 51.2%) as compared to those from the experimental group (136 representing 45.8%). A similar trend in performance across the groups was also evident in those who scored 40% and above since more of the students in this category were found to belong to the control group (7 representing 2.3%) as opposed to those from the experimental (2 representing 0.6%) indicating that though there were slightly more students in the control than the experimental group and the control group had slightly better performers. Their post -test performance was thus made and the results were as indicated in Table 4.4.

Table 4.4 Post- test Performance

			Posttest					Total
			0-20	21-40	41-60	61-80	81-100	
Group	Control		138	14	4	2	1	159
		% of Total	46.5%	4.7%	1.3%	0.7%	0.3%	53.5%
	Experimental		71	41	12	10	4	138
		% of Total	23.9%	13.8%	4.0%	3.4%	1.3%	46.5%
Total			209	55	16	12	5	297
		% of Total	70.4%	18.5%	5.4%	4.0%	1.7%	100.0%

From Table 4.4 which contains the results of the students post test results also show that the students general performance in the test was also poor (Mean=29.6%; SD=17.94) though there was a significant improvement in performance. Specifically, the results show that more students from the control group scored less than 40% (152 representing 51.2%) as compared to those from the experimental group (112 representing 37.7%). However, more of the students in the experimental group scored 40% and above (26 representing 8.7%) as compared to those from the control group (7 representing 2.3%) indicating a significant improvement in performance (an increase of 6.4% from 2.3% to 8.7%) for students who scored 40% and above from the experimental group which could be attributed to the teaching and learning method they were exposed to. An inferential interpretation of the meaning of this trend was sought via Analysis of Variance test and the results were as is shown in Table 4.5 and 4.6.

Table 4.5 Performance for Experimental and Control Groups

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
Control	159	1.20	.604	.048	1.11	1.30	1	5
Experimental	138	1.80	1.059	.090	1.63	1.98	1	5
Total	297	1.48	.897	.052	1.38	1.58	1	5

Table 4.5 gives information an ANOVA result of scores for students' mastery of the topic they were taught. The results shows that the respondents (students) from the experimental group had the highest score (1.80) on the elements of mastery followed by those from the control group (1.20) in that order. A summary of an ANOVA analysis for students score on mastery is represented in Table 4.6.

Table 4.6 ANOVA for Performance in Chemistry for Experimental and Control Groups

	Sum of Squares	Df	Mean Square	F	F Crit.	Sig.
Between Groups	26.871	1	26.871	37.519	2.678	0.010
Within Groups	211.277	295	.716			
Total	238.148	296				

Results from Table 4.6 gives a summary of the students' ANOVA score on mastery. The ANOVA results { $F=37.519$; $df =1$; 295; 296; $P=0.01$; $F \text{ crit. } =2.678$ } in Table 4.6 shows that the observed mean difference was significant at 0.05 level of significance. This means that the students who scored highly on the elements of mastery tended to have been exposed to a better teaching and learning method hence the null hypothesis H_{01} which stated that "there is no significant difference in the performance for students exposed to computer assisted learning compared to those exposed to traditional methods of teaching" was rejected. The research findings which shows that CAL is a better method for teaching and learning of chemistry agrees with those of other researchers such as Herrington (1999) who described computer assisted learnings as intellectual partner that can supports learning by allowing students to use them as tools to construct knowledge, explore and assess information with others and articulate and represent what they know. The International Society for Technology in Education (2005) suggested that teachers who change from traditional learning environment to new learning environment promote active learning, higher level thinking and collaborative and multisensory

stimulation. According to Congram (1995), CAL’s detailed, high-resolution graphics and animations enhance learning and promote a better understanding and knowledge of the content. Further, Dhanjal (1999) considered CAL advantages to include consistency of message, which cannot be assumed with a live instructor, measurability, which can be accomplished using self-check questions, pre-tests and post-tests and customization (Lawson (1999)).

4.4 Effect of CAL on Students Performance Based on Gender

The study also sought to establish the effects of CAL on chemistry students’ gender. The experimental group students pretest and post test results were analyzed comparatively based on gender as is shown in Table 4.7, 4.8, 4.9 and 4.10.

Table 4.7 Student Proficiency based on Gender Pre-test

			Pretest				Total
			0- 20	21-40	41-60	61-80	
Gender	Male		54	9	1	0	64
		% of Total	39.1%	6.5%	0.7%	0.0%	46.4%
	Female		69	4	0	1	74
		% of Total	50.0%	2.9%	0.0%	0.7%	53.6%
Total			123	13	1	1	138
		% of Total	89.1%	9.4%	0.7%	0.7%	100.0%

Results presented in Table 4.7 show that the students’ general performance across gender in the pretest was poor. Specifically, though there were slightly more girls than boys (74 girls compared to 64 boys) in the experimental group, a majority of each gender scored less than 40% in the pretest item (63 boys representing 45.6% and 73 girls representing 52.9%) indicating a significant poor performance in the subject in the pretest item across gender. Thus, of the total student sampled in the experimental group, only 2 (1.4%) students, one from each gender scored either 40% and above in the pretest item. An

analysis of their post-test performance was thus made and the results were as is indicated in Table 4.8.

Table 4.8 Students Proficiency based on Gender Post- test

			Posttest					Total
			0- 20	21-40	41-60	61-80	81-100	
Gender	Male		32	15	9	5	3	64
		% of Total	23.2%	10.9%	6.5%	3.6%	2.2%	46.4%
	Female		39	26	3	5	1	74
		% of Total	28.3%	18.8%	2.2%	3.6%	0.7%	53.6%
Total			71	41	12	10	4	138
		% of Total	51.4%	29.7%	8.7%	7.2%	2.9%	100.0%

From Table 4.8 which contains the results of the students' post test results analysis based on gender still show that a majority of the students performed poorly in the post test item since a total of 112 (81.1%) students still could not manage to score 40% and above. Specifically, the results show that more girls scored less than 40% (65 representing 47.1%) as compared to boys (47 representing 34.1%). With regard to those who scored 40% and above, there were twice as many boys as girls (17 boys representing 12.3% compared to 9 representing 6.5%) unlike equal number of students across the gender scoring 40% and above registered in the pretest item. An inferential interpretation of the meaning of this observation was sought via ANOVA test and the results were as is shown in Table 4.9 and 4.10.

Table 4.9 Scores for Mastery based on Gender

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max.
					Lower Bound	Upper Bound		
Male	64	1.94	1.180	.148	1.64	2.23	1	5
Female	74	1.69	.935	.109	1.47	1.91	1	5
Total	138	1.80	1.059	.090	1.63	1.98	1	5

Table 4.9 gives information on an ANOVA result of scores for students' mastery of the subject relative to gender. The results shows that boys had the highest score (1.94) on the elements of mastery followed by girls (1.69) in that order. A summary of an ANOVA analysis for the students' score on mastery is represented in Table 4.10.

Table 4.10 Scores for Mastery based on Gender – ANOVA

	Sum of Squares	Df	Mean Square	F	F Crit.	Sig.
Between Groups	4.172	1	4.172	5.260	3.043	.023
Within Groups	107.848	136	.793			
Total	112.020	137				

Results from Table 4.10 gives a summary of the students' ANOVA score on mastery relative to gender. The ANOVA results { $F=4.172$; $df=1$; 136 ; 137 ; $P=0.023$; F Crit $=3.043$ } in Table 4.10 shows that the observed mean difference was significant at 0.05 level of significance. This means that the students who scored highly on the elements of mastery tended to perform better on exposure to CAL hence the null hypothesis H_0 which stated that "there is no significant difference in performance and gender for students exposed to computer assisted learning" was rejected. The research findings which shows that CAL as a method for teaching and learning of chemistry promotes more the performance of boys than girls augers well with assertions of Adair (1990) who observed that the use of computer assisted learning is male dominated. These findings also concurs with that of Sadker, (1994) who observed that sitting in the same classroom and listening to the same teacher is received differently by boys and girls. Boys tended to perform better on exposure to CAL. Similarly research in Europe and North America identified boys' greater access to computers in schools and also noted boys' dominance in computer related tasks which lead to a better performance. (Volman (2002)).

4.5 Effect of CAL on Students Performance Based on Age

Lastly, the study sought to compare the effects of CAL on chemistry students' age difference. The experimental group students pre-test and post-test results were analyzed comparatively based on age and the results of the findings were as is shown in Table 4.11, 4.12, 4.13 and 4.14.

Table 4.11 Students Proficiency based on Age (Pre-test)

			Pretest				Total
			0- 20	21-40	41-60	61-80	
Age	14-16		94	10	0	0	104
		% of Total	68.1%	7.2%	0.0%	0.0%	75.4%
	Above 16		29	3	1	1	34
		% of Total	21.0%	2.2%	0.7%	0.7%	24.6%
Total			123	13	1	1	138
		% of Total	89.1%	9.4%	0.7%	0.7%	100.0%

Results presented in Table 4.11 show that similar to previous assertions, the respondents' general performance in the pre-test item was poor since 136 out of the 138 students in the experimental group scored less than 40% in the test with only two students (aged over 16 years) scoring more than 40% in the test. An inquiry of their post-test performance was made and the results were as is indicated in Table 4.12.

Table 4.12 Students Mastery based on Age (Post-test)

			Post-test					Total
			0- 20	21-40	41-60	61-80	81-100	
Age	14-16		57	30	7	8	2	104
		% of Total	41.3%	21.7%	5.1%	4.3%	1.4%	75.4%
	Above 16		14	11	5	2	2	34
		% of Total	10.1%	8.0%	3.6%	2.9%	1.4%	24.6%
Total			71	41	12	10	4	138
		% of Total	51.4%	29.7%	8.7%	7.2%	2.9%	100.0%

Table 4.12 contains the results of the students post test results based on the respondents age. The results is in agreement with the other findings in this study and shows that the students' general performance in the test was poor since a majority of the respondents (112 representing 81.1%) scored less than 40%. However, a slightly higher number of students recorded an improvement in performance which could be attributed to the teaching and learning method they were exposed to though the improvement was almost evenly distributed across the various age subset (17 students representing 9.8% scored 40% and above among students aged 14 – 16 years and 9 representing 7.9% among students aged above 16 years).An Analysis of Variance test is shown in Table 4.13 and 4.14.

Table 4.13 Scores for Mastery based on Age

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
14-16	104	1.73	1.017	0.100	1.53	1.93	1	5
Above 16	34	2.03	1.167	0.200	1.62	2.44	1	5
Total	138	1.80	1.059	0.090	1.63	1.98	1	5

Table 4.13 gives information on the central tendency results of scores for students' mastery of the topic they were taught relative to age. The results shows that the respondents (students) aged above 16 years had the highest score (2.03) on the elements of mastery followed by those aged 14 – 16 years (1.73) in that order. A summary of an ANOVA analysis for students score on mastery is represented in Table 4.14.

Table 4.14 Scores for Mastery based on Age – ANOVA

	Sum of Squares	Df	Mean Square	F	F Crit.	Sig.
Between Groups	2.285	1	2.285	2.052	F Crit.=3.043	0.154
Within Groups	151.432	136	1.113			
Total	153.717	137				

Results from Table 4.14 gives a summary of the students' ANOVA score on mastery relative to age. The ANOVA results { $F=2.052$; $df=1$; 136 ; 137 ; $P=0.154$; $F \text{ Crit.}=3.043$ } in Table 4.14 shows that the observed mean difference was not significant at 0.05 level of significance. This means that there was no significant difference in the effects of CAL on students' performance relative to age variation hence the null hypothesis H_{03} which stated that "there is no significant difference in performance and age for students exposed to computer assisted learning" was confirmed. The research findings which shows that CAL as a method for teaching and learning of chemistry does not significantly affect a specific age of chemistry students agree with that of Demeis and Stearns (1992) and Dietz and Wilson (1985) who found no significant relationship between age and academic achievement when CAL was used. According to these researchers, academic performance is a product of personal determination, cognitive development and motivation as well as several other positive correlates an assertion to which Emina (1986) subscribes. Other researchers who also agree with this line of argument include Aghadiuns (1992), Ugoji (2008), Chansarkar (2001) who insist that performance of students is not affected by learner's age but is associated with learner's entry behaviour.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter gives a summary of the research findings, conclusions, recommendations and suggestion for further research is done. The main purpose of this study was to establish the impact of computer assisted learning on teaching and learning of chemistry. The study investigated the level of proficiency of form two students in a pre-test item, exposed the students to the topic carbon (IV) oxide using CAL on a section and the other section to traditional method of learning. An evaluation of the teaching and learning process was obtained through a post -test item. Information obtained was analyzed quantitatively using cross tabulation and ANOVA with the aid of SPSS version 17 computer software.

5.2 Summary of the Study

From data analysis in chapter four, the study compares CAL and the conventional teaching methods used in teaching and learning which could be contributing to the persistent poor performance of students in chemistry in Murang'a South Sub-County. The contents of the analysis showed that the respondents' general performance in the test items was poor which is in agreement with other findings on students' performance in chemistry in summative tests such as Kenya Certificate of Secondary Examination (KCSE). Specifically, more of the students in the experimental group scored 40% and above as compared to those from the control group in the post test item indicating a significant improvement in performance for students from the experimental group which could be attributed to the effectiveness of CAL teaching and learning method they were exposed to. An ANOVA test interpretation of this finding showed that students from the experimental group scored highest on the elements of mastery compared to those from the

control group, this observation being significant at 0.05 level of significance. This was interpreted to mean that students exposed to CAL perform better than those exposed to traditional modes of learning.

Further, comparative test on the effect of CAL on students' performance based on gender showed that more boys scored 40% and above marks in the post test item unlike equal number of students across the gender scoring in the pretest item. ANOVA test result showed that boys scored highly on the elements of mastery compared to girls, the observation being significant at 0.05 level of significance. This was interpreted to mean that on exposure to CAL method of teaching and learning, boys performed better than girls under similar conditions.

Lastly, a comparative test on effects of CAL on students' performance based on age showed that though a higher number of students recorded an improvement in performance which could be attributed to the teaching and learning method they were exposed to, the improvement was almost evenly distributed across the various age. Additionally, through an ANOVA test result of scores for students' mastery showed that the students with 16 years and above had a higher score on the elements of mastery, this was found not significant at 0.05 level of significance. The findings therefore implied that there is no significant difference in performance of students of different ages exposed to CAL.

5.3 Conclusion

From the foregoing discussion it can be concluded that CAL is a better method for teaching and learning of chemistry as compared to traditional methods. Further, the study showed that on exposure to CAL, boys performed better than girls in chemistry. Finally,

it showed that there is no significant difference in performance of students of different ages on exposure to CAL method.

5.4 Recommendations

It is therefore recommended that various steps be put in place to help harness the potential of CAL in improving the teaching and learning environment of not only Chemistry but the other subject offered. To begin with, the ministry of education in conjunction with other stakeholders should ensure that schools are adequately equipped with ICT hardware and software to enable use of CAL into everyday teaching and learning process. Similarly, they should ensure that necessary policy guidelines are not only formulated but also implemented to foster CAL in the teaching and learning process in schools. Lastly, they should in conjunction with other stakeholders ensure in servicing of teachers on CAL to empower them thus enable its application in the teaching and learning process.

School administrators on their part should endeavor to provide an enabling environment for the use of CAL. This they can do by either providing or expanding existing ICT media resources or facilities in schools to help foster improved CAL. They should also provide for innovative ways to help motivate chemistry teachers like taking them for more capacity building courses and providing them with other incentives so as to empower them to better use CAL in their teaching and learning activities.

Lastly, the chemistry teachers should ensure that they expose their students to more CAL to help improve their proficiency levels in chemistry thus improve their performance in

the subject. They should also ensure that they regularly update themselves with the modern classroom pedagogical approaches thus improve their teaching skills.

5.5 Suggestion for Further Studies

The following areas are suggested for further study:

- a) A study of the impact of teachers' socio-cultural factors on use of CAL in teaching and learning of chemistry.
- b) A similar study be undertaken in other locations to provide comparative data on factors that promote CAL in chemistry and its impact on overall students' performance.
- c) An exploratory study of the effects of students factors on CAL in the teaching and learning of chemistry.

REFERENCES

- Adair, J. G., Sharpe, D., and Huynh, C. L. (1990). The placebo control group: An analysis of its effectiveness in educational research. *The Journal of Experimental Education*, 59(1), 67-86.
- Aghaduins M.C.K (1992). A Path-Analytic Study of Cognitive style Understanding of Science and Attitudinal Variables as Correlates of Achievement in Secondary School Chemistry. Ph.D. Thesis, Unpublished. Ibadan: University of Ibadan
- American Association of University Women (2002). Gender gaps: Where schools still fail our children. Retrieved December 1, 2006 from <http://www.aauw.org/research/GGES.pdf>
- Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R. and Wittrock, M. C. (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives, abridged edition. White Plains, NY: Longman.
- Anthony, J., Drumright, D. G., Whites, M. M., and Seikel, P. J. (1995). A "hands-on" approach to speech science. *Computers and Education*, 24(2), 107-116.
- Archer, J. (1998). The link to higher scores. *Education Week*, 18(5), 10-21.
- Bangert-Drowns, A. R., Kulik, C. L. C., and Kulik, C. C. (1987). The impact of peekability on feedback effects. In Paper presentation at the annual meeting of the American Educational Research Association, Washington, DC (1987, April).
- Barker, L. J., and Aspray, W. (2006). The state of research on girls and IT. *Women and information technology: Research on underrepresentation*, 3-54.
- Bartlett, J. E., II, Kotrlik, J. W. and Higgins, C. (2001). Organizational research: Determining appropriate sample size for survey research. *Information Technology, Learning, and Performance Journal* 19 (1): 43-50.
- Bayraktar, S. (2001). A Meta-analysis of the Effectiveness of Computer-Assisted Instruction in Science Education. *Journal of research on technology in education*, 34(2).
- Becker, H. J. (2000). How exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. *Contemporary Issues in Technology and Teacher Education*, 1(2), 274-293.
- Bollinger (1986), *Case studies in computer Aided Learning*. Falmer press, London.
- Brown, J. S., Collins, A., and Duguid, P. (1989). Situated cognition and the culture of learning. *Educational researcher*, 18(1), 32-42.
- Bruner, J. S. (1961). The act of discovery. *Harvard Educational Review*, 31(1), 21-32.

- Butler, D. (2000). Gender, girls, and computer technology: What's the status now? *Clearing House*, 73(4), 225–229.
- Chansarkar, B.A. and Michaeloudis, A (2001). Student profiles and factors affecting performance. *International Journal Mathematics Education Science and Technology*. Volume 32 (1). pp 97-104.
- Chiriswa, P. (2002). An investigation into the probable factors responsible for poor performance in Kenya Certificate of Secondary Education (KCSE) in Vihiga District of Western Province, Kenya. Unpublished master's thesis, Kenyatta University,
- Christimann, A. (1999); A Comparative Analysis of The Effects of Computer Assisted Instructions on the Student Achievement in Different Science and Demographic Students. *Dissertation Abstract International*. Vol 49 No7.
- Christine A. (2013). *The American heritage dictionary of idioms*. Houghton Mifflin Harcourt.
- Closing the Gender Gap: Gender Gaps Fact Sheet”. (1997). American Association of University Women,
- Congram, G. (1995). "Computer-based training simplifies safety compliance". *Pipeline and Gas Journal*, 222, 52-54.
- Cotton, K. (2001). Computer-assisted instruction. Northwest Regional Educational Library: School Improvement Research Series, 10. Retrieved June 29, 2002.
- Crosser, S. (1998). He has a summer birthday: The kindergarten entrance age dilemma. *Clearinghouse on Elementary and Early Childhood Education*, University of Illinois.
- Daintith, J., and Wright, E. (2008). *A dictionary of computing*. Oxford University Press, Inc.
- DeMeis, J.L. and Stearns, E.S. (1992). Relationship of school entrance age to academic achievement. *Journal of Educational Research*, 86 (1), 20-27.
- DeVries, R., Zan, B., Hildebrandt, C., Edmiaston, R., and Sales, C. (2002). *Developing Constructivist Early Childhood Curriculum: Practical Principles and Activities*. Early Childhood Education Series. Teachers College Press, PO Box 20, Williston, VT 05495-0020.
- Dhanjal, (1999). "Computer-based training in the steel industry". *Steel Times*, 227, 13-14.
- Dietz, C. and Wilson, B.J. (1985). Beginning school age and academic achievement. *Psychology in the Schools*, 22 (1), 93-94.
- Driscoll, M. P. (2000). *Psychology of learning for instruction*. Needham Heights , MA: Allyn ed.). Upper Saddle River, NJ: Merrill/Prentice Hall.

- Emina F (1986). The validation an inventory of scientific attitude. *Journal of STAN*, 24(1and1): 171-178.
- Etukudo, E. U. (2003). Mathematics and information technology: The use of computer teaching and learning mathematics in Nigeria secondary schools. *Information and Communication Technology (ICT) and Science, Technology and Mathematics Education*. Ibadan: Heinemann Educational Books (Nig) Pic, 187-191.
- Fraser, B. J., Walberg, H. J., Welch, W. W., and Hattie, J. A. (1987). Syntheses of educational productivity research. *International journal of educational research*, 11(2), 147-252.
- Gall, J. P., Gall, M. D., and Borg, W. R. (1999). *Applying educational research: A practical guide*.
- Garrison, D. R. (2011). *E-learning in the 21st century: A framework for research and practice*. Taylor and Francis.
- Georges. I' (2001). *The Universal History of Computing: From the Abacus to the Quantum Computer*. New York: John Wiley and Sons. ISBN 0-471-39671-0.
- Gerlach, U.S (1971). *Teaching Media: A Systematic Approach*. Englewood Cliffs Prentice-Hall Inc.
- Gilmore, P. (1985). " Gimme room": School resistance, attitude, and access to literacy. *Journal of Education*, Boston. .
- Gonzalez, G. M., and Birch, M. A. (2000). Evaluating the instructional efficacy of computer-mediated interactive multimedia: Comparing three elementary statistics tutorial modules. *Journal of Educational Computing Research*, 22(4), 411-436.
- Grading System by Country (2015). <http://en.wikipedia.org/wiki/>. Retrieved on 10th April 2015. 2.30pm.
- Hafkin, N. J and Taggart, N. (2001). Gender, information technology, and developing countries: An analytic study. Office of Women in Development, Bureau for Global Programs, Field Support and Research, United States Agency for International Development.
- Herrington, J. (1999); Using Situated Learning and Multimedia to Investigate Higher- Order Thinking. *Journal Multimedia and Hypermedia*, 8(4): 401-421)
- Hogan, S. L., and Adviser-Timpson, W. (2005). Traditional and asynchronous computer-assisted instruction in a community college remedial mathematics course: A mixed methods study of student success and perceptions. Colorado State University.
- Ingule, F. and Gatumu, H. (1996). *Essentials of educational research*. Nairobi: East African publishers

- International Society for Technology in Education. (2005). National educational technology standards for students. ISTE (Interntl Soc Tech Educ).
- Isernhagen, J. C. (1999) Technology: A Major Catalyst for Increased Learning. *T.H.E Journal* 27 (1):30-38.
- Isopahkala-Bouret, U., Rantanen, T., Raij, K., and Järveläinen, E. (2011). European Qualifications Framework and the comparison of academically-oriented and professionally-oriented master's degrees. *European Journal of Higher Education*, 1(1), 22-38.
- Ivers, K. S., and Barron, A. E. (2002). Multimedia projects in education: Designing, producing, and assessing. *Abc-clio*.
- Jenson, J., and Rose, C. B. (2003). Women at work: listening to gendered relations of power in teachers' talk about new technologies. *Gender and Education*, 15(2), 169-181.
- Jimoyiannis, A. (2013). Using SOLO taxonomy to explore students' mental models of the programming variable and the assignment statement. *Themes in Science and Technology Education*, 4(2), pp-53.
- Jonassen, D.H.(2000);*Computer As Mind Tool For School*. Upper Saddle River, Prentice Hall
- Kay, R. H. (2006). Addressing gender differences in computer ability, attitudes and use: The laptop effect. *Journal of Educational Computing Research*, 34, 187–211.
- Kothari, C. R. (2004). *Research methodology: methods and techniques*. New Age International.
- Kwaka, K, (2003): Influence of Teacher' Assessment Practice in Enhancing Performance in Mathematics Among Secondary School Students in Mombasa District, Kenya. Unpublished MED project. Kenyatta University,Nairobi.
- Lawson, S. (1999).Computer-based training: Is it the next wave? *Professional Safety*, 44, 30-33.
- Levine, T., and Donitsa-Schmidt, S. (1997). Commitment to learning: Effects of computer experience, confidence and attitudes. *Journal of Educational Computing Research*, 16(1), 83-105.
- Lin, X (1998); Assessing the Impact of Computer Integration on Students. *Journal of research on learning*. *Educational Researcher*, 18(1), 32-42.
- Marr, P.M. (2000); Grouping Students at the Computer to enhance the study of British Literature. *English Journal* 90(2): 120-125.
- Martyn, S. (2008). True Experimental Design. Retrieved Dec 30, 2014 from Explorable.com: <https://explorable.com/true-experimental-design>

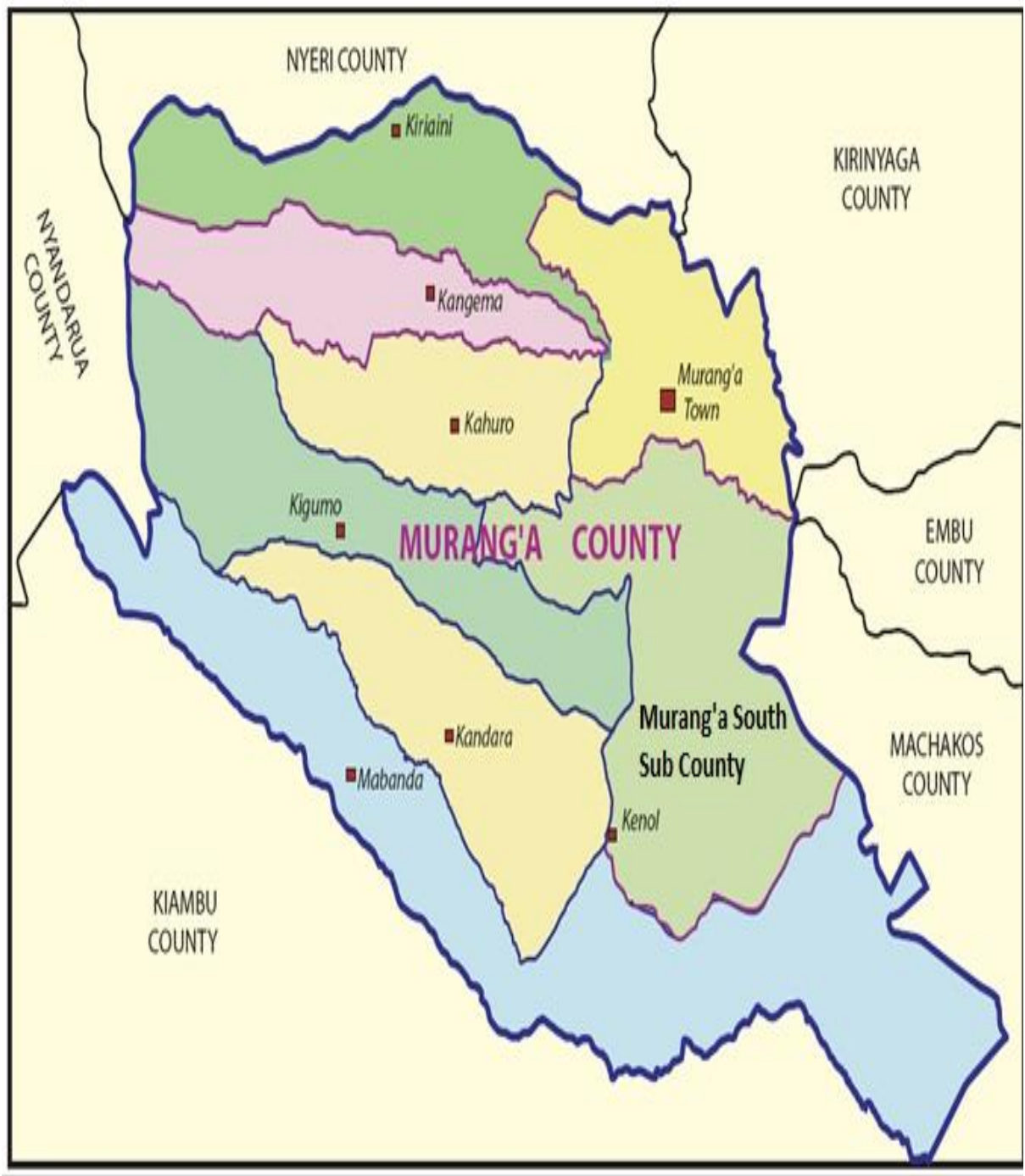
- Mason, R. L., Gunst, R. F., and Hess, J. L. (2003). *Statistical design and analysis of experiments: with applications to engineering and science* (Vol. 474). Wiley. com.
- Miller, G. S. (1999). The effect of computer tutorial software as a mode of instruction in intermediate algebra.
- Ministry of Education Science and Technology Sessional Paper, (2012). Nairobi; Government printers.
- Moore, D. S. (1997). New pedagogy and new content: The case of statistics. *International statistical review*, 65(2), 123-137.
- Morgil, I., Yavuz, S., Oskay, Ö. Ö., and Arda, S. (2005). Traditional and computer-assisted learning in teaching acids and bases. *Chemistry Education Research and Practice*, 6(1), 52-63.
- Murang'a South Sub County K.C.S.E. subject analysis 2005-2010. Nairobi.
- Ogembo, J.O. (2012). Determinants of student's poor performance in chemistry in public schools of Kwale County, Kenya. Unpublished MED thesis in the School of Education of Kenyatta University, Nairobi
- Omwenga, I. E. (2005). Pedagogical issues and e-learning cases: Integrating ICTs into teaching and learning process. Paper presented at the School of Computing and Informatics University of Nairobi. Nairobi.
- Owston, R. D. (1997). The World Wide Web: A technology to enhance teaching and learning?. *Educational researcher*, 26(2), 27-33.
- Park, S. I., Lee, G., and Kim, M. (2009). Do students benefit equally from interactive computer simulations regardless of prior knowledge levels? *Computers and Education*, 52(3), 649-655.
- Pianta, R. C., La Paro, K. M., and Hamre, B. K. (2008). *Classroom assessment scoring system*. Baltimore: Paul H. Brookes.
- Pontecorvo, C., Balacheff, N., Kaye, A., Bouma, H., Liao, T., Orhun, E., and Cunha, L. D. (1997). Final Committee Report of NATO's Special Program for Advanced Educational Technology. *Journal of Educational Technology Systems*, 23(2), 91-153.
- Ranade, M. D. (2006). Development of CAL presentations for science teaching and overview of research findings. *International Journal of Science and Mathematics Education*, 4(4), 763-789.
- Rathgeber, E., and Adera, E. O. (Eds.). (2001). *Gender and the information revolution in Africa* [electronic resource]. Idrc."http://www.idrc.ca/books/focus/903
- Robinson, J. P., and Lubienski, S. T. (2011). The Development of Gender Achievement Gaps in Mathematics and Reading During Elementary and Middle School Examining Direct Cognitive Assessments and Teacher Ratings. *American Educational Research Journal*, 48(2), 268-302.

- Roblyer, M. D., Edwards, J., and Havriluk, M. A. (2006). Integrating educational technology into teaching. Pearson/Merrill Prentice Hall.
- Sadker, M., and Sadker, D. (1994). Failing at Fairness: How Our Schools Cheat Girls (New York. Touchstone, 271-303.
- Samuel, N. J. (2012). Enhancement of Science Performance through Computer-Assisted Instruction among Selected Secondary School Learners in Kenya . Unpublished MED thesis in the School of Education of Kenyatta University, Nairobi
- Sanger, M. J., and Greenbowe, T. J. (2000). Addressing student misconceptions concerning electron flow in aqueous solutions with instruction including computer animations and conceptual change strategies. *International Journal of Science Education*, 22(5), 521-537.
- Sansanwal, D.N (2000); Information Technology and Higher Education. *University News*, Vol.38 No46, 2000.
- Sharp, J., Hopkin, R., James, S., Peacock, G., Kelly, L., Davies, D., and Bowker, R. (2009). Teacher preparation and the national primary science curriculum: a twentieth-anniversary perspective. *Research Papers in Education*, 24(3), 247-263.
- Silverman, S. L., and Casazza, M. E. (2000). *Learning and Development: Making Connections To Enhance Teaching*. Higher and Adult Education Series. Jossey-Bass Inc., Publishers, 350 Sansome Street, San Francisco, CA 94104.
- Sivin-Kachala, J., and Bialo, E. R. (2000). Research report on the effectiveness of technology in schools. Washington, DC: Software Information Industry Association.
- Teijlingen van, E., Rennie, A.M., Hundley, V., and Graham, W. (2001), The importance of conducting and reporting pilot studies: the example of the Scottish Births Survey, *Journal of Advanced Nursing* 34: 289-295.)
- The Kenya National Examination Council (2007); Regulations and Syllabuses. Nairobi; Government Printers
- Tongco, M. D. C. (2007). Purposive sampling as a tool for informant selection.
- Ugoji F.N. (2008). The impact of Counselling on the Academic Performance of Secondary School Students. *Africa Journal for Inter Disciplinary Studies*, 8(2): 67-73
- Ukueze, A.C. (2007). Learner variable of academic performance and Adjustment of Junior Secondary Student .*The Counsellor*, 23(2): 172-183.
- UNESCO Asia and Pacific Regional Bureau for Education “Information and Communication Technologies for Education in Asia-Pacific”
<http://www.unesco.org/Bangkok/education/ict/>

- Vensel, G.J. (1988) The Effectiveness Of Computer Delivered Science Stimulation On The Acquisition Of Process Skill For Gifted And General Fourth And Fifth Grades. Dissertation Abstract International Volume 49, No 10,198.
- Volman, M., and van Eck, E. (2002). Gender equity and information technology in education: The second decade. *Review of Educational Research*, 71(4), 613-634.
- Wambugu, P. W., and Changeiywo, J. M. (2008). Effects of Mastery Learning Approach on Secondary Students Physics Achievement. *Eurasia Journal of Mathematics, Science, and Technology Education*, 4(3), 293-302
- Whitley, B. E (1997). Gender differences in computer-related attitudes and behaviors: A meta analysis. *Computers in Human Behavior*, 13(1), 1–22.
- Wilder, G., Mackie, D., and Cooper, J. (1985). Gender and computers: Two surveys of computer-related attitudes. *Sex Roles*, 13(3), 215-228.
- Wishart, J. (2002); Students and Teacher's Motivation and Learning through Use of CD – ROMs *Journal of Multimedia and Hypermedia* 9(4)333-47.
- Wittrock, M. C. (1990). Generative processes of comprehension. *Educational Psychologist*, 24(4), 345-376
- Yalcinalp, S., Geban, Ö. and Özkan, I. (1995). Effectiveness of Using Computer-Assisted Supplementary Instruction for Teaching the Mole Concept. *Journal of Research in Science Teaching*, 32(10), 1083-1095.
- Zhao, Y., and Lei, J. (2012). Distance Education. *International Guide to Student Achievement*, 442.

APPENDICES

Appendix I: Study Locale



Murang'a County Map

Appendix II: Pre-test

Name.....

GenderMale/Female (tick where appropriate)

Age..... [14-16] [Above16] (tick where appropriate)

CHEMISTRY ACHIEVEMENT TEST

Time: 1 hour

Instructions to candidates

1. Write your name in the spaces provided.
2. Indicate your gender and age in the space provided
3. All answers must be written in the spaces provided in this booklet.
4. Do not remove any pages from this booklet
5. ***This paper consists of four printed pages.***
6. Answer ***all*** questions.

For examiner s use only

Question	1	2	3	4	5	6	7	8	9	10	TOTAL
Marks											

1. Study the chemical equations below and answer the questions that follow.

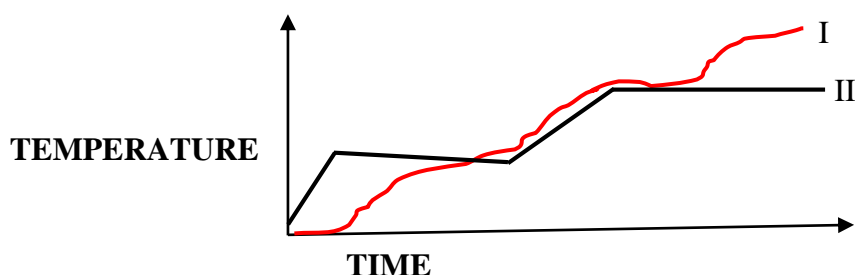


a) The temperature remained constant in process (i) when heating was done.
Explain

b) Explain why XBr_2 has a high melting point.

c) Explain why $XBr_{2(s)}$ does not conduct electricity while $XBr_{2(aq)}$ does.

2. The curve below represents the variation of temperature with time when pure and impure samples of a solid were heated separately.



a) Which curve shows the variation in temperature for the pure solid?

b) Explain your choice

b) How do impurities effect melting and boiling points of substances

3 An element Y has the electronic configuration 2.6

a) Which group of the periodic table does the element belong?

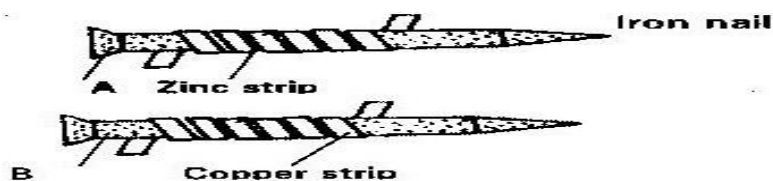
b) In forming ions, does it gain or lose electrons. Explain

c) Write the formula of the compound formed between Y and magnesium metal which is

found in group 2 of the periodic table.

4 The diagram below represents two iron nails with some parts wrapped tightly with

zinc and copper strips respectively.

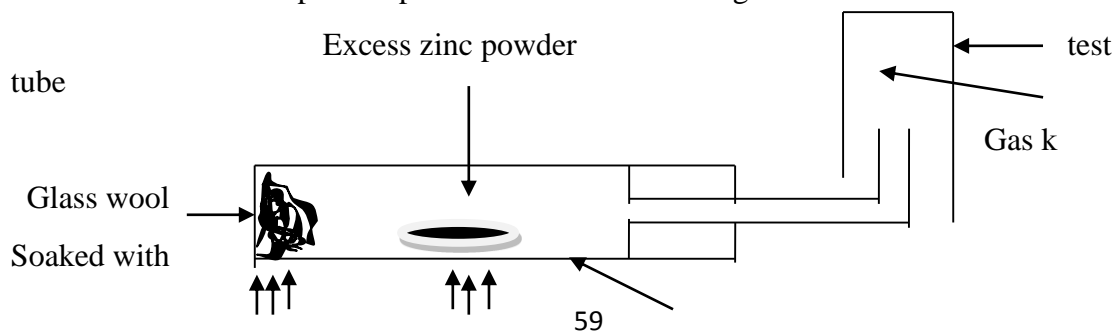


a) After sometime one of the nails had rusted. Which one?

b) Explain your choice

c) Explain why cooking pots made of aluminium do not corrode easily when exposed to air.

5. A student set up the experiment below to collect gas K.



water

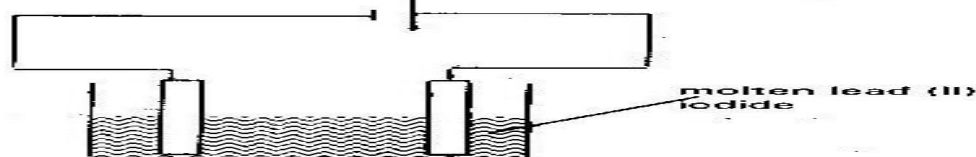
boiling tube

a) Write the symbol equation taking place in the boiling tube

b) Identify gas k

c) The glass wool was heated before heating the zinc powder. Explain

6 The setup up below was used to electrolyze molten lead (II) iodide

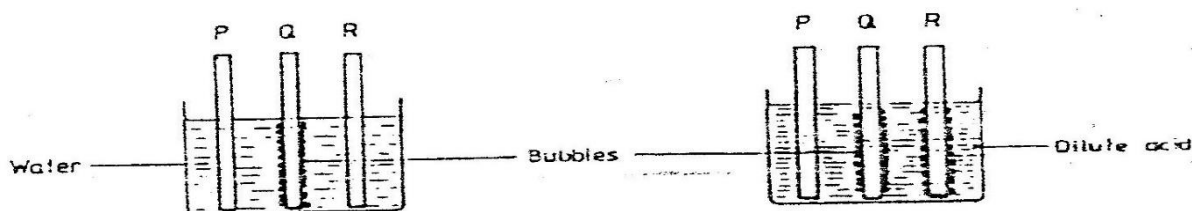


a) Name the two products that were obtained.

b) Write the symbol equation at the negative terminal

c) Give two commercial application of electrolysis

7. In an experiment, rods of metals P, Q and R were cleaned with sand paper and placed in a beaker containing water. Another set of rods was also cleaned and placed in a beaker containing dilute acid.



a) Why is it necessary to clean the rods with sand paper before dipping them into the liquids?

b) Arrange the three metals in order of their reactivity starting with the most reactive.

c) When sodium chloride is reacted with bromine, there is no reaction that takes place. Explain this observation

8. a) Write a symbol equation on laboratory preparation of oxygen gas
- b) Explain the change in mass that occurs when magnesium is heated
- c) Describe how a mixture of oxygen gas and nitrogen gas can be separated

9. a) What is the type of the bond in ammonia molecule
- b) Draw a diagram to show bonding in ammonia molecule.

- c) Ammonia gas has low boiling point. Explain

10 A paper chromatography of a plant extract gave the following results

Solvent	Number of spots
X	6
Y	2
Z	3

- a) Which is the most suitable solvent for purifying the extract .Explain
- b) Ball pen cannot be used to mark solvent front in the above chromatography. Explain
- c) Give two commercial applications of chromatography.

Appendix III: Post-test

Name.....

GenderMale/Female (tick where appropriate)

Age..... [14-16] [Above 16] (tick where appropriate)

CHEMISTRY OF CARBON (IV) OXIDE

Time: 1 hour

Instructions to candidates

1. Write your name in the spaces provided.
2. Indicate your gender and age in the space provided
3. All answers must be written in the spaces provided in this booklet.
4. Do not remove any pages from this booklet
5. *This paper consists of four printed pages.*
6. Answer *all* questions.

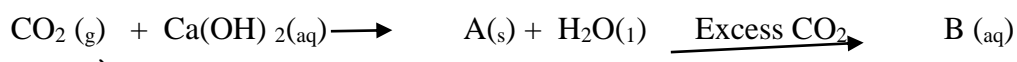
For examiner s use only

question	1	2	3	4	5	6	7	8	9	10	TOTAL
Marks											

1. (a) Give the method used to collect carbon (IV) oxide gas.

(b) Explain why carbon (IV) oxide gas cannot be collected if passed through water.

(c) Name two properties of carbon (IV) oxide which make it suitable for use in fire extinguishers.
2. Study the flow chart below and answer the questions that follow.



- (a) Write the chemical symbol for substances A.
- (b) Write a symbol equation showing how substance B is formed.
- (c) State and explain what is observed when a lighted candle is covered

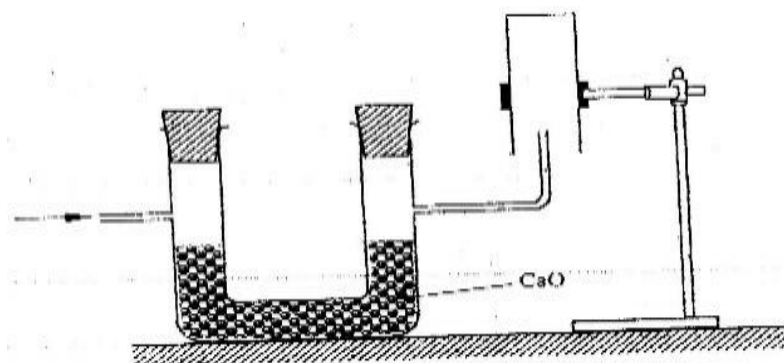
with gas jar full of carbon (IV) oxide.

3. (a) Burning magnesium continues to burn in a gas jar of carbon (IV) oxide to form a white powder and a black solid. Explain this observation.

(b) Name the white powder.

(c) Write a symbol equation between carbon (IV) oxide and the burning magnesium

4. The set-up below was used to collect a dry sample of a gas.



(a) Using a symbol equation explain why the set up cannot be used to dry carbon (IV) oxide gas.

(b) Apart from the method used to dry the gas, identify one mistake in the set up if it was used to collect dry carbon (IV) oxide gas.

(c) Give two effects of carbon (IV) oxide in the atmosphere.

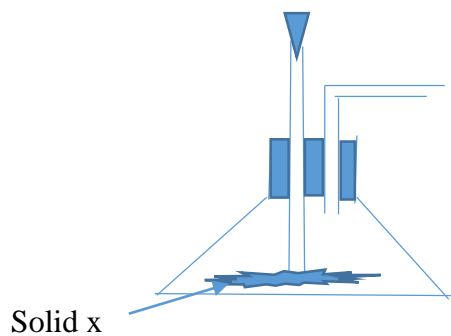
5. The table below shows substances A, B and C. Their corresponding PH values are also indicated.

A	B	C
PH 2	PH 6	PH 10

(a) Which substance is likely to be carbonic acid?

- (b) Explain your choice
- (c) Write a symbol equation on the reaction between water and carbon (IV) Oxide gas
6. (a) Name the compound used to test the presence of carbon (IV) oxide gas.
- (b) Explain your choice.
- (c) When extinguishing a fire caused by burning kerosene, carbon (IV) Oxide gas is used in preference to water. Explain.
7. When excess carbon (II) oxide was passed over heated copper (II) Oxide in combustion tube, copper (II) oxide was reduced.
- (a) Write a symbol equation for the reaction which took place.
- (b) What observation was made in the combusting tube when the reaction was complete.
- (c) Explain why the reaction above is termed as **redox**
8. (a) Name the process in which solid carbon (IV) oxide changes directly into gas.
- (b) Give one use carbon (IV) oxide related to the above mentioned process
- (c) Explain why dilute sulphuric acid does not react fully with calcium Carbonate while dilute hydrochloric acid reacts fully with the same liberating Carbon (IV) oxide.
9. Carbon (IV) oxide gas was passed through water. A blue litmus and a red litmus paper was put in the resulting solution. What observation was made on the
- (a) Blue litmus paper.
- (b) Red litmus paper.
- (c) What can one conclude about carbon (IV) oxide gas based on the observations made above.

10. (a) Complete the set up below to show how a dry sample of carbon (IV) oxide gas can be prepared in the lab.



- (b) Identify solid x
- (c) Write a symbol equation between dilute hydrochloric acid and solid x

Appendix IV: Research Permit

PAGE 2 PAGE 3

Research Permit No. NCST/RCD/13/012/81

THIS IS TO CERTIFY THAT: Date of issue 9th January 2013

Prof./Dr./Mr./Mrs./Miss/Institution Fee received KSh. 1,000

Sammy Nduati Charagu

of (Address) Kenyatta University

P.O.Box 43844-00100, Nairobi

has been permitted to conduct research in

Location Murang'a South District

Province Central

on the topic: Comparison of computer assisted learning to the traditional methods in learning Chemistry in secondary schools in Murang'a South

Applicant's Signature Secretary

National Council for Science & Technology

for a period ending: 9th March, 2013.

