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Integration of Information Communication Technology Instructional Resources on Students' Motivation and Achievement in Chemistry Practical in Secondary Schools in Kenya

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Abstract

Purpose: The main aim of this study was to determine the types of ICT instructional resources integrated and the level of motivation and achievement in learning of chemistry practical in secondary schools.

Methodology: The study was conducted through descriptive survey design. The target population for this study were the teachers of chemistry, form three students and the heads of the institutions who were key informants. The schools were selected using stratified random sampling to ensure that there was equal representation of the region. The teachers of chemistry and ICT assistants were selected using simple random sampling technique while purposive sampling was used to select the heads of institutions. The learners were selected using simple random sampling. In the mixed secondary schools, stratified sampling technique was used to ensure gender equality. A sample is a smaller group selected from the target population; 34 teachers of chemistry were used in this study, 14 ICT assistants were used and 282 form three students in Bungoma County. This study used questionnaires as the main tool for collecting data. Work sheet was availed to the students for the experimental research; the work sheet contained simple questions in chemistry practical. The data collected was analyzed through descriptive and inferential analysis and the results were presented in tables and figures.

Findings: The findings showed that majority of the schools that participated in the study have integrated ICT in teaching and learning of chemistry practical. The computers were available in the sampled schools and were accessible by teachers and form three students for integration in teaching of chemistry. The smart phones were also available but only teachers accessed these smart phones. The smart phones had the appropriate content that could be integrated in teaching chemistry practical. The media platform available in the smart phones could also allow teachers to project the content by use of overhead projectors and allow learners to view simulations and virtual chemical processes. Very few schools lacked the necessary infrastructure to handle ICT integration in teaching and learning of chemistry such as electrical installation and other fittings that could enable the projection of the content. There was no school in the study area that had the smart board which could allow teachers and learners to interact and manipulate the content to suit the needs for particular specific classes.

Unique Contribution to theory, practice and policy: It was concluded that integration of ICT instructional resources could assist learners to perform some experiments in chemistry and provide better opportunities for teachers and students to interact with the content and with each other in the course of teaching and learning chemistry.

Keywords: *Information Communication Technology, chemistry, teachers, learners*

Background of the Study

Integration of ICT is the process of incorporating ICT in the instruction or usage of technology seamlessly for instructional purposes like transacting curricular content and students working on technology to do authentic tasks. Like management, integration involves organizing, handling and administration of materials or operations of instructional use and value according to the established standards.

Computer technology started in 20th century; the first functional computer was commissioned on 15th February 1946 at the University of Pennsylvania in the United States of America (Crawford, 1999). The computer was named ENIAC (Electronic Numerical Integrator and Calculator). Macaulay and Eckert designed it in 1946, which initially was called computer room because it was too big and it was characterized by big physical size with very little memory (Belcher&Olbert, 2003). It has evolved into handheld ICT tools such as microcomputers which are used today such as laptops, ipads and other mobile phones. This process is called miniaturization, which is the gradual reduction in the physical size of the computers. The first computer used electronic tubes instead of chip, which was cooled by water running through tubes to prevent overheating thus resulting into a lot of power use (Murdock, 2007). It formed the first generation computers different from the fifth generation computers in use. The fifth generation computers are used for networking and programing it can support high level multitasking and management of huge data. According to Aniemeka (2013), computers came to Africa in 1980 and this technology was first integrated in military in France, the corporate world,then homes and personal computers some of which are integrated in education. Generally, integration of ICT instructional resources involves organizing, developing and administering media resources. The focus of this operation is proper planning, development, acquisition and use of appropriate experts such as teachers in the institutions, development and use of suitable instructional systems in place to realize the set objectives in education. Educationists have clearly distinguished integration process from utilization in that, integration is well organized and result oriented while utilization is related to application of media principles in education (Hammond, 2013). Application of Information Communication Technologies in secondary schools in Kenya has one major aim, to improve the quality in education (Onchwari, 2009). It is viewed as a major tool for building knowledge societies (UNESCO, 2003) and, particularly as a mechanism at the school education level that could provide a way to rethink and redesign the educational systems and processes, thus leading to quality for all.

In Europe, appropriate use of ICT in secondary school education is considered a key factor in improving quality at this educational level (Sahlberg 2007). The European Community is promoting the utilization of ICT in learning processes through its e-learning Action Plan, one of the aims of which is to improve quality of learning by facilitating access to resources and services as well as remote exchange and collaboration (Commission of European Communities, 2001:2). To be able to understand the implication of this report to secondary school education, the report outlines several aspects to be observed and promoted, such as widespread access to broadband technologies, professional development support policies for teachers, more research into how people teach and learn utilizing ICT, development of new high-quality online content and adaptation of current regulations to make the use of ICT at schools easier, as more recent UNESCO publications also highlighted(UNESCO,2008).

In China, integration of ICT was first initiated in the 1990s (JIAO et al, 2014). After10 years, the ministry of education of the People's Republic of China made important reforms called Chinese New Basic Curriculum Reforms. Just like Kenya's Ministry of Education, China gave priority to Development of ICT in Basic Education considering the ever-increasing population of up to 107.5 million primary school pupil and about 90.8 million secondary school students by the year 2020(MOE, 2020). Since 1998, China has issued many projects such as Rural Elementary and Secondary School Distance Education Project that played a big role as a guide to promoting ICT integration in Basic Education (Wang, et al, Zhong, et al, 2017).

However, despite the large-scale implementation of China's Policy on integration of ICT and numerous descriptions of its contributions, little research has examined its pattern and intention, especially in an empirical way. Considering the country's large scale basic education system and ICT integration projects, giving a policy scenario of it would add an essential part for global experience.

Integration of ICT in China has seen robust growth of virtual classroom interaction between teachers and students in teaching and learning of science (Keengwe, 2009). While examining previous research on policy for ICT integration in basic education in China, education administrators, scholars and teachers all over the world are increasingly interested in integration of ICT in basic education (Onchwari, 2009). Just as alluded by Sahlberg (2007), global educational innovation is symbolized by ICT, which is often presented as both the cause and consequence of educational innovation and change (Clegg et al, 2003).

India has equally ever increasing population like China. Integration of ICT is not a substitution of the teachers in classroom teaching and learning. According to Manas (2016), learning is not learning if a formative shift in one's cognitive schema has not occurred and teaching is not teaching if one has not learned.

In 21st century, technology is considered a potential instrument for bringing revolution in social and cultural lives of the human society (Hargreaves, 2003). India's education system has empowered teachers to interact with learners at an individual level using technology on social platform (Toony, 2001). Statistics from UNESCO, 1998 & 2002 respectively indicate clearly that India has made very significant strides in integration of ICT in its education system. Students and teachers have sufficient access to digital technologies and the internet in their classrooms, schools and the teachers have knowledge and skills to use the new digital tools and resources to help all the students achieve higher academic standards (Takwale et al, 2014). Inspite of all these, the teacher education in institutions in India and in many Asian countries are yet to explore its advantages just as noted by Mishra in his study(Mishra et al, 2006).

Study of Indian education programs reveal quite interesting facts, implementation of ICT integration and its effectiveness in the teaching and learning process and approaches to learning and teaching has been changed dramatically; there is increasing pressure on teachers to prepare them to acquire the needed competencies in ICT as well as professionalizing the teaching service. Students learn to incorporate technology into their own learning process (SITE, 2002).

Integration of ICT in United Kingdom is positioned as a mechanism for educational reform via transformation of teacher practice. Digital technologies are positioned as Vygoskian mediating tools to facilitate change in the schools, improving standards and facilitating personalized learning (Fullan, 2013). Integration of ICT in UK has been given priority in the planning, process and implementation of the curriculum in the schools and colleges (Hammond, 2013). Research conducted in 2008 to 2011 reveal that since the Educational Reform Act of 1988, ICT has been compulsory in UK for pupils from age 5 to 16 years in the maintained schools. The report further draws evidence from the inspection of ICT in primary, secondary and special schools between 2008 and 2011(www.ofsted.gov.uk/070035). ICT tools like films, radio and television, digital technologies are positioned as important tools for reformation and transformation of schooling (Howard & Mozejko, 2015). The major reason for integration of ICT in teaching and learning in the UK schools is improving the standards of education, teaching and learning in the schools, increasing vocational relevance, contributing to knowledge-based economies, enriching the learning experiences, transforming pedagogy to make it more student centred, constructivist in nature and with a focus on higher order learning and facilitating personalized learning.

Teachers use ICT with diverse competencies, classroom practices, conceptions and beliefs (Mama& Hennesy, 2013). Ensuring that teaching quality of inside-school ICT use for desirable learning outcomes needs teacher ICT accessibility, competences, self-efficacy, adaptive teaching goals and creative pedagogies, school technical and political support and the ecological system support (Farina et al, 2015). Other sources recommend and suggest that student learning outcomes may be affected by educational provisions linking inside-out school educational ICT use (Kent&Facer, 2004). The teachers need further professional development to integrate ICT

into curricula, address course objectives and link student inside-out school ICT use for educational purposes (Barrera-Osori &Linden, 2009, Wang et al, 2014). In this same vein therefore, integration of ICT in teaching and learning in the schools depend entirely on the subject teachers and the attitudes of the students who in this case are the main consumers of the ICT.

Digitalization of schools in UK has attracted a number of new stakeholders influencing policy processes and school governing, thus raising questions of appropriate forms of government policy making. School policy adherence in general has been found challenging due to variations in the school context and complexity of policy translation of which it is said there is lack of understanding among policy-makers(Cuban,2013). Another excerpt drawn from digitalization of schools in UK is that pre-service teachers justify the use of particular technology initiative in the schools and has shone light on how they view technology. Teachers appear to take a very techno-centric view focusing on technological artifacts as opposed to the types of learning environment they could facilitate. However, students recognize technology as an artifact as opposed to the human activities they facilitate.

In comparison to African countries, India has considered the great importance of ICT integration in teaching and training. Adequate emphasis is not placed on it; teacher training is often neglected as a traditional practice here without accepting its latest innovations in the face of more immediate visible recent educational goals and objectives (Panigrahi, 2016)

It's much easier to build a gleaming new school than to successfully train a cadre of teachers who are willing to work in challenging situations in this digital era, in poor, rural areas, far from the centres of social and commercial life of a country. The scholars have identified a major shift in emphasis from teaching to learning that created a more interactive and engaging learning environment for teachers and learners. Due to this shift, students navigate through large amounts of information to analyze and make decisions and to master new knowledge domains in an increasingly technological society like the Indian society (Dwyer, 1997, Haris & Hofer, 2011)

The efforts of different governments and administrations have been focusing on providing the schools with good equipment. In 2013 for example, the Jubilee administration hinted to supplying laptops to all public primary schools purposely to equip learners with skills in ICT. However, analysis of educational uses of ICT has been lacking. Therefore, this research will focus on the need to develop appropriate strategies to face this new teaching role and additionally, the learners' role when integrating ICT in the teaching and learning processes in secondary schools in Kenya. The role and the perspective of teachers have become highly relevant, highlighting them as crucial players in the process. Particularly, teachers use technology depending on their perceptions and trust in the way it can contribute to the teaching and learning process (Hoffer, 2011). It will be imperative to be closer to teachers in order to understand what they do with the ICT equipment supplied or what they might do with

technology in their classrooms and in relation to their work. Integration of ICT instructional resources in secondary education is connected to achievement in education; the main reason in utilization of the same resources by teachers and learners is to objectively produce the desired results. Studies by Nachmiasis et al, (2008); Somekh (2008) and Webb (2002), reveal very interesting facts about utilization of ICT educational resources in secondary education, they contend that ICT integration strengthens the traditional lecture method and practices. They found out that it is possible for teachers to develop innovations by taking advantage of what technology has to offer. There is quite a number of software available for utilization by the teachers of chemistry to interact with the students; there is virtual laboratory that is a web-based software for interactive learning based on simulation of the real phenomena. It allows learners to explore a topic by comparing and contrasting different scenarios, to pause and to restart application for reflection and do note taking, to get practical experimentation over the internet. It is actually laboratory facility that is on virtual space to be accessed through platforms like Zoom, YouTube and others that are developed. In addition, other studies by (Kirkpatrick and Peck, 2001); show that technology is mainly used to develop low-level teaching and learning processes, suggesting that teacher- centred approaches are a setback. The platforms allow the learners to manipulate this laboratory with little instruction from the teachers of the subject. The Education sector in Kenya takes a huge share of government expenditure, which goes to equip schools with ICT educational resources to boost teaching and learning of science subjects in both primary schools and secondary schools. These instructional resources are materials or events that create the conditions necessary for learning to occur. Bruce *et al,* (2009) posit that education's central goal should be to build the learning capacity as well as developing knowledge and skills that are integrated seamlessly, to do this, the education stakeholders should be ready to spend.

Kenya Vision 2030 envisages creating a globally competitive and prosperous Nation with a high quality of life by the year 2030. The objective of the social pillar is investing in the education of the people of Kenya in order to improve the quality of life specifically through education and training. It was upon this basis that ICT equipment was released to Kenyan public schools to achieve these set objectives (The Republic of Kenya 2008).

Learners are taught chemistry through various teaching techniques. The major objective for learning chemistry in secondary schools is to acquire relevant technical and scientific skills necessary for economic development and to apply in secondary education KICD (2010). Thus, teachers are supposed to design the learning environment that can provide the experiences and lessons that respond to the students' prior knowledge in chemistry. According to Aggarwal (1995), a teacher of chemistry should maximize the practical study by controlling relevant factors such as; educational purposes, educational context, teaching materials, educational environment, conduct of the students, behavior of the instructors and interrelations between the students and the instructors in practice, the school classroom management and the network of instruction such as intellectual education, moral education and counseling. The teacher of

chemistry should therefore consider utilizing the ICT instructional resources available to enhance understanding of the subject. According to Otunga (2011), Utilization of these resources enhances effective teaching and learning of science to boost performance in the National Examinations. In this case, good performance in chemistry is a clear indicator of learning that occurred because of the teacher investing in thorough preparation before instruction. All the above teaching and learning resources encourage the hands-on active teaching and learning that can bring about effective and efficient instruction in the subjects. There is a connection between the presence of ICT instructional resources in an institution of learning and the actual utility where the learners to bring about learning utilize the same resources (Ozmen, 2008). The ability to search for information using the ICT equipment available in secondary schools, download the information, observe the diagrams and scientific processes using ICT media keenly, and recreate the mental images produced through observation of these features allows them to process the information and apply it in answering the questions in chemistry (Chang, 2002).

Objectives of the Study

The objective of this paper is to determine the types of ICT instructional resources integrated and the level of motivation and achievement in learning of chemistry practical in secondary schools.

Theoretical Framework

This study was pegged on Jerome Bruner's theory of instruction. The instruction consists of leading the learner through a sequence of statements and restatement of a problem or a body of knowledge that increase the learner's ability to grasp, transform and transfer what is learned. In short, the sequence in which a learner encounters materials within a domain of knowledge affects the difficulty that will be experienced in achieving mastery. If it is true that the usual course of intellectual development moves from enactive through iconic to symbolic representation of the world, it is likely that an optimum sequence will progress in the same direction.

The optimal sequence cannot be specified independently of the criterion in terms of which final learning is to be judged. A classification of such criteria will include atleast the following;

a) The speed of learning
b) Resistance to forgetting
c) Transferability of what has been learned to new instances
d) Form of representation in terms of which has been leaned in terms of cognitive strain imposed
e) Effective power of what has been learned in terms of its generativeness of new hypotheses and combinations.

Instruction is provisional state that has as its object to make the learner of problem- solver self-sufficient. The tutor must correct the learner in a fashion that eventually makes it possible for the learner to take over the corrective function himself. Otherwise, the result of

instruction is to create a form of mastery that is contigent upon the perpetual presence of the teacher.

Bruner further proposed three models of representation as discussed in this framework. This suggests that it is effective when faced with new material to follow a progression from enactive to symbolic representation, this holds true even for adult learners. Bruner also suggests that a learner even of very young age is capable of learning any material so long as the instruction is organized appropriately; in sharp contrast to the belief by other theorists like Piaget and other stage theorists. The five representations are explained as follows:

- **Enactive mode of representation**

Thinking is based on the physical action, an infant learns by doing, rather than by internal representation or thinking. It also involves encoding the physical action based information and storing in the memory; for example, in the form of movement as in muscle memory: a baby might remember the action of shaking a rattle. This mode continues later in many physical activities like learning how to ride a bicycle, playing the keyboard and rudimentary skills in typing on the computer keyboard. Many adults can perform a variety of motor tasks like typing, sewing a shirt, operating a lawn mower and so on. This would be difficult to describe in iconic or symbolic form.

- **Iconic mode of representation**

This mode of representation is based on the sensory images or icons, usually visual ones like pictures in the minds, for some this is the conscious while for others say they do not experience it. In this study, the learners were required to carry out some tasks on the computers using the icons of the apparatus used in titration to get the same results like in real titration that involve use of conventional apparatus. When learning a new subject, it is often helpful to have diagrams or illustrations to accompany the verbal information. Thinking is based on the use of other mental images such as hearing, smell or touch. ICT allows the learners to interact with virtual apparatus and in combination with the enactive mode, can carry out tasks and capture the same data required in answering questions in chemistry practical, after all, the examiners in chemistry practical only require the data collected during the practical session to measure achievement in chemistry practical.

- **Symbolic mode of representation**

The symbolic or word representation is the last development in the learner. This is where the information is stored in the form of a code or symbol such as language. This mode is acquired around six to seven year-olds according to Piaget's concrete operational stage. In the symbolic. In the symbolic stage, knowledge is stored primarily as words, mathematical symbols, or in other symbol systems such as music. Titration part of the practical examination carries the heaviest mark in comparison to ionic determination in the qualitative analysis, to be able to have learners

enjoy doing titration in the daily practice, there must be additional representation like words for instruction to the candidate, sound to add flavor to the mundane task of titration and mathematical symbols to direct the learners in analysis of the results of virtual titration done. Symbols are flexible in that they can be manipulated, ordered, classified and so on. So that the user is not constrained by the actions or images which have a fixed relation to that which they represent.

CONCEPTUAL FRAME WORK

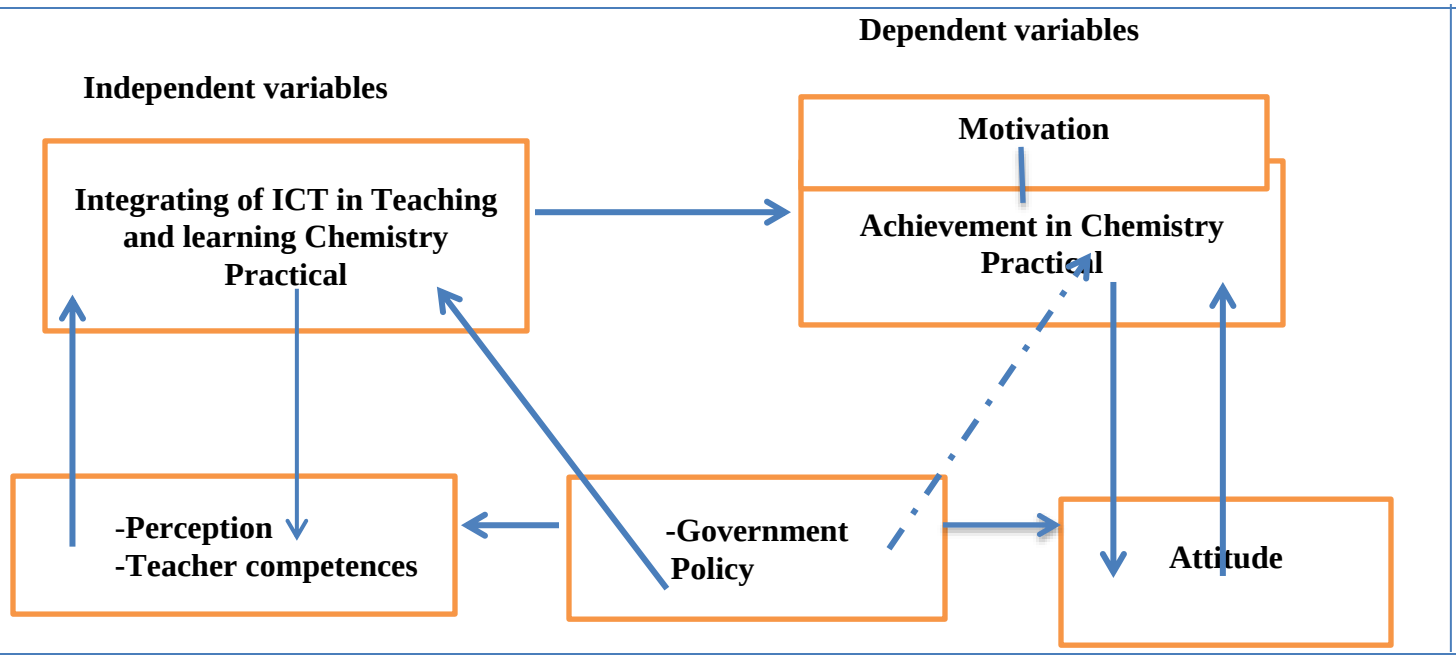

Figure 1: Conceptual Framework

Source: The Author

From the above conceptual framework, integration of ICT instructional resources in teaching and learning of chemistry practical constitute the independent variable as it can be manipulated by both the students and teachers to be able to achieve the desired results in chemistry practical. As independent variable, integration of ICT allows the teachers and learners to be the masters of what they do while ICT becomes the tool in their hands to be utilized in any direction that achieves the best output in chemistry practical.

Integration of software such as chemdraw allows the teachers and learners to identify and draw all the shapes of chemistry apparatus that are used in carrying out practical activities. On the other hand, chemix is an application which provide the platform for the teachers and learners to virtually add one chemical substance to another to get the expected compounds and record the results in the form of data. The visual codes offer the opportunity for teachers and learner to have additional components to chemdraw and chemix to allow learners chance to interact with any

chemistry practical session. All the above described components when integrated produce the learning experiences which then change the way teachers and learners interact with the universe using the senses. Changes in attitude of learners towards chemistry and particularly chemistry practical is the cardinal and ultimate goal of teachers and learners.

Achievement in chemistry practical is the main dependent variable, but motivation also leads to the confidence needed to achieve the desired goals in teaching and learning chemistry. Other intervening variables like government policy provide direction such as regulating how ICT is used in education and content that is availed to learners for consumption. Government policy influences the attitudes of teachers and learners towards use of ICT instructional resources. Punitive policies create negative attitudes that will affect motivation and eventually achievement in chemistry practical. Good policies change attitudes, reinforce motivation, and boost achievement. These intervening variables act as the gear of integration of ICT instructional resources which when properly engaged changes the direction and shortens time taken to achieve the goals of education. Similarly, government policy alters the way teachers and learners perceive ICT, perception and teacher competences determine the extent of integration and therefore, very important tenets in chemistry practical.

The learners store all the information acquired from the practical activities in the memory which then can be retrieved anytime to be used by the learners in solving the subsequent problems. Finally, the sum of all the aspects demonstrated in the conceptual framework constitute quality in learning and achievement in chemistry practical.

Types of ICT Instructional Resources

ICTs are of the major contemporary factors shaping the global economy and producing rapid changes in the society (KICD, 2013). They can transform the nature of education where and how learning takes place and the roles of students and teachers in the learning process (Chijioke, 2007). There is no doubt to this fact that traditional learning environments have been impacted by the internet, social media, and smart phones (Wekesa, 2003). The traditional classrooms now have to compete with the independent writers and bloggers as well as social media websites, and other users-generated content venues have influenced the way in which students are willing to learn (Aniemeka, 2013). According to Wayne (2000), Individuals, institutions, economists, business leaders, and Government officials from the public, private, and non-profit sectors are looking to ICT for better, more efficient and safer ways of providing services. The educational use of computer technology continues to grow worldwide with integration of ICTs in schools having been made compulsory in the developed world since the beginning of 1980(Cotton, 1997).

While ICT in developed countries is compulsory, in Kenya and other developing nations, ICT integration in education is considerably more recent, small-scale and experiment (Wekesa,

2008). The adoption of computers in education in Kenya is deemed to increase due to acquisition of basic computer skills. The integration of computers in education began in early 2000s in Kenya and this has gone all the way to aid in teaching, communication, and research. Right now, every subject has a computer application and currently the deliberate efforts by the government to provide laptops to every class one in public schools has made this venture successful.

Teaching of chemistry in secondary school aims at imparting certain skills to the learner that makes him/her equipped to exploit the resources in the environment without causing destruction. The teacher of chemistry must understand that he/she must develop scientific skills among the learners. These skills once internalized by the learners, can cause them to make use of scientific knowledge in their day-to-day life. In each of the topics in chemistry, the teacher will find that certain skills are developed more than others. He/ she must be careful not to ignore any of them all through the teaching process. The skills include but not limited to; observing, recording of data, drawing, classifying, communicating, measuring, predicting, inferring, identifying and controlling variables, formulating and testing hypotheses, and defining, interpreting data, experimenting and constructing models. All these skills can be acquired by use of ICT instructional resources available. These skills would only be achieved if the teacher of chemistry adopts an approach that encourages exploration. During the twenty thirteen presidential campaigns the current Kenyan president promised to provide laptops for Kenyan primary school learners, a pledge that has now turned into an ambitious multimillion Digischool scheme. From twenty sixteen about 5000 laptops for primary school pupils and teachers arrived at Jomo Kenyatta International Airport, Nairobi, and the first installment of some 1.2 million devices. The teachers should encourage the learners to consider themselves as scientists. This way, the learners will feel free to point out questions and set out ways of carrying out inquiries that seek answers to the questions. For efficient and effective management of these ICT devices, learners should get used to operating these ICT devices to achieve the objectives of every planned lesson. The teacher should demonstrate what is expected in order for the learner to visualize the expected results. This is how ICT educational resources come on board.

Following this valiant yet risky investment from the government, the teachers of chemistry must identify and assess the benefits and short falls of ICT integration with secondary school curriculum in Kenya. Barasa (2005) commenting on instruction in Kenya, highlights the fact that the learning resources and the teacher awareness of their availability and utility enhance learner performance. He further notes that, situations where there is evidence to show failure by society or government to provide equal access to such learning resources could be seen as denial of a child's right to proper education. This information raises questions than answers; the society in question is the Ministry of Education, Teachers Service Commission, Kenya Institute of Curriculum Development and other groups that support education in this country, without leaving out the political divide; should the ICT instructional resources be supplied to learners through support of these agencies, or should the teacher of chemistry be empowered to develop

his/her own software for use in the classroom instruction? The curriculum developer is mandated to design the software part of the ICT instructional resources which should be incorporated in the curriculum implementation process.

The teachers are probably the most important resource that any country has. This is because an efficient human capital development depends on the quality and effectiveness of teachers. One of the reasons for management and utilization of ICT lies in the type of the outcome of instructional process. The quality of doctors, teachers, lawyers, accountants, engineers, and other professionals depends on how well they have been prepared on their various roles in the society by their teachers, therefore, teachers play a key role in the overall human resource. There is however, a strong indication that most teachers in secondary schools in the developing countries have been conscripted into the teaching profession due to their inability to gain entry other professions. This implies that teaching in developing countries has two lots of teachers: those who chose the profession for intrinsic reasons and those, for reasons beyond their control, have found themselves in the profession. Okumbe J. (2007) argues that the main issue in teacher development is that a good proportion of them enter the teaching profession with low morale. He suggests that a consciously designed teacher development is a must if work, motivation and job satisfaction are to be improved to make teaching a 'Willing profession'. The use of ICT learning resources is influenced by the philosophy of education and learning theories.

Ancient Greek philosopher Aristotle (384-324 BCE) developed realism. The teaching and learning of science is based upon this philosophy whereby; first the learner perceives an object and records sensory data about the object, in this case the software in the mind, then the mind sorts these data into qualities always present in the object by identifying the necessary qualities, the learner abstracts a concept of the object and recognizes it as belonging to a certain class, Ornstein (2011).From this philosophy, it can be inferred that ICT learning resources can be very useful in transmitting knowledge and skills in science to learners. Barasa (2005) confirms in Otunga (2011) that availability of teaching resources and the teacher awareness of their utility enhances learner attainment. Comenius cited in Daniel.M. (1995) that use of objects to illustrate concepts will enhance assimilation of the lesson. The teacher while preparing the lesson should organize the lesson into easily assimilated small steps that make learning gradual, cumulative, and pleasant, Ornstein (2011). Chemistry is practical in nature and there are a number of learning resources that can reinforce acquisition of concepts that can be used by the learner to solve novel situation.

Johnson (1990) argues that education can no longer be based on a single teacher or a single textbook trying to dispense knowledge, skills, and expertise that children need to know, develop, and learn for the rest of their lives. Hingesel (1989) indicates that teachers need the tools which help children to learn and develop a passion for learning. ICT in schools creates a better environment throughout the school, for example through e-mail, discussion groups and even live

chat rooms. The utilization of ICT have extremely beneficial motivational influence on a learners learning capabilities, The learners are proven to express themselves through ICT instructional resources by being able to complete tasks given.

Many teachers of chemistry have been over relying on textbooks as reference materials, but the knowledge is dynamic. To cope with the trend, they should acquaint themselves with information searching skills so as to be ahead of the learner. According to Chia and Duthie (1993), ICT instructional resources are very profound in the social context as they result in cognitive change as analyzed, while Kirkpatrick and Cuban (1998) also confirm that computers in teaching and learning process have very significant effect on cognitive outcomes in learners, particularly in secondary schools. By being ahead, the teacher will be a useful learning resource by planning, organizing, directing, and guiding learners for self-discovery as they interact with teachers. Blok et al (2002) presented some meta-analysis of the effect of use of computers in teaching and learning processes and in academic results, it could be confirmed from his study that cognitive change occurs when learners are motivated in searching for information to solve scientific questions. The studies previously cited such as use of book and printed materials are no longer the only source of information. The development of educational theories, international trends to self-learning, taking into account differences of individual learners, makes them the axis of the educational process, and the teacher's role changes into a leader and facilitator of the learning process.

Samikwo (2013) concluded that availability and use of teaching and learning resources in schools impacted positively on students' achievement in chemistry examination. Ngaruiya (2012) observed that, the traditional approaches to teaching and learning continues to predominate in the learning institutions and this has hindered utilization of non-book media. Tutors and pupils in the learning institutions have not shown a commitment to the production of their own learning resources preferring to use what is already made.

To conclude, Kafu (2010) suggests that learning resources in particular should always be manipulated to suit all forms of learning situations and styles like interactive learning, problem-based learning (PBL), independent studies, individual and mass instruction. Based on this view, ICT learning resources remain as objects or materials until their value is identified, selected, developed, and utilized in the instructional process. ICT equipment is in this view, the mediator of instruction and is integrated during teaching and learning process to enhance understanding of the content material being taught.

RESEARCH METHODOLOGY

Research Design

The study was conducted through descriptive survey design. The researcher adopted the positivist philosophy; the reality of integration of ICT in teaching and learning of chemistry

practical can be quantified empirically. This informed the use of questionnaires to the form three learners, teachers of chemistry. According to Mugenda (2003), descriptive survey involves collection of data in order to determine whether and to what degree a relationship exists between two or more quantifiable variables.

Study Population

The target population for this study were the teachers of chemistry, form three students and the heads of the institutions who were key informants. The teachers of chemistry have undergone the professional training in ICT through in- service training and therefore could utilize the ICT instructional resources. Form three students are in position to utilize ICT instructional resources, this study was conducted in Bungoma County that according to the Ministry of Education statistics (2019) has about 212 secondary schools, both public and private. It was assumed that the teachers of chemistry have undergone the professional training, while the ICT assistants have the training in their field and form three students are in position to utilize the ICT equipment.

Sampling Techniques

The schools were selected using stratified random sampling to ensure that there was equal representation of the region. The teachers of chemistry and ICT assistants were selected using simple random sampling technique while purposive sampling was used to select the heads of institutions. The learners were selected using simple random sampling. In the mixed secondary schools, stratified sampling technique was used to ensure gender equality.

Table 1: Categories of Schools by School Type in Bungoma County

Category of School	Boys'	Girls'	Mixed	Total
National	**1**	**1**	**-**	**2**
Extra county	**8**	**7**	**5**	**20**
County	**8**	**7**	**4**	**19**
Sub-County	**4**	**5**	**9**	**18**
Private	**3**	**3**	**3**	**9**
Total	**24**	**23**	**21**	**68**

The total number of schools sampled was 68

Sample Size

A sample is a smaller group selected from the target population; 34 teachers of chemistry were used in this study, 14 ICT assistants were used and 282 form three students in Bungoma County.

Table 2: Table Showing the Sample Size

Respondents	Target Population (N)	Sample population(n)	Percentage (%)	Sampling Technique
Teachers	**91**	**34**	**37.4**	**Purposive**
Students	**1258**	**282**	**22.4**	**Simple Random**
ICT Technicians	**34**	**14**	**41.2**	**Purposive**
Total Sample Size	**1383**	**330**	**100**	

Data Collection Instruments

This study used questionnaires as the main tool for collecting data. Work sheet was availed to the students for the experimental research; the work sheet contained simple questions in chemistry practical.

Data Analysis Procedure

Quantitative data was collected from 282 students, 34 teachers of chemistry, and 14 ICT assistants from 34 secondary schools. The data was collected by the researcher as he was moving from one school to the next. He was assisted by the subject teacher who administered questionnaires to students because the students were well known to him or her and therefore collected reliable information. The researcher also connected with ten teachers of chemistry online to administer the work sheet to students to perform a simple chemistry experiment and answer three questions which were marked and the results relayed to the researcher online for analysis. The KCSE document and analyzed KCSE results were obtained from the deputy principal's office or the principal's office.

DATA ANALYSIS, PRESENTATION, INTERPRETATION AND DISCUSSION

Demographic Characteristics of Teachers

The teachers were asked to describe their personal profile including gender, age, years of experience teaching Chemistry, and training capacity. The findings were as shown below.

Table 3: Gender of the Respondents

Gender	Count	Percentage
Male	18	52.9%
Female	16	47.1%
Total	**34**	**100.0%**

Source: Field Data

The findings of table above show that majority of the respondents, 52.9% (18) were male while 47.1% (16) were female. The findings show that most of the teachers of Chemistry in the schools were male. Similarly, the researcher demonstrated gender inclusivity in the study by ensuring that both male and female participated in the study. The findings by Tanui (2003) show that ICT can help teachers to do better than what they already know and act as amplifiers of the existing practice. This means that ICT is a tool in the hands of the teacher of chemistry practical that should help the teacher achieve the desired end with ease. According to Wasike (2013), the manner in which the learning environment is organized is critically important because learners might not learn all that is taught in a single exposure to teaching using conventional methods. The teachers of chemistry should be proficient enough in using ICT instructional resources that are currently fitted with enough applications, which can aid in the process of teaching chemistry practical. Using ICT in teaching and learning chemistry practical would favour those who are used to them.

Table 4: Age of the Teachers

Age in Years	Count	Percentage
25-35 years	23	67.6%
36-45 years	8	23.5%
46-55 years	3	8.8%
56-66 years	0	0.0%
above 66 years	0	0.0%
Total	**34**	**100.0%**

Source: Field Data

The findings of Table show that majority of the respondents, 67.6% of the respondents were of the age between 25 to 35 years, 23.5% were of the age between 36 to 45 years, and 8.8% were of the age between 46 to 55 years. None of the respondents was above the age of 55 years. The findings show that most of the study participants were young and energetic to participate in the teaching activities. All the participants were mature enough to be able to give reliable information to the study. Teacher's experience is very significant, the teachers who have been in the field for long can create very conducive environment for learners (Mingaine, 2013). Besides, the experienced teachers have the ability to create interesting and interactive learning environment that facilitates a pedagogical shift entailing an educational interaction between teachers and learners. Furthermore, experienced teachers are able to do an orderly presentation of digital content that can help the learners interact and achieve the learning experience.

Table 5: Level of Training in Teaching Chemistry Subject in Secondary School

Level of Training	Count	Percentage
Certificate	0	0.0%
Diploma	5	14.7%
Degree	28	82.4%
Post Graduate Degree	1	2.9%
Total	**34**	**100.0%**

Source: Field Data

The study findings of Table show that 82.4% of the selected teachers were having University undergraduate degree training in teaching Chemistry Subject at secondary schools, 2.9% had University postgraduate degree training in teaching Chemistry Subject at secondary schools, while 14.7% had diploma training in teaching Chemistry Subject at secondary schools. This shows that most of the teachers of Chemistry who participated in the study were well trained in teaching Chemistry subject at the secondary schools.

Demographic characteristics of Learners

The learners were asked to describe their personal profile including gender, age, years of study, and mode of delivery in teaching.

Table 6: Gender of the Learners

Gender	Count	Percentage
Male	167	59.2%
Female	115	40.8%
Total	**282**	**100.0%**

Source: Field Data

The table shows that majority of the respondents, 59.2% were male while 40.8% were female. The findings show that the rate of enrollment of the male students in the selected secondary school was higher than that of the female students. These findings are in agreement with Zimmerman (2004), that among the primary and secondary school going children, girls use computers 5 hours a week for play games whereas boys spend 13 hours a week for the same purpose. This then means that the students like computer very much and can continue playing with it without ever getting bored. The study findings also indicated that the researcher ensured gender inclusivity when selecting students to participate in the study. The previous findings by scholars show that boys spend more time with computers enjoying playing online games this can be harnessed in education to create a very conducive environment for learning chemistry practical(Wasike,2013).

Types of ICT Instructional Resources Used in Learning of Chemistry Practical in Secondary Schools in Bungoma County.

The first objective of the study was to determine the types of the ICT instructional resources integrated in teaching and learning of chemistry practical in secondary schools. The teachers were asked to state the types of the ICT instructional resources used in teaching and learning of chemistry practical in their respective. The following describe the extent to which the ICT instructional resources were availed in schools. 1 = Not Available (N), 2 = Very Rare (VR), 3 = Rare (R), 4 = Common (C), 5 = Very Common (VC)

Table 7: Types of ICT Teaching and Learning Resources.

ICT Equipment	N	VR	R	C	VC	Modal Class
Computers	2	3	3	19	7	Common
	5.9%	8.8%	8.8%	55.9%	20.6%	
Smart Phones	2	0	0	13	19	Very common
	5.9%	0.0%	0.0%	38.2%	55.9%	
Smart Board	22	1	2	4	2	Not Available
	71.0%	3.2%	6.5%	12.9%	6.5%	
Overhead Projector	8	5	4	15	2	Common
	23.5%	14.7%	11.8%	44.1%	5.9%	
Smart Television	20	5	2	3	3	Not Available
	60.6%	15.2%	6.1%	9.1%	9.1%	

Average level of Availability of ICT Resources	Mean(%Mean)	Std. Dev.	Std. Error of mean	Minimum	Maximum
	3.0044 (60.0%)	.82447	.14140	1.00	4.80

Source: Field Data for Teachers

The table above shows that Smart Phones are the very common ICT tools for teaching and learning in the schools as indicated by majority of the respondents, 55.9% and 38.2% who rated the availability of the Smart phones as very common and common respectively. Similarly, Computers and Overhead projectors were commonly used in teaching and learning of Chemistry subject as indicated by majority of the respondents, 55.9% and 44.1% respectively who rated the resources to be commonly available.

However, Smart Televisions and Smart Boards were not available in most of the selected secondary schools as indicated by 60.6% and 71% of the respondents respectively on average, the availability of the ICT learning and teaching resources in the secondary schools in teaching Chemistry was at 60% rated by the teachers as commonly available. The researcher asked the selected teachers to state how frequently they used the ICT resources in teaching and learning.

Table 8: How often are ICT Equipment used in Teaching and Learning of Chemistry Practical?

ICT Equipment	Frequently	Common	Rare	Very Rare	Not Used At All	Modal Class
Computers	5	7	14	4	4	Rare
	14.7%	20.6%	41.2%	11.8%	11.8%	
Smart phones	5	12	11	4	2	Common
	14.7%	35.3%	32.4%	11.8%	5.9%	
Smart board	1	1	4	3	23	Not used at all
	3.1%	3.1%	12.5%	9.4%	71.9%	
Smart television	1	2	5	1	25	Not used at all
	2.9%	5.9%	14.7%	2.9%	73.5%	

Source: Field Data for Teachers

The findings of table show that majority of the selected teachers, 41.2% showed that the schools rarely use computers in the teaching and learning of the chemistry subject. However, the findings of Table 4.10 indicated that the computers are commonly available. These findings therefore show that despite computers being available in the schools, they are rarely used in the teaching of Chemistry practical. Akinbobola & Ikitde (2008) in their study indicated that instructional resources such as ICT act as advance organizers on students' motivation to learn science. ICT particularly sequence and chain the story map, highlighting only the main ideas in a simplified table, flow sequence and matrix. Then Mlambo (2011) and Tanner & Allen(2004) in their studies alluded to the fact that students are motivated and achieve more when ICT is used in teaching and learning.

The findings of the study concur with that of the key informants who suggested that most schools have preferred to buy computers and smart phones since they're relatively cheap to afford and directly applicable to their level of teaching and learning as indicated in one of the quotes below:

> *Most of these secondary schools have not adequately invested in ICT resources for teaching and learning. It is only during this time of Covid-19 pandemic when they have been forced into use of ICT resources in virtual teaching and learning. It is unfortunate that most of these schools are not in financial capacities to*

acquire ICT resources like Smart Televisions and Smart Boards for teaching and learning, instead they have invested in computer desktops and some of the teachers even use their smart phones to facilitate online teaching and learning which sometimes is not effective.

The schools were not able to invest in smart Boards and smart televisions because of one single reason; these are very expensive in comparison to the computers and smart phones. These findings are consistent with Unwin (2009) who contends that "ICT can be a catalyst by providing the tools which teachers use to improve teaching and by giving learners access to electronic media that make the concepts clearer and more accessible". The smart phones available ad computers were used to provide the platform for teaching and learning chemistry therefore increasing the motivation and achievement in chemistry (Wanjala, 2005). To summarize it all, Clements and Samara (2001) agreed that computers offer unique opportunities for teaching and learning through exploration, creative problem solving and self-guided instruction.

Table 9: Use of ICT in Learning Content in Chemistry

Do you use ICT when learning some content in chemistry?	Count Response	Percentage count	Chi-Square test of difference in proportions	
Yes	55	19.6%	Chi-Square	103.214[a]
No	225	80.4%	Df	1
Total	**280**	**100.0%**	p-value	.000

Source: Field Data for Students

The findings of Table show that 80.4% of the selected students claimed that they have not been using ICT when learning some content in chemistry. Similarly, the Chi-square test value was found to be significant, $x^2(1) = 102.214$, p-value =0.000 < 0.05 showing that the 80.4% of the respondents who said "No" were significantly higher than the 19.6% who said "Yes". These findings indicated that most of the selected secondary schools seemed not to have been using ICT in the teaching and learning of some content of Chemistry.

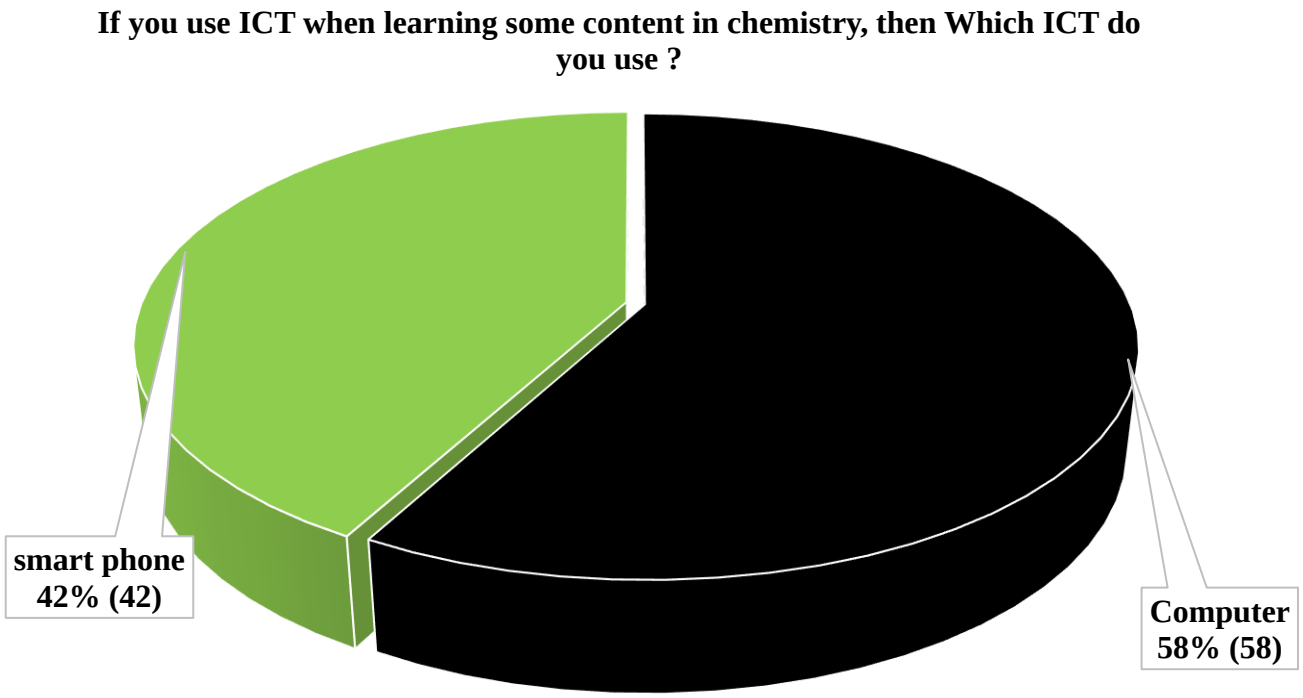

Figure 2: ICT to use when learning some content in chemistry

Source: Students Data

The findings of figure above shows that 58% (55) of the selected students used computer as ICT resource in learning Chemistry while 42% were using Smart Phones in learning Chemistry.

ICT Facilities used in Learning of chemistry practical

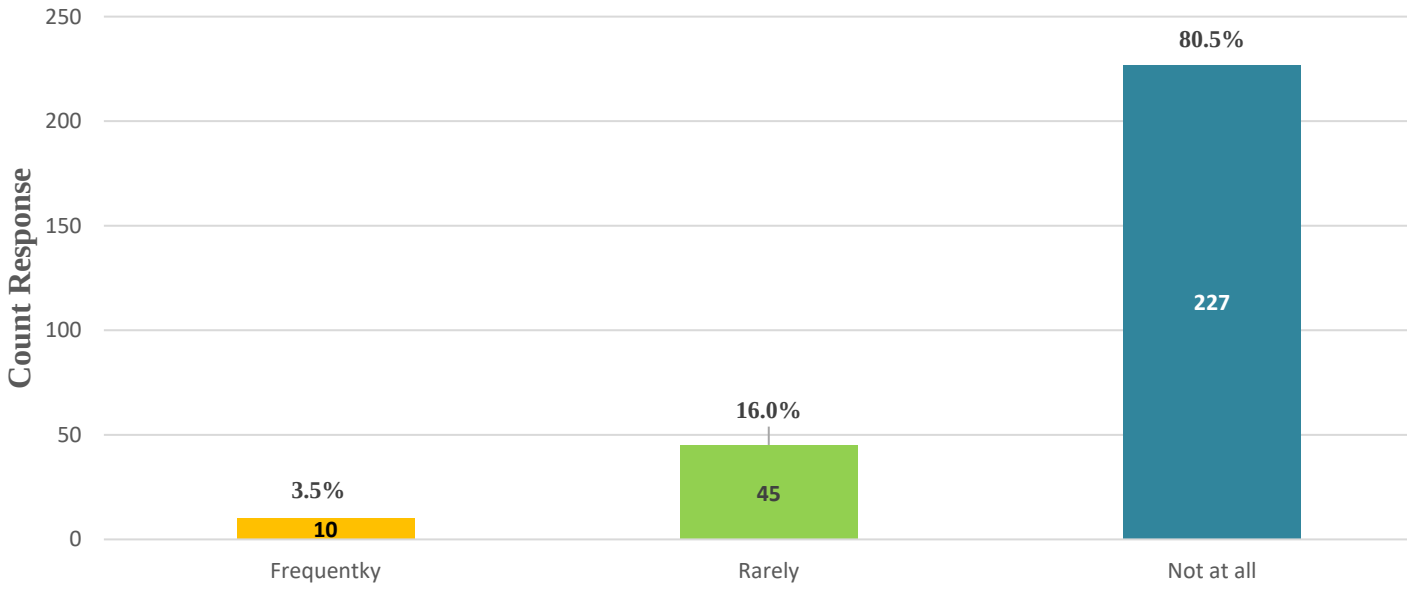

Figure 3: ICT Facilities used in Learning of chemistry practical

Source: Students Data

The findings of figure above show that majority of the respondents, 80.5% do not at all use the ICT equipment in Chemistry lesson, 16% rarely used the ICT equipment, and 3.5% frequently used the ICT equipment in Chemistry lesson. These findings indicate that the use of ICT in the teaching and learning of Chemistry in the schools is minimal.

The findings shown in the figure paints a grim picture of what goes on in schools. The largest percentages of learners do not use ICT at all in the actual teaching and learning in the classroom. This then means that most teachers still use the traditional methods of teaching chemistry practical could be the major impeding force that leads to declining performance in chemistry practical over the years. These findings are in agreement with those of Belcher&Olbert (2003), who in their research paper found out that 78.7% of learners do not use computer or any ICT tool. To be able to succeed, learners are supposed to interact with the digital content using ICT. Performance in its sense is the motivating factor for students (Tanui, 2002); students repeatedly doing poorly in chemistry practical examinations demotivates them resulting in a sense of apathy. Based on other findings, use of ICT could be a game changer. According to Zaman, Shamim&Clement (2011), asserted that ICT could help to reinforce the importance of education, increase networked society where information is shared for the common good of learners, raise the quality of education by making teaching and learning of science and other subjects an active process connected to the real life.

Table 10: Use of ICT in Learning Some Content in Chemistry

How often do you use virtual laboratory in chemistry learning?	Count Response	Percentage count	Chi-Square test of difference in proportions	
Frequently	5	15.2%	Chi-Square	9.455
Rare	9	27.3%	Df	2
Not At All	19	57.6%	p-value	0.009
Total	33	100.0%		

Source: Field Data for Students

The table shows that 57.6% (19) of the selected teachers claimed that they have not been using virtual laboratory in Chemistry teaching and learning, 27.3% indicated that they rarely used virtual laboratories while 15.2% frequently use virtual laboratory in Chemistry teaching and learning. The Chi-square test value was found to be significant, $x^2(2) = 9.455$, p-value = 0.009 < 0.05 implying that the percentage of those teachers not using virtual laboratories was

significantly higher than the percentage of those teachers who frequently nor rarely use the virtual laboratories in teaching Chemistry. These findings show that most of the secondary schools were not using virtual laboratory in learning chemistry practical. These findings were also supported by one of the key informants who suggested that most of the secondary schools had not transited to virtual laboratories in teaching practical in Chemistry practical sessions as indicated in the quote below from one of the key informants:

> *Virtual laboratories are still a concept that has not been implemented in most of the secondary schools, not only for Chemistry practical, but for all other practical subjects like Biology. This has been influenced by lack of adequate ICT resources such as computers, relevant software and lack of internet among others. Similarly, most of the teachers or technicians who are leading practical subjects in these schools do not have adequate knowledge and skills in software for running virtual libraries and therefore this concept of virtual libraries is still not implemented in the secondary schools.*

The findings are consistent with several other related studies suggesting that use of well-designed electronic learning programs enhances communication in the classroom during science learning (Kiboss 2000, 2002, 2002, 2011). In another study where concepts and capabilities taught to learners using ICT software, the performance was similar, meaning that ICT can change the pedagogical efficiency if utilized well for purposes of learning (Chin et al, 2012).

Virtual laboratory is still a concept not adopted by most secondary schools. It is an innovative way of presenting titration practical, which can equip the learners with the motivation to carry out the experiment on their own and analyze the results from the experiment. Studies by Callister however present a different opinion, he argues that it all depends on how it is used, by whom and for what purpose. On the other hand, conventional methods have contributed to poor learning and therefore achieved poor results of students in National Examinations (Kanguru, 1986; Konana, 1995; Mbuthia, 1996; Too.1996).

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary of the Study

The study highlighted the background information from the global perspective to the local perspective. This led to anchoring the statement of the problem and the purpose of the study. The objectives and research questions were articulated to bring about the significance of the study, limitations, scope, assumption, conceptual framework, theoretical framework.

The study contains a review of the literature related to the study. The review was done in line with the research objective. The literature was reviewed under the following sub topics in

reference to learning of chemistry: use of ICT instructional resources in the global perspective, legal provisions on the integration of ICT instructional resources, availability of ICT instructional resources, perception of teachers and learners towards integration and utilization of ICT instructional resources, the extent of integration of ICT instructional resources in secondary schools, techniques used in teaching of chemistry in secondary schools, cooperative learning and ICT instructional resources, concept mapping and ICT, challenges of integration of ICT instructional resources in the classroom, the knowledge gap in the reviewed literature and the chapter summary. A critique of the reviewed literature was provided to anchor the study.

The study elaborates the methodology comprising of: the study design, description of the study area, study population, sampling techniques and sample size, description of sampling techniques and sample size, data collection instruments which includes questionnaires for form three students, teachers of chemistry and ICT technicians, observation schedule, work sheet, validity and reliability of the research instruments, data analysis procedure and ethical consideration of the research.

The study detailed the findings from the analysis of data and how it is interpreted and discussed based on the objectives of the study. Both descriptive and inferential statistics were employed to summarize the information from the sampled schools.

Summary of the Findings

The following is the summary of the significant findings of the study in tandem with the stated objective.

Types of ICT Instructional Resources utilized in Learning of Chemistry practical in Secondary Schools.

The objective of the study was to determine the types of ICT instructional resources integrated in teaching and learning of chemistry in secondary schools in Bungoma County. The following were the findings of the study:

Majority of the schools that participated in the study have integrated ICT in teaching and learning of chemistry practical. The computers were available in the sampled schools and were accessible by teachers and form three students for integration in teaching of chemistry. The smart phones were also available but only teachers accessed these smart phones. The smart phones had the appropriate content that could be integrated in teaching chemistry practical. The media platform available in the smart phones could also allow teachers to project the content by use of overhead projectors and allow learners to view simulations and virtual chemical processes. Very few schools lacked the necessary infrastructure to handle ICT integration in teaching and learning of chemistry such as electrical installation and other fittings that could enable the projection of the content. There was no school in the study area that had the smart board which could allow teachers and learners to interact and manipulate the content to suit the needs for particular specific classes. Therefore, integration of ICT instructional resources could assist learners to perform some experiments in chemistry and provide better opportunities for teachers

and students to interact with the content and with each other in the course of teaching and learning chemistry. Teachers' notes and practical content could be shared between teachers from various schools that participated in the study, but students could only interact with these notes and practical content when the teachers decided to integrate ICT lessons.

REFERENCES

Abrami, P.C. (2001). Understanding and promoting complex learning using technology. In P. Abrami (Ed.), *Understanding and promoting complex learning using technology. Educational Research and Evaluation, 7* (2-3), 113-136.

Ajaja, O.P& *Erauwoke, O.U (2010).Effects of Cooperative Learning Strategy on Junior Secondary School Students' achievement in Integrated Science*. Electronic Journal of Science Education, 14(1), P1-18.

Akpınar, E. & Ergin, O. (2007). *The effect of interactive computer animations accompanied with experiments on 6th grade students' achievements and attitudes toward science*. International Journal of Emerging Technologies in Learning, 2(2), 36-41.

Alacapınar, F. G. (2003*). The effect of traditional education and education via computer on the students' gain.* Eurasian Journal of Educational Research, 10, 40-45

Alkan, C., Deryakulu D., Simsek N., (1995). *Ogretim teknolojilerine giris "Discipline Sürec urun".* Ankara: Onder Matbaacılık.

Aniemeka,E.O.(2013*). Social Media and Entrepreneurship Education: Pedagogical Implications of Computer Mediated Communication in Higher Learning in Africa. PhD Thesis*. Greenleaf University, Melbourne.

Arnseth. & Hatlevik, O.E. (2010). *Challenges in Aligning Pedagogical Practices and Pupils Competences with the Information Societies Demands*: The Case of Norway. Hershey: IGI.

Barak, M., Lipson, A., & Lerman, S. (2006). *Wireless laptops as means for promoting active learning in large lecture halls. Journal of Research on Technology in Education, 38,* 245–263.

Belcher,J.W.,&Olberts. *Field line motion in classical electromagnetism*. The American journal of physics71, 220-228

Bramlett, R.(1994).*Implementing Cooperative Learning. A fieldstudy evaluation of*

school-based consultant. Journal of School of Psychology, 32(1), 67-84.

Bruce, (2009).*Models of Learning Tools for Teaching.OpenUniversity Press:* Glasgow.

Brunner, Jerome S. (1966). *Towards a Theory of Instruction. Harvard University Press,* Cambridge, M.A.P.9.

Carrie, B. F. (2006). *In-class laptop use and its effects on student learning.* *Computers Education 50 (2008) 906–914*

Çepni, S., Taş, E. & Köse, S. (2006). *The effects of computer assisted materials on students' cognitive levels, misconceptions and attitude toward science*. Computers and Education, 46, 192-205.

Carbo, M.(1983). *Research in Reading and Learning Style: Implications for Exceptional Children. Exceptional children*, 49,486-494.

Chang, C.Y.(2002). *Does-Computer assisted instruction, problem solving =improved science outcomes*? A pioneer study. The journal of educational research, 95(3). 143-150

Chijioke. (2007). *Policy Networks and the Transformation of Secondary Education Through ICTs in Africa: The Prospects and Challenges of The NEPADS E-Schools Initiative.* IJEDCT,2007,Vol.3,Issue1.pp.65-87.

Chin, Fluck, Ranmuthugala & Penesis, (2012). *ICT Curriculum Transformation of Mathematics in Primary Schools.* International Journal for Cross-Disciplinary Subjects in Education (IJCDSE), Volume 2, Issue 3, September 2011. Toony. (2001). *Schooling Issues Digest No. 2*: Information and Communication Technology for Teaching and Learning.

Trimmel, M., & Bachmann, J. (2004). *Cognitive, social, motivational and health aspects of students in laptop classrooms.* Journal of Computer Assisted Learning, 20,151– 158.http://www.coi.gov.uk/coi/depts/GTT/coi1680e.ok

Toffler, A. (1970). *Future Shock.* New York: random House.Touliatoes, J.S., & Compton, N. H. (1988). *Research Methods in Human Ecology/ Home Economics*. Iowa State University Press/AMES.

UNESCO. (1998*). World Education Report, Teacher and Teaching in A changing World*. UNESCO.

UNESCO,(2002*). Information and Communication Technology in Teacher Education. A planning Guide*. UNESCO.

Unwin, D. &Light, D. (2009*). The Role Of ICT In Enhancing Education In Developing Countries: Findings From An Evaluation Of The Intel®Teach Essentials Course In India,Turkey,And Chile Journal* .Education In International Development

Wabwoba. (2006*). An assessment of computing levels of education managers: Kenya.*

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