FACTORS INFLUENCING INTEGRATION OF DIGITAL RESOURCES IN SCIENCE TEACHING AND LEARNING IN SECONDARY SCHOOLS OF MURANG’A COUNTY-KENYA

BY

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SEPTEMBER 2016.
DECLARATION

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

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DEDICATION

I dedicate this research thesis to my family for their ultimate encouragement and sincere support during my entire Master’s degree education programme. Your love, prayer and motivation kept me strong when the going got tough. I owe you every success.
ACKNOWLEDGEMENT

First I am grateful to God for giving me the inner strength I needed to see the end of my master’s degree education. More so am grateful for the divine strength I received in writing this work. Secondly I am grateful for the consistent and professional guidance provided throughout the period of writing this research work by my supervisors Dr. David W. Khatete and Dr. Samson R. Ondigi. Your suggestions and advice in writing this thesis has been of overwhelming assistance. You have expanded my knowledge in research: The knowledge gained will help me beyond the limits of this research work to the responsibilities ahead. I also would like to appreciate the administrators of the schools visited, the teachers and learners alike who contributed immensely from which the data of this study was generated.

Thanks also to the Almighty God for The Late Dr. Ndichu Gitau who also in so many ways assisted me to implement important suggestions for this research area.

I can’t fail to recognise the time and efforts spent by Nancy in typing and arranging this research Thesis. The labour you put in this work was of great encouragement.
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<tr>
<td>CEMASTEA</td>
<td>Centre for Mathematics Science and Technology Education in Africa</td>
</tr>
<tr>
<td>CFSK</td>
<td>Computers For School Kenya</td>
</tr>
<tr>
<td>EFA</td>
<td>Education For All</td>
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<td>GIS</td>
<td>Geographic Information Systems</td>
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<td>ICDL</td>
<td>International Computer Driving License</td>
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<td>ICT</td>
<td>Information, Communication and Technology</td>
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<td>INSET</td>
<td>In-service Training</td>
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<td>KCSE</td>
<td>Kenya Certificate of Secondary Education</td>
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<td>KICD</td>
<td>Kenya Institute of Curriculum Development</td>
</tr>
<tr>
<td>MOE</td>
<td>Ministry Of Education</td>
</tr>
<tr>
<td>NEPAD</td>
<td>New Partnership for Africa’s Development</td>
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<td>NI3C</td>
<td>National ICT Integration and Innovation Centre</td>
</tr>
<tr>
<td>SMASSE</td>
<td>Strengthening of Mathematics and Science in Secondary Education</td>
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<tr>
<td>SPSS</td>
<td>Statistical Package for Social Sciences</td>
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<tr>
<td>TAM</td>
<td>Technology Acceptance Model</td>
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<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organisation</td>
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<td>US</td>
<td>United States</td>
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<td>UTAUT</td>
<td>Unified Theory of Acceptance and Use of Technology</td>
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Abstract

There has been a move towards using digital resources in classroom teaching and learning over a decade now in most developed countries. This study sought to establish and analyze factors that influence integration of digital resources in science teaching and learning in Secondary Schools of Murang’a County-Kenya. The objectives of this study were to identify the interrelationship between the various aspects of the teacher’s experience and the use of digital learning resources and to identify the factors that influence science teachers’ decisions on whether or not to integrate digital resources in teaching-learning situations. This study adopted a survey research design. Murang’a County provided an ideal area of study as it has various categories of secondary schools distributed across the county. It has 267 secondary schools; by use of stratified sampling, 30 schools which represent 11.24% of all the public secondary schools were selected for the study. The study involved 90 science teachers selected by stratified sampling from various subgroups in the population. Three methods of data collection were used namely; questionnaires, interview guides and observation schedules. The questionnaires were filled by the teachers to find out those factors that influenced the integration of digital resources in the teaching and learning of science in schools. The Interviews were used so as to dig deep into the opinions held by the science teachers on integrating digital resources in the teaching and learning and the observation schedules used to ascertain information given by the respondents. A pilot study was conducted in five schools selected representing the various categories of school as sampled for the purpose of testing the reliability and validity of the research instruments. Reliability was tested using the Cronbach’s alpha coefficient. The data collected was analysed using both qualitative and quantitative procedures. Descriptive statistics was used to analyse the data and responses from the questionnaires were tabulated, edited and coded to facilitate categorization. This was carried out using SPSS data analysis programme. Qualitative data was analysed and presented in form of discussions, explanations and in a narrative form. The study established that there is minimal use of digital resources in the teaching and learning in the classroom. Factors found to influence the integration of digital resources in classroom teaching and learning included teachers’ attitude, management attitudes, lack of ICT infrastructure, poor or lack of computer training and technical issues such as; support and maintenance of digital resources and availability and access of digital resources. Based on the findings of the study, it was concluded that there is need for continuing discussion, planning and evaluation of all ICT investment in education to gain a better insight into how digital resources can be integrated successfully into the teaching and learning environment. The study recommends that teachers be encouraged to integrate digital resources in the teaching and learning process as well as train teacher trainees to apply digital resources in their programs when in school in order to be able to use the technology to supplement their teaching activities. Also the study recommends for continuous evaluation of the use of digital resources within schools through observing, recording and analyzing on regular basis to facilitate development of integration of these resources. The findings from this research provide secondary schools with a framework of reference on successful integration of digital resources in science teaching and learning.
CHAPTER ONE

INTRODUCTION

1.1 Background of the study.

The use of information and communication technology (ICT) creates a powerful learning environment in the classroom and it transforms the learning and teaching process in which students deal with knowledge in an active, self-directed and constructive way (Volman & van Eck, 2001). ICT is not just regarded as a tool, which can be added to or used as a replacement of existing teaching methods. ICT is seen as an important instrument to support new ways of teaching and learning. It should be used to develop student’s skills for cooperation, communication, problem solving and lifelong learning (Plomp, Anderson, Law & Quale, 2009).

The effectiveness of use of digital resources to teaching is always being associated with the learning methods, pedagogy, equity, access and many other variables (UNESCO, 2004). The U.S government for example has realised that technological change is necessary for its educational system to remain relevant and competitive (UNESCO, 2004). Research findings over the past 20 years provide some evidence as to the positive effects of the use of ICT on pupils’ learning (Mumtaz, 2000; Hattie, 2009). In spite of such projects, the effects of numerous training programmes and an investment by schools in ICT resources, there has been a disappointingly slow uptake in schools in both developed and developing countries (Cox et al, 1999; Passey, D. & Samways, B. (Eds) (1997). In addition, little research is available for the Kenyan context.

Kenya has an ICT policy framework and implementation strategy with measurable outcomes since inception of The National ICT Integration and Innovation Centre (NI3C) at the Nairobi University’s Kenya Science campus. The Kenya’s Vision 2030 is anchored on knowledge
based economy with ICT as the main driver in all sectors including education. To achieve the Kenya Vision 2030 in education, a number of initiatives have been launched to introduce computer studies in schools and to integrate ICT in pedagogy. The initiatives include the teacher in-service training (INSET programs) conducted at the Centre for Mathematics Science and Technology Education in Africa (CEMASTEA) and at Kenya Institute of Curriculum Development (KICD) with the aim of starting computer studies in schools and integrating ICT to teaching. Teachers in selected secondary schools have been trained as ‘trainers of trainers’ so that they can do capacity building of other teachers in a cascading way (Ministry of Education, 2010). Also the New Partnership for Africa’s Development (NEPAD) led model schools project and most recently the laptop program in primary schools are of the view that Kenyan schools participating in such a project of introducing ICT integration would act as model schools and other schools would replicate the successes achieved, Ayere, et al (2010).

The Kenya Institute of Curriculum Development (KICD), which is mandated to design, develop and produce digital content for use in schools in line with the national curriculum, has embarked on a digital content design and development project, however the government has pointed out that the integration of ICT to teaching and learning is largely at the basic levels (MOE; 2006). This study attempts to examine factors influencing the integration of digital resources into teaching and learning sciences in secondary schools in Murang’a County - Kenya. It examines teachers’ integration and use of digital resources in the school and explores factors identified as affecting digital resources use in the teaching and learning in the classroom. A better understanding of the factors that influence teachers’ decision to use or not to use technology helps in understanding the extent of technology integration in teaching and learning of science.
1.2 Statement of the Problem

Many researchers in education have found technology as most powerful when used as a tool for problem solving, conceptual development and critical thinking (Katitia, 2012). Karsenti (2009) indicates that in schools where ICT was integrated in pedagogy which was learner-centered, the learners performed much better than similar groups taught using teacher-led methods which were teacher-centered in the achievement test.

Performance of the physical sciences at Kenya Certificate of Secondary Examination (KCSE) in Murang’a County for example, has been below average compared to other subjects. According to data collected from the Murang’a County Kenya Certificate of Secondary Examination (KCSE) result analysis, the performance for Chemistry, Physics and Biology has been below the County mean scores in the years 2012, 2013 and 2014 at percentages deviation of between 2% and 21%. In the year 2014 alone, of the 21 subjects done by various secondary schools in the county, 15 subjects scored a mean grade which was above the county mean score and only 6 subjects were below, the physical sciences accounting for 50% of those that were below the county mean score (Murang’a County, 2014). According to a SMASSE basement study (1998), scientific knowledge is mainly ‘given’ and not ‘discovered’ in many schools. This refers to lecture methods used by facilitators as opposed to practical approach where learners discover facts and concepts. In lieu of this, SMASSE advocated for quality learning using teaching and learning resources and in-servicing teachers on the use of information and communication technology to improve science and mathematics performance in the country.

In view of this, it can be deduced that since the nature of learning in the classroom depends on the learning methods used in delivering content thereby influencing the learning outcome, the integration of digital resources in teaching sciences is expected to ease understanding of some abstract concepts in science thus making learning and understanding easy. If this were
to be the case, then integration of these resources in learning would not only improve performance but also encourage interest and develop skills of problem solving and life-long learning.

1.3 Purpose of the Study.

The main intention of this study is to investigate factors that influence the integration of digital resources in teaching and learning sciences in Secondary Schools in Murang’a County-Kenya. Science covers the broad fields of human knowledge concerned with facts held together by principles (rules). Scientists discover and test these facts and principles using scientific methods that involve an orderly system of solving problems. In this study, the factors that influence integration of digital resources in teaching and learning of physical sciences which include physics, chemistry and biology were examined.

The study sought to enrich previous studies and test the interplay between teacher variables and the integration of digital resources into classroom teaching of sciences in Secondary Schools in Murang’a County-Kenya. Existing literature were examined to explore possible factors affecting the use of digital resources into science education in Kenya. It was postulated that understanding these factors was vital for improving the utilization of digital resources and other resources in the teaching and learning of science. Also, the detection of barriers to the slow uptake of integrating the digital resources provides information that is helpful in mounting in-service teacher training programs. The researcher seeks to make research oriented and informed recommendations that facilitate in improving the use of ICT in teaching and learning of science to achieve the desired effect.
1.4 Objectives of the study

The study sought to:

I. Identify the interrelationship between the various status of the teacher’s experience with use of digital learning resources and actual integration of these resources in the classroom.

II. Investigate the factors that influence teachers’ decisions to integrate or not integrate digital resources in teaching and learning of science.

III. Establish the strategies for adoption to address those factors that may hinder effective integration of digital resources into science teaching and learning.

1.5 Research Questions

This study sought to answer the following questions:

I. What factors affect the integration of digital resources in the teaching and learning of science in secondary schools in Murang’a County?

II. What challenges are likely to be faced by science teachers as they use digital resources in their classroom teaching?

III. What strategies can be put in place to overcome challenges faced by science teachers in their attempt to integrate digital resources in their classroom teaching?

1.6 Significance of the Study

To encourage the incorporation of ICT in schools calls for insight into factors that affects their use in the classrooms. This study seeks to examine teachers’ experiences on factors that facilitate or impede the use of technology in their classrooms. The purpose is to generate
information to encourage the use of digital resources for science teaching and help teachers adopt best practices that enhance the integration of these resources and at the same time deal with ensuing challenges. The study will also encourage the structuring of the teacher-training programs to enhance training and capacity building of teachers on ICT pedagogies to enhance teaching and learning. It is hoped that this study will also help the school stakeholders reach the right balance between working with teachers and how ICT can create new, open learning environments that make learning more effective.

1.7 Delimitation of the Study

This study is delimited to factors that influence the integration of digital resources to teaching and learning of sciences in secondary schools in Murang’a County – Kenya. Though the researcher examines the interrelationship between the various statuses of the teacher’s experience with existing ICT structures, this research does not carry out an in-depth study into the issues of ICT studies such as the status and extent of use of information and communication technology in management.

1.8 Limitations of the study.

This study was limited to the following factors;

1. Though a large sample from secondary schools in Murang’a County-Kenya was involved in the study, the sample was still too small to reflect the Kenyan teacher population in a representative way (out of 267 secondary schools, 30 schools which represent 11.24% of all the public secondary schools in the county were selected for the study) This affects the generalization of the findings to all the secondary schools in Kenya and to other countries as well.
2. The data in this study was obtained via teacher questionnaire and interview with teachers. The study did not build on classroom observations of actual use of digital resources and only relied on the responses as provided by the teachers. This limitation also affects the generalization of the findings which were based on responses assumed to be honest.

1.9 Assumptions.

In this study, there were two key assumptions. These were that:

1. Integration of digital resources into teaching and learning in secondary schools in Kenya is largely at the basic levels and that there has been a slow uptake in schools.

2. The schools selected have access to digital resources for teaching and learning but there is minimum use in classroom situations.

1.10 Theoretical Framework.

Various models exist for trying to predict and explain human behavior. This research was grounded within the theoretical framework of the Unified Theory of Acceptance and Use of Technology (UTAUT) model developed by Venkatesh, Morris, Davis, & Davis (2003).

1.10.1 Unified Theory of Acceptance and Use of Technology (UTAUT)

A number of theoretical models have been proposed to facilitate the understanding of factors impacting the acceptance of information technologies. Among these studies, the Technology Acceptance Model –TAM- (Davis, 1989) is one of the most influential in explaining Information Technology integration behaviour. The key purpose of TAM was to provide a basis for discovering the impact of external variables on internal beliefs, attitudes, and intentions.
TAM assumes that beliefs about usefulness and ease of use are always the primary determinants of information technologies adoption in organizations. According to TAM, these two determinants serve as the basis for attitudes toward using a particular system, which in turn determines the intention to use, and then generates the actual usage behaviour. Perceived usefulness is defined as the extent to which a person believes that using a system would enhance his or her job performance. Perceived ease of use refers to the extent to which a person believes that using a system would be free of mental efforts (Davis, 1989).

However, the original TAM model was created to examine Information Technology adoption in business organizations. The model’s suitability for predicting general individual acceptance, especially in education, needs to be explored.

![Technology Acceptance Model](image)

**Figure 1.1: Technology Acceptance Model.**


Venkatesh, et al (2003) developed the Unified Theory of Acceptance and Use of Technology (UTAUT) model to consolidate previous TAM related studies. In the UTAUT model, performance expectancy and effort expectancy were used to incorporate the constructs of perceived usefulness and ease of use in the original TAM study. Although the UTAUT model posits that the Effort Expectancy construct can be significant in determining user acceptance of information technology, concerns for ease of use may become non-significant over
extended and sustained usage. Therefore, perceived ease of use can be expected to be more salient only in the early stages of using a new technology and it can have a positive effect on perceived usefulness of the technology.

\[ \text{Performance Expectancy} \]

\[ \text{Effort Expectancy} \]

\[ \text{Social Influence} \]

\[ \text{Facilitating Conditions} \]

\[ \text{Behavioral Intention} \]

\[ \text{Use Behavior} \]

\[ \text{Gender} \]

\[ \text{Age} \]

\[ \text{Experience} \]

\[ \text{Voluntariness Of Use} \]

**Figure 1.2: Unified Theory of Acceptance and Use of Technology (UTAUT)**


1.11 Conceptual Framework.

For the purpose of this study, the framework adapted for analyzing the various variables that influence the integration of digital resources to classroom science teaching was the *Combined Model* as discussed by Stols, G. & Kriek, J. (2011). Stols & Kriek, developed the model that explains the relationship between beliefs and behavior as developed by Fishbein, M & Ajzen, I. (1975). The model includes external factors such as general technology proficiency and
ICT infrastructure as well as organisational issues; expectations of colleagues and the administration which influence the integration of digital resources in teaching. This *Combined Model* has the potential to improve the understanding of technology use by teachers in general, and also in their classroom for instruction.

**Independent Variables**

- Perceived usefulness
- Perceived ease of use
- Perceived compatibility

- Expectations of colleagues and Administration
- Expectations of parents

- General technology proficiency
- ICT infrastructure (access, cost, speed)

**Dependent Variable**

- Integration of Digital Resources in Teaching.

**Extraneous Variable**

- Behavioural Intention

**Figure 1.3: Conceptual Framework: Combined Model. Adapted from Stols, G. & Kriek, J. (2011).**

The above conceptual framework represents on one end, the independent research variables hypothesized to be factors affecting the integration of digital resources into classroom teaching and learning of sciences and the integration of digital resources in teaching as the dependent variable of this study.
1.12 Definition of terms.

The following terms are defined within the context of this study.

**Digital resources:** Teaching and learning materials that exist in digital form such as digital audio and/or digital pictures

**Digital content:** Any piece of teaching and learning material that is published in digital form (audio or visual) that can be available for download or distribution on electronic media.

**Information, Communication and Technology (ICT):** Diverse set of technological tools and resources used to communicate, create, disseminate, store, and manage information.

**Technology Integration:** Incorporating technology resources – computers, digital cameras, software applications, the Internet, among others in daily classroom practices to enhance student learning.

**Learning:** A process by which an individual acquires and retains knowledge, skills, values and attitudes which cannot be attributed to natural growth and development.

**Science:** A field of human study concerned with facts held together by principles (rules). These facts and principles are tested by the scientific method, an orderly system of solving problems. In this study, the factors that influence integration of digital
resources in teaching and learning will be limited to physical sciences which include physics, chemistry and biology.

**Teaching:** A process of telling or showing someone (a student) how to do something either through talking, telling, explaining, showing, illustrating or demonstrating to enable acquisition of knowledge.
CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of literature on current research on factors that influences integration of ICT in teaching and learning and gives a background picture of how new information, communication and technology tools have been adopted in schools.

2.2 Teacher’s Role and ICT

Marcinkiewicz (1994) stressed that the full integration of computers into the education remains a distant goal unless interrelationships between the various statuses of the teachers’ experience with use of ICT are studied. According to Cuban (2001), many teachers don't understand how to incorporate technology into their teaching. Cuban further cited lack of understanding about ICT learning strategies as a major issue that affected successful incorporation of online learning. Teacher training colleges and universities are now making it compulsory to offer ICT studies so as to equip their teacher trainees with skills necessary to integrate ICT tools in classroom teaching and learning. According to Sandholtz & Reilly (2004) learning designers and teachers should be supported in their quest to match learning tasks to learning technology, thereby improving their understanding as well as their effective use of technology. For teachers to take up the challenge of incorporating ICT in their classroom teaching it is therefore important to provide them with the technical and pedagogical skills to achieve effective integration.
2.2.1 Schools’ Management Role in ICT integration.

The school’s management plays a vital role in determining whether digital resources are integrated in classroom teaching and learning or not. Studies report that the attitudes and opinions that the schools managers hold towards integration of digital resources in classroom teaching and learning affects how they are used. Mooij & Smeets (2001) indicate that when the school management is not interested and committed in the implementation of ICT use, their integration in the school is affected negatively. Demetriadis et al. (2003) also found out that the managements’ attitudes influenced teachers to undertake training in ICT. Teachers displayed a positive attitude to undertake training if the management displayed the same positive attitude.

2.2.2 ICT use in schools

Researchers have been concerned in studying the rationale for using ICT in the classroom since the advent that ICT creates a powerful learning environment and that it transforms the learning and teaching process. Research findings over the past two decades provide some evidence as to the positive effects of the use of ICT on pupils’ learning (Mumtaz, 2000; Hattie, 2009). Sanya (2001) states that there are four ways ICT can support basic education: (i) supporting education in schools, (ii) providing non-formal education for out-of-school children and adults, (iii) supporting pre-service distance education of teachers and their in-service professional development, and (iv) enhancing the management of schools. Sanya (2001) makes a cautionary observation by quoting ‘‘Putting computers in classrooms and wiring up schools does not of itself create exciting new learning situations that are about changing the ethos of classrooms and the culture of institutions’’.

By adopting ICT, we can offer high quality education. Ehrmann (1994) identified four distinct faces of quality education, which can be supported by ICT: learning by doing, real
time conversation, delayed time conversation and directed instruction. Hawkridge et al (1990) suggested that the use of ICT could improve performance, teaching, and administration, have a positive impact on education as a whole. The Dakar Framework for Action (World Education Forum, Dakar, Senegal, April 2000) also stressed the use of ICT for achieving ‘Education For All’ (EFA) goals and recommended, “ICT must be harnessed to support EFA goals at an affordable cost. These technologies have great potential for knowledge dissemination, effective learning and the development of more efficient education services.” Technology should be used as a tool to support educational objectives such as skills for searching and assessing information, cooperation, communication and problem solving - which are important for the preparation of children for the knowledge society (Drent & Meelissen 2008).

Researchers have also found that computers enhance teaching and learning by providing opportunities to practice and to analyze, offering better access to relevant articles and teaching and learning materials. Every classroom teacher should use learning technologies to enhance their students' learning in every subject - because ICT can engage the thinking, decision making, problem solving and reasoning behaviours of students (Grabe & Grabe, 2001). In fact, innovative use of ICT can facilitate student-centered learning (Drent, 2005), engage students in constructivist classrooms and enhance their social interaction (Dodge, Colker, & Heroman, 2003). It has been shown to improve their cognitive development (Nir-Gal & Klein, 2004), increase creativity (O’Hara, 2008), and improve their problem solving skills (Sarama & Clements, 2001).
2.2.3 Integration of ICT in schools.

Studies have shown that not all teachers may be willing to integrate ICT in classroom teaching and learning (Mumtaz, 2000). Tondeur et al. (2008) carried out a study on the use of ICT in schools and found out three ways in which ICT is incorporated in education. First, he indicated that ICT is used in learning of the basic skills of computer, secondly, computers are used to provide information and finally as a tool to facilitate learning. The development of these indicators has made it possible for researchers to carry in-depth studies on how ICT integration is implemented in schools.

2.3 ICT and teacher professionalism

Teachers need to be actively involved in the selection, design and evaluation of digital resources for their classroom use. According to Demetriadis et al. (2003), the potential of ICT use in the classroom develop confidence to teachers and this empowers them to integrate the ICT tools even more. As teachers develop skills in ICT, their integration to teaching and learning becomes more effective.

Teachers have a very key role in classroom management. The development of ICT use in the classroom has extended this role. It therefore becomes important to equip teachers with the necessary professional knowledge and skills so that full potential of use of digital resources in the classroom is attained. Demetriadis et al. (2003) further notes that the integration of ICT to a large extent is affected by pedagogical views held by teachers. Niederhauser & Stoddard (2000) indicates that pedagogical beliefs by teachers may not be changed easily as they involve a complex web of interrelated teacher aspects and consumes a lot of time. When adequate time is used and resources provided to all teachers, they are able to develop confidence and build up competence in computer skills.
2.3.1 The Place of ICT and the Learner

Teachers especially those with experience may from time to time feel reluctant to adapt or change from their traditional ways of teaching to embracing ICT now that the integration of ICT in classroom teaching and learning is an emerging trend in education. Becker (2001) has it that teachers that are contented to continue using the conventional teaching methods are not willing to adopt the use of ICT tools in their classroom teaching. Examining and assessing the value of any digital resource for use in classroom teaching and learning will encourage teachers to adopt them for their classroom use (Cuban, 2001). Studies have been initiated to show the opportunities ICT tools presents to the teacher and learner so that teachers embraces this new phenomenon of integration of ICT.

There are a number of learner-specific motivational aspects which are attributable to the use of ICT education. These aspects include enhanced commitment to the learning task, enhanced enjoyment and interest, increased self-esteem and increases in independence and confidence (Cox et al, 1999). Furthermore, Cox et al (1999) show that many educators perceive ICT as a tool for improving the presentation of material, for making lessons more fun for the learners and for making administration more efficient. In addition, ICT provides fast and accurate feedback to learners (BECTA, 2003). It is also believed that the use of ICT in education could promote ‘deep’ learning and allow educators to respond better to the different needs of different learners (Lau & Sim, 2008).

2.4 Factors affecting teachers’ use of ICT tools in teaching and learning.

Several studies have documented the factors that affect teacher’s use of ICT tools in classroom teaching and learning. This section highlights those factors that several studies have found to affect teachers integration of ICT tools. Mumtaz (2000) categorized these factors as factors that touch on two broad issues which include: (1) Technical issues such as
lack of ICT tools and resources, lack of technical support, and (2) Teaching and Learning issues which include various teachers attitudes and beliefs, teachers experience, confidence and competence in use of ICT resources among others.

For the purpose of this study which examines the factors that influence integration of digital resources in teaching of sciences in secondary schools, the studies whose purpose identifies technical issues and teaching and learning issues as influencing integration of ICT in classroom teaching and learning have been reviewed.

2.5 Technical issues

Effective use of ICT tools means that when encountered with technical issues that hinder proper use of these tools, then it will be easier for the user to have an understanding of working around to solve the issue at hand. Lack of technical support in has been sighted as one of the major factors that have affected the effective adoption of ICT tools in teaching and learning environments. In a study by Demetriadis et al. (2003) lack of ICT technical support was as a significant factor affecting teachers’ motivation to use digital resources. Teachers felt that since they possessed little or no technical competences they were not ready to use ICT in their classroom teaching.

2.5.1 Access to school resources and ICT support

Access to ICT infrastructure and resources in schools is a necessary condition to the integration of ICT in education (Plomp, Anderson, Law & Quale, 2009). Effective adoption and integration of ICT into teaching in schools depends mainly on the availability and accessibility of ICT resources such as hardware and software. Obviously, if teachers cannot access digital resources, then they will not use them. Therefore, access to computers, updated software and hardware are key elements to successful adoption and integration of technology.
A study by Yildrim (2007) found that access to technological resources is one of the effective ways to teachers' pedagogical use of ICT in teaching.

2.5.2 Availability of ICT equipment

Availability of digital resources in schools has contributed significantly to increase teachers’ willingness to incorporate ICT in classroom teaching (Tondeur et al. 2008). Kessy et al. (2006) and Ford (2007) recognize that the acquisition of ICT tools such as computer hardware and software, the setting up of the communication infrastructure and their maintenance has been said to be costly in majority of schools in developing countries and this has inhibited their adoption in the classroom. In general, most developing countries lack proper infrastructure that support reliable supply of hardware and software facilities and it becomes increasingly difficult for schools to effectively introduce technology into classroom teaching and learning. Effective use of digital resources is dependent upon the availability and accessibility of ICT resources (e.g. hardware, software and communications infrastructure). Most countries in Africa do not have a good infrastructure in terms of their transportation, minimal electricity connections in schools and few broadcasting and communication facilities. This has made it difficult for schools to successfully equip and integrate digital resources into classroom teaching and learning. In the case of Kenya, until recently the government is increasing electricity connection and subsidizing it to make it relatively affordable by institutions. For schools to encourage a positive attitude towards integration of digital resources, then there is need to adequately invest in providing and increasing availability of these resources.

2.5.3 Time as a factor of Planning and Instruction.

Studies have indicated that lack of time for undergoing ICT training, lack of time for preparing digital resources and lack of time for the actual use of digital resources in the
classroom and time for accessing the resources as the main issues when integrating ICT tools. Galanouli et al. (2004) sighted two key problems experienced by teachers in integrating ICT as exploitation of their personal time and lack of time provided for training of computer skills.

Robertson et al. (1996) reports that many teachers finds that it takes a lot of time to design a teaching resource and if schools have a busy environment, then it would be a constraint for them to familiarise themselves with ICT. If managers of the school institutions do not provide ample time for teachers to interact with the emerging trends in educational technology, then little or no incorporation of technology in the classroom will take.

2.5.4 Training and professional development

Professional development for teachers is a key factor to successful integration of computers into classroom teaching. Several studies have revealed that whether beginner or experienced, ICT-related training programs develop teachers' competences in computer use (Bauer & Kenton, 2005; Franklin, 2007; Wozney et al., 2006), influence teachers' attitudes towards computers (Hew & Brush, 2007; Keengwe & Onchwari, 2008) as well as assisting teachers reorganize the task of technology and how new technology tools are significant in student learning (Plair, 2008). Sandholtz & Reilly (2004) claim that teachers' technology skills are strong determinant of ICT integration, but they are not conditions for effective use of technology in the classroom. They argue that training programs that concentrate on ICT pedagogical training instead of technical issues and effective technical support, help teachers apply technologies in teaching and learning.

In Kenya, Intel Corporation teach programme is currently supporting the transition from traditional teaching methods through educating teachers in the integration of ICT into primary and secondary school, Karsenti, (2009). Using a model dabbed “train the trainer”.
25 participants are selected from teacher training colleges, Centre for Maths and Science and Technology Education in Africa, Kenya Institute of Curriculum Development and Kenya Education Staff Institute, to work on the development of online material to then orient 250,000 teachers nationwide.

Hadley & Sheingold (1993) concluded that for teachers to use ICT more often in their classroom teaching, they have to be provided with appropriate ICT skills for them to build confidence and experience. The more the experience teachers have in using technology, the more the frequency of use.

2.5.5 Technology Investment.

Successful integration of digital resources in classroom teaching and learning requires that institutions invest in providing the digital resources. Schools that lack these resources or lack a funding support will face a serious constraint in implementing ICT use in the classroom. Mumtaz (2000). According to Kenya ICT 4E situational analysis report by Swarts & Wachira (2009), investments in technology in schools have been realized in the following ways: M.O.E is reported to disburse Ksh1.5 million to 213 schools evenly distributed across the country to be used to acquire 25 new computers per school, 1 printer per school, educational software and sensitize ICT teacher on technical maintenance. Computers for Schools Kenya (CFSK) reported to have installed 18,000 computers in over 600 schools with 20 computers per school. The ICT Trust Fund has provided 200 schools with 20 computers each. The NEPAD e-schools project provided 6 schools with 20 computers each. The Rural School Project has provided 4500 computers to a number of unidentified schools. Overall, the analysis indicated that 15,450 computers have been disbursed to 1300 secondary schools out of over 4000 schools. Although the projects improved teacher’s ability to use basic computer, the integration of digital resources into classroom teaching has been very slow.
2.6 Teaching and learning issues

The successful integration of ICT into the classroom depends on the ability of teachers to structure their learning environments in non-traditional ways, merging technology with new pedagogies UNESCO (2008). There is substantial evidence that, in the right hands and used appropriately, ICT can be an effective tool in supporting teaching and learning (Hattie, 2009). Though this is true, not all countries are currently able to benefit from the developments and advances that technology can offer Kozma, R et al (2002).

2.6.1 School ICT policy

Research shows evidence that an increase in classroom use of ICT in classroom can be linked to a favourable policy environment (Tearle, 2003). School-level policy produces the desirability to build a coherent and supportive community of practice associated with effective, regular, and consistent ICT use (Dawes, 2001). ICT-related school policies are linked to national policies as developed by the Ministry of Education (MOE). The Ministry promotes ICT use, but links this explicitly to the prescribed national curriculum, the central examination system and teacher-led didactical strategies. An ICT policy itself does not automatically result in the adoption of innovations unless all actors involved are clearly aware of this policy. Research of Fullan (1991) shows that the adoption of innovation in schools depends on the democratic process of planning change by involving all school related actors. If teachers share the values expressed within a school policy and understand the implications, this policy is more likely to influence practice (Kennewell, Parkinson, & Tanner, 2000). Recent research of Tondeur et al. (2008) shows that successful integration of ICT is much more likely when teachers share the values expressed within the school policy and understands their implications. National policies and school curricula in most African
countries treat ICT as a discrete subject in the form of computer science or information technology when assessed by the national examination boards, (Wanjira, 2009).

2.6.2 Teacher characteristics / pedagogical beliefs

van Braak et al. (2004) reported that the success and integration of ICT into classroom heavily depends on the teachers attitudes towards ICT. Teachers that are more likely to integrate ICT tools in classroom teaching and learning are those that have developed a positive attitude towards technology use. Demirci (2009) conducted a study on teachers’ attitudes towards the use of geographic information systems (GIS) by geography teachers in Turkey and revealed that though barriers such as lack of hardware and software existed, teachers positive attitudes towards GIS was an important determinant to the successful integration of GIS into geography lessons.

In a similar study, Teo (2008) teachers were more positive about their attitude towards computers and intention to use computer than their perceptions of the usefulness of the computer and their control of the computer. Also, Drent & Meelissen (2008) conducted a study about factors which influence the innovative use of ICT by teacher educators in the Netherlands and revealed that student-oriented pedagogical approach, positive attitude towards computers, computer experience, and personal entrepreneurship of the teacher educator have a direct positive influence on the innovative use of ICT by the teacher. Teachers’ own beliefs on education also affect how ICT is incorporated in teaching and learning. Research (Ertmer, 2005) and Becker, (2001) have found that teachers who use the conventional teacher-led teaching methods are less likely to incorporate the use of computers in their classroom teaching compared to those teachers who learner-centered teaching methodologies. Research have shown that teaching methods that are used determines the levels of incorporation of ICT tools in teaching and learning. Teachers with relatively strong constructivist beliefs who also have strong traditional beliefs use ICT more frequently
(Tondeur et al. 2008). These studies suggest that the potential of technology in classroom teaching and learning is enhanced by the teachers who believe in student-centered methodologies which favours learning through discovery (Ertmer, 2005).

2.6.3 Gender and ICT

Gender differences and the use of ICT have been reported in several studies. However, studies concerning teachers' gender and ICT use have cited female teachers' low levels of computer use due to their limited technology access, skill, and interest (Volman & van Eck, 2001). Research studies revealed that male teachers used more ICT in their teaching and learning processes than their female counterparts (Kay, 2006; Wozney et al., 2006). Jamieson-Proctor, Burnett, Finger & Watson (2006) conducted a study on teachers' integration of ICT in schools in Queensland State. Results indicated that female teachers were integrating technology into their teaching less than the male teachers. But the situation was different in mid-western US basic schools where Breisser (2006) found that females' self-perceptions about technology competence improved while males' self-perceptions about technological dominance remained unchanged. The study was in agreement with (Adams, 2002) that female teachers applied ICT more than the male teachers. This study confirms report by Yukselturk & Bulut (2009) that gender gap has reduced over the past years, presently, a greater number of females than males have used the internet. However, some studies revealed that gender variable was not a predictor of ICT integration into teaching (Norris, Sullivan, Poirot & Soloway, 2003). In a research conducted by Kay (2006), he found that male teachers had relatively higher levels of computer attitude and ability before computer implementation, but there was no difference between males and females regarding computer attitude and ability after the implementation of the technology. He claims that quality preparation on technology can help lessen gender inequalities.
### 2.6.4 Age of teacher and Computer Use.

Though some research reported that teachers' experience in teaching did not influence their use of computer technology in teaching (Niederhauser & Stoddart, 2000), most research showed that teaching experience influence the successful use of ICT in classrooms (Wong & Li, 2008; Giordano, 2007; Hernandez-Ramos, 2005). Gorder (2008) reported that teacher experience is significantly correlated with the actual use of technology. In her study, she revealed that effective use of computer was related to technological comfort levels and the liberty to shape instruction to teacher-perceived student needs. Also, Baek, Jong & Kim (2008) claimed that experienced teachers are less ready to integrate ICT into their teaching.

Similarly, in United States, the (U.S National Centre for Education Statistics, 2000) reported that teachers with less experience in teaching were more likely to integrate computers in their teaching than teachers with more experience in teaching. According to the report, teachers with up to three years teaching experience reported spending 48% of their time utilizing computers, teachers with teaching experience between four and nine years, spend 45% of their time utilizing computers, teachers with experience between 10 and 19 years spend 47% of the time, and finally teachers with more than 20 years teaching experience utilize computers 33% of their time. The reason to this disparity may be that fresh teachers are more experienced in using the technology.

Further, Lau & Sim (2008), conducted a study on the extent of ICT adoption among 250 secondary school teachers in Malaysia. Their findings revealed that older teachers frequently use computer technology in the classrooms more than the younger teachers. The major reason could be that the older teachers having rich experience in teaching, classroom management and also competent in the use of computers can easily integrate ICT into their teaching. The result is in agreement with Russell, Bebell, O'Dwyer, & O'Connor, (2003) who
found that new teachers who were highly skilled with technology more than older teachers did not incorporate ICT in their teaching. The researchers cited two reasons: new teachers focus could be on how to use ICT instead of how to incorporate ICT in their teaching. Secondly, new teachers could experience some challenges in their first few years of teaching and spend most of their time in familiarizing themselves with school’s curriculum and classroom management.

But in a survey of almost 3000 teachers, Russell, O'Dwyer, Bebell & Tao (2007) argued that the quality of ICT integration was related to the years of teacher service. However, Granger, Morbey, Lotherington, Owston & Wideman (2002) conducted a qualitative survey on factors contributing to teachers’ successful implementation of ICT in Canada and found no relationship between teachers' teaching experience and experience in the use of ICT implying that teachers’ ICT skills and successful implementation is complex and not a clear predictor of ICT integration.

2.6.5 Impact on the Learner and Teacher in Learning.

It is clear that many different types of technology can be used to support and enhance learning, Hepp, et al (2004) reports that schools should profoundly revise present teaching practices and resources to create more effective learning environments and improve life-long learning skills and habits in their students.

There is a clear difference between teachers who choose digital learning resources to enhance understanding of a particular topic, and those who choose resources merely to present students work in a new way without any direct application to the topic. The evidence shows that when teachers use their pedagogical knowledge both of the subject and also of how students understand and learn the subject, they can then maximise the effects of using ICT in terms of increasing student’s attainment (Cox et al., 2003). The effect on attainment is greatest when pupils are challenged to think and to question their own understanding.
2.6.6 Teacher Confidence in using ICT

Studies reveal that teachers become reluctant to incorporate technology in their classroom teaching if they lack confidence. Bialo & Sivin-Kachala (1996) reported that when teachers are not sufficiently trained they will not develop confidence to carry out full integration of ICT in teaching and learning in the classroom. With proper training on how to implement ICT, teachers can offer crucial advice on how to select, integrate and evaluate computer tools to support teaching and learning as they are the backbone in any curriculum.

2.6.7 Teacher Motivation to using ICT

Teacher motivation plays a pivotal role in integration of digital resources in the teaching and learning environment. Ertmer (2005) found out that teachers displayed less motivation to integrate technology in teaching when they were not convinced that students will show desirable outcome in performance during the learning progress. According to Zhao & Cziko (2001) three conditions that are important for teachers to incorporate technology in teaching and learning are firstly, teachers must hold the belief that technology do not compromise the existing educational standards but is used to promote learning at all levels. Secondly, teachers must not view that incorporating technology in their teaching is an addition of lesson workloads but rather should as a tool to help in the teaching process. Finally, teachers need to be in charge of the classroom and not view technology as a replacement to classroom management. The teacher should believe in being in control of the classroom. When teachers meet these conditions, they will be encouraged and motivated to integrate digital resources in classroom teaching and learning.
2.7 Conclusion and Summary of Existing Gaps.

The integration of digital resources into classroom teaching is a developing and expanding concept. It is clear that the slow uptake of integration of digital learning resources in many schools is as a result of factors that exist that will influence teachers’ incorporation of ICT tools in the classroom. The rationale for integrating digital resources in the teaching and learning has been reviewed in this chapter which has identified and explored a number of the factors that have been found to affect teachers’ adoption of ICT in the classroom. In light of this, not many studies have in fact explored those factors that influence teacher’s decisions whether or not to integrate digital resources in science teaching and learning in the Kenyan context. A study by Kariuki (2012) concluded that research has not been conducted to establish factors affecting ICT integration in schools that received funding from the Ministry of Education under economic stimulus programme (ESP) project. Moreover, although the process of integrating technology is evolutionary, and although it is acknowledged that teachers' pedagogical philosophies and practices are affected by their classroom experiences, there exist a knowledge gap in examining the introduction of digital resources in teaching and learning of science in Kenyan context. This study sought to enrich previous studies and test the interplay between teacher variables and the integration of digital resources into classroom teaching of sciences in Secondary Schools in Murang’a County-Kenya. Connections are made with existing literature to explore possible factors for introducing digital resources into science education in Kenya. Understanding these factors was vital for improving the utilization of digital resources and other technological aids in the teaching and learning of science. Also, the detection of barriers that may be contributing to the slow uptake of integrating the digital resources provide information that is helpful in supplementing existing in-service teacher training programs.
CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This Chapter describes the research design and methodology applied in this study and is organized into relevant subsections. These are: the location of study, target population, sampling strategy and sample size, and the instruments used in data collection. This is followed by a section on piloting and the process of standardisation of instruments used. Thereafter data collection procedure and ethical considerations are described. Finally, the methods of data analysis and the mode of presentation of the data are discussed.

3.2 Research Design.

This study adopted a descriptive survey design which employed both quantitative and qualitative methods. This design was deemed appropriate as it sought to find out varied viewpoints on the factors that influence integration of digital resources in teaching of sciences.

The study was designed to allow a quantitative analysis. The decision to use quantitative analysis technique and to give a statistical report was determined by levels of measurement of the variables in the study, the questions being addressed, and the type and level of information expected in reporting the findings.

3.3 Location of the study

The study was conducted among public secondary schools in Muranga County-Kenya. Muranga County is one of the 47 Counties in Kenya and is divided into eight Sub-Counties namely; Gatanga, Muranga East, Muranga South, Kigumo, Kandara, Kangema, Kahuro and Mathioya. Muranga County was chosen for the study because of the following
considerations; first, the proximity of the area to the researcher made the logistics for the study easier as it increased the chances between the researcher and the respondents to interact at personal levels both formally and informally, secondly, a study of this nature has never been conducted in the County and thirdly, the location was appropriate as it comprised of all the categories of school required for the study.

3.4 Target Population

Turabian (1987) defines the target population as a group to which a researcher would make a generalisation on. In this study, the target population comprised public secondary schools in Murang’a County-Kenya which are 267 in number. The science teachers in these public schools were earmarked for involvement in the study. The County has 2 national schools, 16 county schools and 249 sub-county schools. The distribution of the various categories of these schools is as shown in the sampling grid, table 3.1

3.5 Sampling Technique and Sample size

3.5.1 Sampling Techniques

Sampling is the procedure that the researcher used to select the subjects that were included in the study. Both probability and non-probability sampling technique were used to get the sample size. Probability sampling is a method that ensures that each member of the target population has a known and non-zero chance of being selected into the sample (Ogula, 2005). This ensured that all the subjects had an equal chance of being selected to participate in the study. Non probability sampling is a method that ensures that the elements in the target population have an unknown chance of being selected in the sample (Ogula, 2005). The two sampling techniques were applied as follows:
3.5.1.1 Public secondary schools

There are 267 public secondary schools in the County. Two (2) of the schools are national, 16 are county schools and 249 are sub-county schools. One of the national schools was purposively selected to participate in the study because it did receive a lot of government funding to purchase ICT equipment and also received training on ICT implementation, integration and use, both in school management and in curriculum delivery.

The researcher used stratified sampling to select four (4) secondary schools out of the sixteen (16) county secondary schools. This method was used in order to ensure that, boys’ schools and girls’ schools were well represented in the sample. To select the sub-county schools, the researcher used stratified sampling in order to achieve the desired representation from various subgroups in the population (Mugenda & Mugenda, 2003). The school strata included girls’ boarding, boys’ boarding, mixed boys’ boarding, mixed girls’ boarding, mixed boarding and day schools and mixed day schools. The schools that were selected to participate in the study included; 3 girls’ boarding school, 3 boys’ boarding school, 2 mixed school (girls board), 1 mixed school (boys board), 2 mixed boarding and day schools, and 14 mixed day schools. The sample selected therefore constituted 25 sub-county secondary schools.

3.5.1.2 Science Teachers.

The County has 267 public secondary schools. Out of these, 30 schools were selected to participate in the study. By stratified sampling, three science teachers were selected in each school in order to achieve desired representation from various subgroups in the population. The strata included Physics teachers, Chemistry teachers and Biology teachers. In a case where there were less than three science teachers in a school, the researcher selected another school in the same category and strata to replace the shortfall. The sample of the respondents comprised 90 teachers who participated in this study because they are the users of digital
resources in classroom teaching. Of these, 10 were randomly selected for the researcher to make classroom observation.

**Table 3.1 Sampling Grid**

<table>
<thead>
<tr>
<th>Category of school</th>
<th>Type of school</th>
<th>Population</th>
<th>Sample Selected</th>
<th>Science Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>Girls Boarding</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Boys Boarding</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>County</td>
<td>Boys Boarding</td>
<td>7</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Girls Boarding</td>
<td>8</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Boys Day</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sub-county</td>
<td>Boys Boarding</td>
<td>13</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Girls Boarding</td>
<td>13</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Mixed School (Girls Board)</td>
<td>9</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Mixed Day and Boarding</td>
<td>199</td>
<td>14</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Mixed Day</td>
<td>5</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Mixed School (Boys Board)</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Boys Day and Boarding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>267</td>
<td>30</td>
<td>90</td>
</tr>
</tbody>
</table>

**3.5.2 Sample Size**

Since this was a descriptive study, according to Mugenda & Mugenda, (2003) and Gay, (1992) 10 percent of the accessible population is considered adequate. Therefore 30 (11.24%) out of the 267 schools were selected for the purpose of this study. The sampling frame was divided into homogenous subgroups; the urban side of the county and the rural part of the county by use of stratified random sampling method to obtain a sample. The method ensured
each sub group was represented proportionally within the population, and then a random sample was drawn from each subgroup.

The sample size was arrived as follows; there are two (2) national schools in the county from which by use of random sampling, one (1) was selected to participate in the study. This formed a sample which constituted 50% which was a good representation of the national schools in the total population. There are sixteen (16) county schools in the county. Four (4) schools were selected to participate in the study. This formed a sample which constituted 25% of the county schools which was a good representation of the target population. The last category is the sub-county schools whose total population is 249 schools. Twenty five (25) sub-county schools were selected to comprise 10.04% of the sub-county schools in the target population.

All categories of schools represented in the study were as follows; boys boarding 6 schools, girls boarding 5 schools, mixed day and boarding 2 schools, mixed day 14 schools, mixed school (girls board)-2 schools and mixed school (boys board)-1 school. This formed 11.24% of the target population, which was in line with Gay’s (1992) recommendation.

3.6 Instrumentation

In choosing the methods of data collection, the researcher considered the questions to be answered and the sources of information that were available. Also, the researcher put into account how the information was to be organized, analysed, interpreted and then reported to various audiences, Cohen, et al (2007).

The study used a combination of instruments as suggested by Kane (1995) that use of complimentary methods reveals discrepancies since a single method can neither be sufficient
nor reliable. Questionnaires, Scheduled Interviews and observation checklist were the instruments chosen for this study.

3.6.1 Questionnaires for Teachers

Questionnaires were also structured in an effort to meet the research objectives. Mugenda & Mugenda (2003) put it that researchers administer questionnaires to some samples of a population to learn about the distribution of characteristics, attitudes, or beliefs. In this study, the questionnaires typically entailed several questions that were structured into response categories; open ended questions which enabled the respondents to discuss issues without their responses being confined. The questions were developed by the researcher and underwent correction by experienced teachers. The questionnaire was also modified during piloting after a parallel instrument was given out to check its authenticity. The questions examined quite vigorously the bias, sequence, clarity, and validity of the responses. Closed questions included an array of choices/answers from which the respondents chose. Such questions are easier and quicker to answer and the responses are more comparable among respondents. The closed questions had multiple choices where the participants were ticking to indicate their opinion without necessarily giving details.

The researcher prepared one set of questionnaires which was administered to the science teachers of the selected secondary schools. This survey was preferred as major instruments of primary data collection and the responses from the respondents were considered in the analysis of data since the researcher wished to obtain a specific and precise amount of information from a large number of subjects. Survey research was the most preferred mode of inquiry for making inferences about the total large population of Murang’a county secondary school science teachers based on data drawn from a relatively small number of teachers of the total population. The basic aim of using the survey instrument was to describe and explain
statistically the factors that influence the integration of digital resources into teaching and learning of science subjects in Secondary Schools, and as put by Gay, (1992) survey research gives the researcher an easier way to the data analysis process.

3.6.2 Interview guide for Science Teachers.

In this study, the in-depth interview used the informal directed conversation with a bid to find answers to the research questions. The informal conversation interview is an in-depth interview that typically is much more like conversations than formal events with predetermined response categories, Mugenda & Mugenda (2003).

In the in-depth interviews the researcher sought to find out the experiences of science teachers in integration of digital resources to classroom teaching and learning and the effect these resources have in the learning process. Since this type of interviewing describes the meaning of a concept that several individuals share, the teachers were asked about their efforts and impact in implementation of digital resources integration. The interviews rested on the assumption that there is a process from initiation of digital resources integration to experiences that can be narrated. The interview questions were prepared by the researcher guided by the research objectives to collect data directly as the respondents were probed further for detailed descriptions and comprehensiveness as needed.

3.6.3 Direct Classroom Observation Schedule.

Here, the researcher was a direct observer of the events on this study. The direct observation schedule which was developed by the researcher was a checklist to ascertain information given by respondents by observing the events that took place in the classroom environment. In direct observation the researcher does not typically try to become a participant in the context. However the direct observer does strive to be as unobtrusive as possible so as not to
bias the observation. Direct observation suggests a more detached perspective where the researcher is watching rather than taking part.

### 3.7 Piloting

The pilot study was conducted in five schools across each of the categories of schools in the county to represent the various characteristics of schools in the population. Three sub-county schools were selected for piloting because they accounted for 93% of schools in the County.

**Table 3.2 Piloting Frame for Schools**

<table>
<thead>
<tr>
<th>Category of School</th>
<th>Type of school</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>National School</td>
<td>Girls boarding</td>
<td>1</td>
</tr>
<tr>
<td>County School</td>
<td>Boys boarding</td>
<td>1</td>
</tr>
<tr>
<td>Sub-County School</td>
<td>Mixed day and boarding</td>
<td>1</td>
</tr>
<tr>
<td>Sub-County School</td>
<td>Mixed day</td>
<td>2</td>
</tr>
</tbody>
</table>

Piloting was done in order to test whether there were any items that the respondents may have had difficulty in understanding, inadequate wording, identify items that may have been omitted during the construction of the questionnaire and provided an indication on how the data collecting instrument performed in the field. The data obtained from the piloting was analysed to see if the suggested methods of analysing were suitable for the study. The schools that were used for the pilot study did not participate in the final study.

**3.7.1 Validity**

An instrument is regarded as valid when it can measure what it is supposed to measure. The questionnaire underwent pilot study to test whether differences found with the measuring instrument reflected true difference among those tested. Face and content validity was
ascertained by experts in the field of education. Their recommendations and suggestions were put into consideration and for the preparation of the final instruments presented to the field of research.

3.7.2 Reliability

To measure the consistency of the instruments, a test-retest procedure was used in the piloting. Science teachers from the schools selected for piloting filled the questionnaire and were requested after two weeks to fill the same copy of the instrument. The collected data were verified for reliability. Cronbach’s alpha coefficient was used as a measure of internal consistency to indirectly indicate the degree of items in measuring of a single construct. The reliability coefficient was found to be 0.7970 which was above the critical value of 0.7 (Kaplan & Saccuzo, 1990). This critical value is the recommended reliability for most questionnaires. So given the determined reliability, the questionnaire was considered reliable and was therefore adopted for collecting data.

3.8 Data Collection Procedure

The researcher, upon receiving authorization to conduct the research from the Ministry of Education, Science and Technology made an initial visit to the secondary schools to explain the purpose of the study and make the relevant appointments.

3.8.1 Teacher Questionnaires

A cover letter briefing the respondents about the purpose of the study accompanied each questionnaire. The researcher discussed with each respondent and set an agreed time frame for collection of the completed questionnaires. After the agreed period of time elapsed, the researcher made follow-up by reminding the respondents who had not returned the completed
questionnaire. This was done through telephone conversations or actual visit depending on the location of the respondents.

### 3.8.2 Interview schedule with Teachers

The interviews were carried out by the researcher in person after classroom observation was made. During the interview the researcher made brief notes with the permission of the respondents. This personal interview allowed the researcher to collect data directly as the respondents were probed further for detailed descriptions and comprehensiveness as needed. Where allowed, transcription of the interview was done but only included complete thoughts and useful information. The researcher transcribed interviews immediately so as to resolve any ambiguity while the memory was still fresh. The notes and transcripts were reviewed to refine and modify questions based on evolving topics. After the interviews, the researcher read over the interview notes and wrote a summary of themes.

### 3.8.3 Classroom Observations

Classroom observations were made the same day the researcher carried out the interviews. The researcher accompanied the teacher to class to make observation of the actual integration of digital resources in the science teaching and learning. The students were notified before the lesson that there would be a visitor in their class who was carrying out a research so as not to interfere with their natural and spontaneous responses. During the observation, the schedule was filled based on the classroom activities which involved teacher’s aspects of integrating digital resources in teaching and learning. Additional remarks were made to respond to other necessary aspects of the variables not captured in the research tool. The results were then used to supplement data collected in the questionnaire and that from the interviews so that the conclusions drawn were meaningful, precise and representative.
3.9 Data Analysis and Presentation

3.9.1 Data analysis from Questionnaires

Raw data obtained from the field using the teachers’ questionnaire were organized and edited to detect errors and omissions and to correct them. They were coded by assigning numerals and other symbols so that responses could be put into limited categories. It was important because the data were mainly descriptive and therefore required translation from qualitative to quantitative form. After coding, the data were classified by arranging them into groups or classes to reduce the large volume of data and put them into homogenous groups to get meaningful relationship. They were analysed by using the SPSS data analysis programme utilizing descriptive statistics. Frequency and percentages were mainly used. Percentages in regard to the various variables were then applied and tabulated by arranging same kind of data in a concise and logical manner that helped in answering the research questions.

3.9.2 Data analysis from Interviews

Qualitative data collected through interviews with teachers was guided by the use of the interview schedule (see appendix B). Field notes from the interviews were read carefully paying particular attention to comments, ideas and concerns from the respondents. From this information, the researcher wrote a narrative and an interpretive report in order to give a vivid description of the factors that influence the integration of digital resources into teaching and learning of sciences in secondary schools in Murang’a County - Kenya.

3.9.3 Data analysis from Observation Checklists.

A record of all available digital resources indicating either their adequacy or inadequacy level was made in the observation checklist (see appendix C). Items were quantified, organized and then analysed by utilizing descriptive statistics. The items level of availability, signs of use and level of providence was captured in percentages to enable description of the same to be
made at discussion and conclusion sections of the study. To add to the above, data from the observation checklist was analysed by summing up the multiple items within the schedule to supplement the data on the questionnaire.

3.10 Ethical Considerations

Before data collection exercise commenced, the researcher first obtained a research permit from the Ministry of Education, Science and Technology and the science teachers informed on the intention to carry out the study. Only consenting science teachers were involved in the study. The researcher was fully responsible for maintaining the dignity and welfare of all participants. This obligation also entailed protecting them from harm, unnecessary risks, or mental and physical discomfort that may be inherent in the research procedure.

In presentation of this study, the researcher was fully ethical and did not fabricate or falsify data in this publication. In addition, the researcher has not presented the work of others as his own. This study has not failed to give appropriate credit for the work of others through citations. Finally, the information collected is treated with as much confidentiality as possible and is not used for any other purpose other than the research study.
CHAPTER FOUR

REPORTING AND DISCUSSION OF THE FINDINGS

4.1 Introduction

The aim of this study is to examine factors influencing the integration of digital resources into teaching and learning of sciences in secondary schools in Murang’a County - Kenya. It examines teachers’ integration and use of digital resources in the school and explores factors identified as affecting digital resources use in the teaching and learning in the classroom environment. The findings are presented in this chapter.

For the purpose of this study the researcher designed the questionnaire and interview questions to examine specific variables identified by research as influencing teachers’ integration of digital resources. Self-administered questionnaires were distributed to science teachers in the selected secondary schools where a response rate of ninety-one percent was recorded. Semi-structured interviews were conducted to the same teachers to assess perceptions regarding the value of digital resources in teaching and learning of science and the perceived factors influencing their integration.

Qualitative research analysis methods were used to assess the interview responses for observed patterns of behaviour, beliefs, values and practices associated with use of digital resources.

4.2 Teacher demographics - Age / Sex / Subjects/ Teaching experience

The researcher included a number of questions on the questionnaire to ascertain the exact make up of the study sample group under investigation. Teacher demographics were recorded using the questionnaire, data were collected on age, gender and the science subject taught.
4.2.1 Respondents by Age

The age of the respondents varied greatly in this study with sixteen percent aged twenty to thirty years, thirty-two percent aged thirty-one to forty years, thirty percent aged forty-one to fifty years and twenty-two percent aged fifty-one to sixty-five years (Figure. 4.1).

![Age of Teachers as the Respondents](image)

**Figure 4.1: Respondents by Age.**

It would appear from the results that age was not a barrier affecting the integration of digital resources in teaching and learning. During the interviews the more experienced teachers did not display any significant negativity towards using digital resources; conversely these teachers expressed a strong desire to continue in upgrading their ICT competencies. This finding is supported by similar findings in a study by van Braak et al. (2004).

This finding indicates that there could be no relationship between the teachers’ age and integration of digital resources in teaching as older teachers could use these resources in the classrooms more than the younger teachers as the new teachers take time to familiarise
themselves with the schools’ curriculum and classroom management, a finding that was also revealed by Lau & Sim (2008)

4.2.2 Respondents by Sex

The researcher sought to find out whether the sex of the respondents influenced how digital resources are integrated in the teaching and learning of science. The respondent’s sex was recorded as fifty-seven percent male and forty-three percent female respectively. The results of both the interviews and questionnaires found no significant differences in responses based on sex of the respondents. This finding indicates that, it is the level of preparedness to use digital resources that would contribute to teachers’ successful integration of the resources in the classroom.

4.2.3 Respondents by Subjects Taught

The subjects taught by the respondents in this survey are represented in Figure 4.2. All the three science subjects (Physics, Chemistry and Biology) offered in secondary school were represented in the study. The distribution was as follows; thirty-six percent-Biology, twenty-five percent-Physics and thirty-nine percent-Chemistry.

Figure 4.2: Respondents by Subjects Taught.
All the three science subjects taught (Physics, Chemistry and Biology) within the schools were represented in the study. From analysis of the findings all the three subjects reported minimal use of digital resources in the teaching and learning in the classroom environment. This finding appeared to indicate that there were underlying factors that brought about the minimal use of digital resources ranging from teachers’ experience and competence in the use of ICT, availability of these digital resources and other ICT equipment, schools’ support in investing in technology among others discussed in detail in this chapter.

4.2.4 Respondents by Teaching Experience.

The number of years teaching experience of each respondent was also recorded. The study found that the schools has high levels of experienced teaching staff with forty-two percent of staff reporting at least twenty years teaching experience (Figure 4.3). These high levels of teaching experience correlate directly with the age demographics of the respondents with fifty-two percent of the sample aged over forty-one years old.

![Figure 4.3: Respondents by Teaching Experience.](image-url)
The researcher concluded that the even distribution of number of years teaching experience amongst the science teachers in the schools was very useful for examining factors that affect both experienced and inexperienced teachers integration of digital resources.

4.3 Teaching and Learning issues

This study investigated independent variables associated with teaching and learning that may influence teachers’ integration of digital resources. The independent variables examined included teachers beliefs. Do teachers own constructivist or behaviourist beliefs influence use of digital resources? Do teachers’ computer experience, support and training influence teachers’ computer use? Finally, do teachers’ attitudes towards computers influence their computer use?

4.3.1 Teachers’ beliefs towards integrating digital resources in teaching science.

Teachers’ constructivist or behaviourist teaching beliefs were identified and recorded during the semi-structured interview. The teachers interviewed reported conflicting results. Forty two percent of the interviewed respondents believed teachers that followed the behaviourist teaching theory were less likely to integrate digital resources in their teaching. The remaining fifty eight percent of respondents believed that teachers who follow a behaviourist teaching theory were able to adapt and integrate digital resources into their teaching. A number of the Interviewees did acknowledge that teachers following the behaviourist methodologies may experience higher levels of anxiety initially but over time they adapt to the new teaching and learning tools. This finding is also consistent with Ertmer (2005) who state that teachers who hold the constructivist belief, upon familiarizing themselves with using computer technology in the classrooms, integrate these resources with ease.
The researcher investigated respondents’ attitudes towards using digital resources in the classroom in the questionnaire. When asked if the respondent experienced frustration using digital resources in the classroom twenty-four percent agreed or strongly agreed. A further forty-four percent of respondents disagreed or strongly disagreed with this statement whilst thirty-two percent of respondents neither agreed nor disagreed with the statement (Figure 4.4). From the interview schedule, one fifth of the respondents said that they felt confident in using digital resources in the classroom and frustration would only arise if they had not prepared for a lesson well. One physics teacher in a boys’ boarding school commented:

I would only get frustrated in integrating digital resources in my lessons when I have not adequately prepared my resources well. Things might go wrong along the lesson. What if the computer fails me? Or the projector isn’t well set? I believe with proper prior preparation, I will not get frustrated and my lesson would be great.

![Pie chart showing attitudes towards using digital resources in class](image)

**Figure 4.4 Frustration experienced when using digital resources in the classroom**

This is an indication that, a display of positive attitude towards integrating digital resources in the classroom plays a major role in increasing the frequency of successful integration. A view also reported by van Braak et al (2004).
The questionnaire also investigated respondent’s own personal beliefs into whether students learn more or less when digital resources are used in the classroom. Fifty-eight percent of respondents agreed or strongly agreed that students learn more when digital resources are used in the classroom. Four percent disagreed with the statement while the remaining thirty-eight percent of the respondents neither agreed nor disagreed that students learn more when digital resources are used in the classroom (Figure 4.5).

![Students learn more when digital resources are used in the classroom](chart)

**Figure 4.5: Students level of learning when using digital resources in the classroom.**

This shows that, teachers’ own beliefs affect the level of integration of digital resources in the classroom. Those teachers who hold the view that students learn more when digital resources are used in the classroom showed high level of willingness to use these resources. This indicates that the beliefs held by teachers have the potential to either increase or reduce the integration of these resources in teaching and learning of science.

Forty-two percent of respondents disagreed or strongly disagreed that students learn less when digital resources are used in the classroom. Twenty-two percent of respondents agreed
or strongly agreed that students learn less when digital resources are used in the classroom whilst thirty-six percent of respondents neither agreed nor disagreed (Figure 4.6).

![Students learn less when digital resources are used in the classroom](image)

**Figure 4.6: Students learning levels when using digital resources in the classroom**

These results were in agreement with what majority of the teachers interviewed responded. Two-fifth of the respondents recognized that integrating digital resources in teaching enhanced their teaching experience.

Many concepts in my Chemistry lesson that sound abstract are well understood when I incorporate short video clips in my lesson. My students are able to relate what I teach to what they experience in real-life situations. They are able to construct knowledge from their natural environment which to me means more learning.

Respondents were asked if they would like to use more digital resources in the classroom to ascertain if respondents viewed digital resources as a tool that they would like to use more in the teaching and learning in the classroom environment. Sixty-two percent of all respondents reported a positive response that they would like to use more digital resources in the classroom. Eight percent of respondents disagreed with the statement and thirty percent of respondents neither agreed nor disagreed with the statement (Figure 4.7).
More than two-fifth of the respondents interviewed agreed that using digital resources in the classroom would assist them in achieving their specific lesson objectives. Half of the respondents felt that lack of training opportunities and knowledge acquisition for ICT integration in teaching and learning would affect the frequency of use of these resources.

These findings indicate that the majority of teachers, if granted with access to digital resources for their subjects, they would create more effective learning environments and maximise the effects of using these resources in terms of improving lifelong learning skills and habits in their students.

The researcher sought to find out whether the respondents’ use of computers has increased since commencing employment as a teacher. Fifty-nine percent of respondents agreed or strongly agreed that the use of computers has increased since being employed. Twenty-six percent strongly disagreed or disagreed with the statement while the remaining fifteen percent of the respondents neither agreed nor disagreed that the use of computers has increased since being employed (Figure 4.8).
This finding revealed that teachers’ experience influences their use of computer technology in teaching. The study showed that the schools has high levels of experienced teaching staff with forty two percent of staff reporting at least twenty years teaching experience (see figure 4.3). older teachers having rich experience in teaching and in classroom management can easily integrate digital resources in their teaching than new teachers who first spend time in familiarizing themselves with school’s curriculum and classroom management, a view that is also shared by Russell, et al (2003).

4.3.2 Computer Experience, Support and Training

Teacher computer experience and supportive use of computers were recorded using the questionnaire and the from the interview schedule. Questions related to computer experience, access to computers at home and in school, use of ICT hardware and software and amount of time spent on a computer were included. The levels of computer experience, support and training received were assessed in this study (Figure 4.9). The levels of computer training undertaken by respondents varied greatly with forty percent reporting no formal computer training and a majority fifty-two percent of respondents had completed a basic computer
introduction course. The results also found out that eight percent of the respondents have completed an intermediate course in computer. No respondent reported having the International Computer Driving License (ICDL) qualifications or any other computer training.

Figure 4.9: Levels of computer training.

The results of the Interviews undertaken with staff correlated with the questionnaire results with seventy-two percent of Interviewees reporting low levels of computer experience, support and training with sixty percent of these interviewees reporting levels of computer training that do not exceed basic computer training and experience. The remaining twenty-eight percent reported high levels of computer experience, support and training.

Computer training provision by the schools was assessed on the questionnaire and through interview questions. The questionnaire findings reported fourteen percent of respondents strongly agreed or agreed that ICT training in the schools was satisfactory. Twenty-four percent neither agreed nor disagreed with the statement and the majority sixty-two percent of respondents strongly disagreed or disagreed suggesting they were dissatisfied with the level
of training provided by the schools (Figure 4.10). In the interview responses all respondents declared a desire to improve computer skills. Indeed a comment by one teacher of Biology illustrated this;

I have not adequately embraced the use of digital resources in my teaching because I feel inadequate in handling computer tools. I only have the basic computer operation skills of formatting, editing and document set-up. I would however appreciate if I am professionally empowered through advanced ICT training.

![The provision of ICT training in the schools is satisfactory](image)

**Figure 4.10: Provision of satisfactory ICT training.**

These results indicate that, though majority of teachers reported a positive response that they would like to use more digital resources in the classroom (figure 4.7), the lack of or low level of pedagogical training in ICT influences teachers’ attitude towards computers. It is these skills that help teachers reorganize the task of technology and how new technology tools are significant in students learning as suggested by Hew & Brush, (2007); Keengwe & Onchwari (2008).

Eighty-eight percent of respondents believed that further computer training to teachers should be provided. The remaining twelve percent neither agreed nor disagreed (Figure 4.11).
Figure 4.11: Provision of further staff computer training.

In question fifteen on the questionnaire respondents’ responses indicated that seventy four percent identified lack of sufficient computer training as a barrier to teachers integrating digital resources in the classroom. These suggestions indicate that effective technical support and ICT pedagogical training are key factors to successful integration of digital resources in classroom teaching and learning of science.

4.3.3 Teacher and Management Attitudes

Computer attitudes were measured using an adapted version of van Braak & Goeman’s (2003) ‘General attitudes towards Computers’ scale. The question is composed of a list of fifteen statements designed to ascertain respondents’ confidence levels using digital resources, anxiety levels towards using digital resources and attitudes towards digital resources support. The five point likert scale is used where responses range from strongly agree to strongly disagree. The lower the scale score the more positive the attitudes are towards using digital resources. The use of likert scales are advocated by Cohen et al. (2007) as they allow for flexibility in quantitative analysis of responses. The questionnaire found eighty-two percent of teaching staff agreed or strongly agreed that they have a positive
attitude towards using digital resources in the study school (Figure 4.12). Eight percent of respondents disagreed with the statement that they have a positive attitude towards digital resources and ten percent of respondents neither agreed nor disagreed with the statement.

![I have a positive attitude towards using digital resources in the classroom](image)

**Figure 4.12: Positive attitude towards using digital resources in the classroom.**

The findings revealed that a high percentage of teachers’ in the schools have a very positive attitude towards integrating digital resources in their teaching. While this result is encouraging it is important to investigate further the reasons for the eight percent negative response to this question.

Nine percent of teachers in the study reported feeling competent and confident using digital resources in the classroom. A further sixty-four percent disagreed or strongly disagreed to feeling competent and confident using digital resources in the classroom. Twenty-seven percent of respondents neither agreed nor disagreed with the statement (Figure 4.13). The responses for question fifteen reported eighty percent of respondents identified lack of confidence using digital resources as a barrier to using digital resources in the teaching and learning. These results were in agreement with the results of the interviews conducted whereby two-thirds of the respondents mentioned that they felt incompetent and lacked
confidence in integrating digital resources in the classroom teaching. One comment illustrated this;

...although I hold the view that incorporating digital resources in my teaching enhances learning, I do not feel competent and confident in using them as I feel to not have undertaken proper ICT training and that these resources are inadequate in our school to practice using them.

![I feel competent and confident using digital resources in the classroom](image)

Figure 4.13: Competency and confidence levels using digital resources in the classroom.

The results in this study do reflect the trend suggested by Mumtaz (2000) that if teachers feel competent and confident using ICT in the classroom they display a more positive attitude towards using ICT. The research does highlight negative confidence and competence levels using digital resources may not correlate the exact same response to a teacher’s positive attitude towards digital resources. The results show a difference in positive responses with eighty-two percent of respondents recording a positive attitude response to using ICT while only nine percent recorded a positive response to competence and confidence levels using ICT.

Management attitudes towards digital resources were recorded in an interview. Respondents were also asked in the questionnaire if they believed management supported teachers’ use of digital resources. Eight percent agreed or strongly agreed that management supported digital
resources use. Twenty-four percent disagreed or strongly disagreed that management supported digital resources use and the remaining sixty-eight neither agreed nor disagreed (Figure 4.14).

![I believe the management in the school support teachers using digital resources](chart.png)

**Figure 4.14: Management’s support for teachers’ use of digital resources.**

In question fifteen (e) in the questionnaire, the respondents were asked whether management viewed ICT as a priority. Seventy-two percent of respondents reported that they believed management did not view ICT as a priority.

The study established that that there is a relatively large number of teachers in the various schools that are not convinced of the school managements’ support for integration of digital resources in teaching and learning. This study would suggest that for effective integration of digital resources to teaching and learning in the classroom, there need to be commitment from the government of Kenya, administrators, teachers, parents, students, and the community. That is, all the stakeholders and responsible authorities including teachers and other staff should be aware of the importance of technology in developing student’s learning and should strive to overcome the barriers which prevent the use of technology in classroom
settings, so that students can benefit effectively from these resources. Afshari et al, (2009) states that it is crucial to involve those who have a stake in the outcomes, including teachers, parents, students, and the community, and allow them to assist in the creation of the vision by contributing their knowledge, skills, and positive attitude. Therefore, a clear vision of digital resources integration in schools that is shared by all members of the school community promotes effective use of these resources in the classroom.

4.3.4 Use of specific ICT tools and software packages

Question nine on the questionnaire was designed to investigate the specific ICT tools being used by respondents in the teaching and learning in the classroom environment. The results of the questionnaire are presented in the following table (Table 4.1) reflecting the ICT tools and the frequency of their use by teachers. The most frequently used ICT tool was the computer with fifty-two percent of respondents using it often or very often. The data projector was the second most used ICT tool with respondents reporting twelve percent used this tool often or very often. The digital camera, video camera and scanner reported very high levels of never being used by the respondents. None of the respondents reported to ever have used an interactive whiteboard. Data from the observation checklist also supported these findings as majority of the respondents (90%) did not have digital resources within the classroom for use with the computers. Of the respondents observed, 7% were observed to use video clips in their teaching.
Table 4.1: Use of ICT tools by teachers.

<table>
<thead>
<tr>
<th></th>
<th>Never (%)</th>
<th>Seldom (%)</th>
<th>Sometimes (%)</th>
<th>Often (%)</th>
<th>Very often (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Computer</td>
<td>20</td>
<td>16</td>
<td>12</td>
<td>24</td>
<td>28</td>
</tr>
<tr>
<td>(b) Printer</td>
<td>43</td>
<td>30</td>
<td>18</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>(c) Data projector</td>
<td>65</td>
<td>16</td>
<td>7</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>(d) Digital camera</td>
<td>94</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(e) Digital video camera</td>
<td>98</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(f) Scanner</td>
<td>84</td>
<td>11</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>(g) Interactive Whiteboard</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Use of ICT software by respondents was also investigated and the following table (Table 4.2) recorded the frequency of use by teachers in the school. The respondents were found to be more likely to use Microsoft Word and the Internet when compared to other ICT software. Very low usage of creative software for photo editing, video editing, website design and computer aided design was recorded. This observation was also deduced from the observation checklist where in majority of schools the digital resources were not available for use in class.
Table 4.2: Use of ICT software by teachers.

<table>
<thead>
<tr>
<th></th>
<th>Never (%)</th>
<th>Seldom (%)</th>
<th>Sometimes (%)</th>
<th>Often (%)</th>
<th>Very Often (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Microsoft Word</td>
<td>14</td>
<td>8</td>
<td>11</td>
<td>19</td>
<td>48</td>
</tr>
<tr>
<td>(b) Microsoft Excel</td>
<td>58</td>
<td>14</td>
<td>9</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>(c) Microsoft Powerpoint</td>
<td>43</td>
<td>22</td>
<td>5</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>(d) Internet</td>
<td>23</td>
<td>6</td>
<td>10</td>
<td>35</td>
<td>26</td>
</tr>
<tr>
<td>(e) Email</td>
<td>65</td>
<td>29</td>
<td>5</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>(f) Digital photo editing</td>
<td>98</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(g) Digital video editing</td>
<td>97</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(h) Music editing /downloading</td>
<td>94</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>(i) Computer Aided Design</td>
<td>97</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

The results recorded on the questionnaire correlate with the interview responses to similar questions in relation to use of ICT software. A general desire to improve and learn how to use a wider range of ICT software was observed.

The results of the study into use of ICT tools and software packages revealed a significant thirty six percent of respondents claiming that they never or seldom use the computer in their teaching and learning environment. This finding agrees with the researcher’s observation where there was minimal integration of digital resources in classroom teaching and learning as well as teachers’ response on availability of ICT facilities in their schools where a significant sixty eight percent disagreed or strongly disagreed that their schools have good ICT facilities. This suggests that lack of ICT infrastructure may result to teachers’ lack of
willingness to integrate ICT into their teaching and learning environment. Fifty two percent of respondents reported using the computer often or very often in the classroom this is a positive step towards integration of digital resources.

4.3.5 Digital resources use with specific teaching groups

Respondents were asked to identify the teaching group that they use digital resources most frequently with on the questionnaire. The study found teachers used digital resources most frequently with form threes and form fours, 26% +28% respectively. Lower levels of digital resources use were reported with form ones and form twos levels, 10% + 10% respectively while twenty-six percent of teachers reported never using digital resources in their teaching (Figure 4.15).

![Teaching group using digital resources](image)

**Figure 4.15: Teaching group using digital resources.**

These observations were also made during the observation schedule where it was noted that where digital resources were used, especially video clips and interactive video, it was in form
three and four as majority of these resources were comprehensively covering content beyond the form one and two levels.

4.4 Technical issues

The second area that this study will focus on is how technical issues may influence teachers’ integration of digital resources in the teaching and learning of science in the classroom. The study investigated a range of technical issues that may arise through the use of digital resources in the teaching and learning. Results were recorded in the questionnaire and interviews. Areas explored include the technical skills to use specific ICT tools and software packages, the amount of time spent on computers, the level and type of ICT tasks undertaken by the teacher, training undertaken by the teacher and access to computers and Internet.

4.4.1 Time for use of digital resources

The questionnaire examined the area of time as a factor influencing the integration digital resources in science teaching and learning. Respondents were asked to give details of the amount of time they spend on average using computers in school on an average day. The data was recorded and is presented in Table 4.3.

Table 4.3: Amount of time spent using digital resources in school.

<table>
<thead>
<tr>
<th>Time</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) I never use digital resources in school</td>
<td>69%</td>
</tr>
<tr>
<td>(b) Up to 20mins</td>
<td>1%</td>
</tr>
<tr>
<td>(c) Up to 40mins</td>
<td>6%</td>
</tr>
<tr>
<td>(d) Up to 1hr</td>
<td>10%</td>
</tr>
<tr>
<td>(e) Up to 2hrs</td>
<td>12%</td>
</tr>
<tr>
<td>(f) Other</td>
<td>2%</td>
</tr>
</tbody>
</table>
The results show a very high sixty-nine percent of respondents reported never using digital resources at school. In question fourteen respondents were asked to use a Likert scale to find out if using digital resources in the classroom takes up too much time. Seventy-six percent agreed or strongly agreed that using digital resources takes up too much time. Conversely, fourteen percent disagreed or strongly disagreed with the statement that using digital resources takes up too much time (Figure 4.16).

![Using digital resources in the classroom takes up too much time](image)

**Figure 4.16: Using digital resources in the classroom takes up too much time.**

The area of time was further investigated in the questionnaire where respondents were asked to identify the barriers that they believed were inhibiting integration of digital resources in the classroom. The results show that thirty-six percent of respondents believe there is not enough time to learn how to integrate digital resources; fifty-eight percent believe that there is not enough time to prepare digital resources for class use and fifty-four percent of respondents agreed that there is no time allocated to discuss or share digital resources in their subject areas.
The study revealed seventy six percent agreed or strongly agreed that using digital resources takes up too much time this finding is supported by Galanouli et al. (2004) who reported that over-exploitation of teachers’ time to use ICT was a serious concern amongst teachers. Fourteen percent of respondents disagreed or strongly disagreed with this statement. This result may suggest that lack of time was viewed by the majority of teachers’ as a significant barrier. Respondents were asked to respond to specific questions in relation to time on the questionnaire. Thirty-six percent of respondents believed that there was not enough time to learn how to use digital resources. A significantly high fifty-eight percent believed that there was not enough time allocated to prepare digital resources for class use suggesting that teachers’ would welcome the opportunity to have the time to prepare their own resources. It is alarming to report that fifty-four percent of respondents agreed that there has been no time allocation to allow for discussion and sharing of digital resources in their subject areas. It is obvious that if more time was made available to encourage and develop ICT collaboration amongst teachers’ teaching and learning in the classroom would be beneficial to learners.

4.4.2 Access to digital resources

Respondents’ access to computer and internet at home and in school were assessed in the questionnaire as well as in the observation checklist for classroom teaching. The level of access to computers and the internet was very low. The respondents reported thirty-six percent had access to a computer at home and twenty-two percent had access to the Internet at home. When questioned on the type of internet connection at home, ninety-eight percent used a mobile broadband connection and the remaining two percent reported having a broadband connection. None of the respondents used a dial-up phone line connection. The observation checklist showed that 28% of the respondents would rely on the internet provided from the schools computer laboratory while the majority 72% did not have access of internet.
in their school. Digital resources were also observed to be lacking in the classrooms. It is obvious that, if teachers have access to digital resources for their subjects, this would foster a positive attitude towards encouraging teachers’ integration of them in the classroom learning environment.

4.4.3 Access to other ICT equipment

The researcher asked respondents to indicate if they believed the school had very good ICT facilities. The results show four percent 4% agreed that the school has very good ICT facilities, sixty eight percent strongly disagreed or disagreed and twenty eight 28% neither agreed or disagreed with the statement (Figure 4.17).

![Pie chart showing responses to school ICT facilities](image)

**Figure 4.17: The school has very good ICT facilities.**

The response recorded in the questionnaire was also recorded in the interview responses. All interviewees reported very low satisfaction levels with the ICT facilities in the school. According to this data collected, the low level of satisfaction with the ICT facilities in the school may be largely due to low level of improvisation and low level of resource acquisition.
by the schools. Obviously, if teachers cannot access digital resources, then they will not use them.

Respondents were also asked if they were satisfied with the current computer room booking system in the school. Twelve percent of all respondents reported being satisfied while forty-two percent of respondents disagreed or strongly disagreed that the computer room booking system in the school was satisfactory. A majority forty-six percent neither agreed nor disagreed largely because they do not even have a computer room in their school (Figure 4.18).

![Image of a pie chart showing satisfaction levels with computer room booking system.]

**Figure 4.18: Satisfaction levels with computer room booking system.**

Good availability of ICT resources effects teachers ICT use positively. It is therefore important to encourage school managers and governments to continuously improve the provision of these resources to schools.
4.4.4 ICT tasks undertaken

The researcher also gathered information on the tasks that teachers use ICT for and how often they perform these tasks (Table 4.4). The majority of respondents reported very low levels of using ICT to create quizzes, word searches, download video clips and to send or receive email. In total eighty-four percent of respondents reported using ICT to prepare examination material for students. Respondents also reported using ICT for class content preparation and for preparing worksheets. Collaboration was evidently low with only four percent of respondents reported using ICT often or very often for sharing resources.

Table 4.4 ICT tasks in teaching.

<table>
<thead>
<tr>
<th>Task</th>
<th>Never</th>
<th>Seldom</th>
<th>Sometimes</th>
<th>Often</th>
<th>Very Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Creating Quizzes</td>
<td>42%</td>
<td>18%</td>
<td>24%</td>
<td>10%</td>
<td>6%</td>
</tr>
<tr>
<td>(b) Creating Word searches</td>
<td>56%</td>
<td>16%</td>
<td>14%</td>
<td>12%</td>
<td>2%</td>
</tr>
<tr>
<td>(c) Creating PowerPoint’s</td>
<td>43%</td>
<td>22%</td>
<td>5%</td>
<td>18%</td>
<td>12%</td>
</tr>
<tr>
<td>(d) Downloading video clips</td>
<td>58%</td>
<td>16%</td>
<td>20%</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>(e) Sending / Receiving Email</td>
<td>44%</td>
<td>20%</td>
<td>16%</td>
<td>4%</td>
<td>16%</td>
</tr>
<tr>
<td>(f) Preparing Exam materials</td>
<td>16%</td>
<td>-</td>
<td>12%</td>
<td>28%</td>
<td>44%</td>
</tr>
<tr>
<td>(g) Maintaining student records</td>
<td>40%</td>
<td>12%</td>
<td>24%</td>
<td>14%</td>
<td>10%</td>
</tr>
<tr>
<td>(h) Completing project work</td>
<td>34%</td>
<td>6%</td>
<td>28%</td>
<td>18%</td>
<td>14%</td>
</tr>
<tr>
<td>(i) Preparing content for class</td>
<td>36%</td>
<td>24%</td>
<td>16%</td>
<td>6%</td>
<td>18%</td>
</tr>
<tr>
<td>(j) Preparing worksheets/handouts</td>
<td>42%</td>
<td>34%</td>
<td>16%</td>
<td>2%</td>
<td>6%</td>
</tr>
<tr>
<td>(k) Contacting other teachers</td>
<td>63%</td>
<td>30%</td>
<td>3%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>(sharing ideas/resources)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The results found that teachers were quite limited in their use of ICT applications. Very low levels of using ICT to create quizzes, word searches, download video clips and to send or receive e-mail were reported. In total eighty-four percent of respondents reported using ICT to prepare examination material for students. Respondents also reported using ICT for class content preparation and for preparing worksheets. Collaboration was evidently low with only four percent of respondents reported using ICT often or very often for sharing resources. These findings suggest the need for further encouragement and provision of ICT training for specialist ICT applications may encourage increased use of ICT in the classroom.

4.4.5 Digital resources support and ICT maintenance

Respondents were asked to report on the level of support with digital resources in the school on the questionnaire. One percent agreed that the level of support with digital resources in the school was satisfactory. Seventy-two percent of respondents disagreed or strongly disagreed that the level of support with digital resources was satisfactory and twenty-seven percent neither agreed nor disagreed with the statement (Figure 4.19).

The level of ICT support in the school is satisfactory

![Pie chart showing satisfaction levels of ICT support]

Figure 4.19: Satisfaction levels of ICT support.
Respondents were asked if they believed the maintenance of ICT equipment in the school was satisfactory. Six percent agreed with the statement. Seventy percent of respondents did not believe maintenance of ICT was satisfactory (Figure 4.20). Eighty-two percent of all respondents identified lack of technical support as a significant barrier to integrating digital resources in the teaching and learning of science in the classroom.

![Pie chart showing satisfaction levels](chart.png)

**Figure 4.20: Satisfaction levels of maintenance of ICT equipment in the school.**

The Interview responses with respondents also reported levels of dissatisfaction with ICT maintenance within the schools. Where available it was observed that the digital resources were kept in good working condition when it is the teachers who kept the resources.

The results of this study concur with the findings of Mumtaz (2000) and Demetriadis et al. (2003) who cite lack of ICT support and maintenance as a significant barrier affecting teachers’ integration of digital resources. Through the provision of further ICT support and maintenance within schools it may be possible to positively affect teachers’ integration of digital resources in their teaching and learning.
CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction.

The main purpose of this study was to examine the factors that influence the integration of digital resources in teaching and learning sciences in Secondary Schools in Kenya. The study adopted a descriptive survey design which employed both quantitative and qualitative methods. Stratified random sampling procedure was used to arrive at the sample of the respondents. Data collected was processed and analyzed using the Statistical Package for Social Sciences (SPSS) data analysis programme. Descriptive statistics such as frequencies and percentages were used to summarize the data. This chapter provides the summary of the findings of the study draws conclusions and makes recommendations based on the findings.

5.2 Summary of the findings.

The main findings are summarized below on the basis of themes developed from the objectives of the study.

5.2.1 Teacher demographics - Age / Sex / Subjects / Teaching experience.

The study established that age was not a significant barrier affecting the integration of digital resources in teaching and learning. During the interviews the more experienced teachers did not display any significant negativity towards using digital resources; conversely these teachers expressed a strong desire to continue in upgrading their ICT competencies. This finding is supported by similar findings in a study by van Braak et al. (2004).

The results of both the interviews and questionnaires found no significant differences in responses based on sex.
From analysis of the findings all the three science subjects taught (Physics, Chemistry and Biology) reported minimal use of digital resources in the teaching and learning in the classroom environment. The researcher concluded that the even distribution of number of years teaching experience amongst the science teachers in the schools was very useful for examining factors that affect both experienced and inexperienced teachers integration of digital resources.

5.2.2 Teachers’ attitudes towards integrating digital resources in their teaching.

The findings revealed that a high percentage of teachers’ in the schools have a very positive attitude towards integrating digital resources in their teaching. The results do reflect the trend suggested by Mumtaz (2000) that if teachers feel competent and confident using ICT in the classroom they display a more positive attitude towards using ICT. The research does highlight negative confidence and competence levels using digital resources may not correlate the exact same response to a teacher’s positive attitude towards digital resources.

5.2.3 Management support towards integrating digital resources in teaching.

These results suggested that there is a considerable number of respondents that are not convinced that management support integration of digital resources or did not view it as a priority. These observations suggest the need to encourage school leaders and managers to see the gains brought about by integrating digital resources and support their use in schools.

5.2.4 Availability of specific ICT tools and software packages.

The results showed that lack of ICT infrastructure result to teachers’ lack of willingness to integrate ICT into their teaching. The integration of digital resources in the schools is relatively high when the majority of respondents interviewed suggested that they had very low levels of use of digital resources prior to commencing employment in the schools.
5.2.5 Digital resources use with specific teaching groups.

The findings showed that there was high usage of digital resources in form three and four but low in form one and two. This may be a result of the wide range of digital resources available through ICT that have been developed for senior classes. Regardless of the reasons for using or not using ICT with specific teaching groups the researcher would suggest that integration of digital resources needs to be continuously encouraged amongst all teaching groups to enhance the teaching and learning of science for all students.

5.2.6 ICT training.

The results highlight the need for continuous computer training and upgrading of ICT skills to teachers. The provision of further computer training would provide teachers with an opportunity for continuing professional development. It is possible that the lack of an ICT policy that includes provision for a continuous structured ICT training programme may be hindering the teachers’ integration of digital resources in schools.

5.2.7 Technical issues.

5.2.7.1 Time for use of digital resources.

It is obvious that if more time was made available to encourage and develop ICT collaboration amongst teachers’ teaching and learning in the classroom would be beneficial to learners.

5.2.7.2 Access to ICT resources.

The results suggest that good availability of ICT resources effects teachers ICT use positively. It is therefore important to encourage school managers and governments to continuously improve the provision of these resources to schools.
5.2.7.3 ICT tasks undertaken.

The findings suggest the need for further encouragement and provision of ICT training for specialist ICT applications may encourage increased use of ICT in the classroom.

5.2.7.4 ICT support and maintenance.

In concurrence with the findings of Mumtaz (2000) and Demetriadis et al. (2003) lack of ICT support and maintenance as a significant barrier affecting teachers’ integration of digital resources. Through the provision of further ICT support and maintenance within schools it may be possible to positively affect teachers’ integration of digital resources in their teaching and learning.

5.3 Conclusions of the Study.

The conclusions of this study were derived from the major findings and were based on the research objectives. The first objective of this study was to identify the interrelationship between the various status of the teacher’s experience with use of digital learning resources and actual integration of these resources in the classroom. The study established that by having a diverse spread in teacher demographics, it was representative of the teacher profiles within the selected secondary schools. The results showed that age was not a significant barrier affecting the integration of digital resources in teaching and learning. During the interviews the more experienced teachers did not display any significant negativity towards using digital resources; conversely these teachers expressed a strong desire to continue in upgrading their ICT competencies. This finding is supported by similar findings in a study by van Braak et al. (2004).
The researcher concluded that the even distribution of number of years teaching experience amongst the science teachers in the schools was very useful for examining factors that affect both experienced and inexperienced teachers integration of digital resources.

The second objective of this study was to investigate the factors that may influence teachers’ decisions to integrate digital resources in teaching and learning of science. Teachers’ attitudes were recorded in the study. The findings revealed that a high percentage of teachers’ in the schools have a very positive attitude towards integrating digital resources in their teaching.

The third research objective was to establish strategies for adoption to address those factors that may hinder effective integration of digital resources into science teaching and learning. This study highlights the need for continuing discussion, planning and evaluation of all ICT investment in education to gain a better insight into how digital resources can be integrated successfully into classroom teaching and learning environment. The findings of this study will create an awareness of the factors that are currently affecting teachers’ digital resources use in science teaching and learning.

5.3.1 Management and stakeholders attitudes.

The study established that that there is a relatively large number of teachers in the various schools that are not convinced of the school managements’ support for integration of digital resources in teaching and learning. This study would suggest that for effective integration of digital resources to teaching and learning in the classroom, there need to be commitment from the government of Kenya, administrators, teachers, parents, students, and the community. That is, all the stakeholders and responsible authorities including teachers and other staff should be aware of the importance of technology in developing student’s learning and should strive to overcome the barriers which prevent the use of technology in classroom settings, so that students can benefit effectively from these resources. Afshari et al, (2009)
states that it is crucial to involve those who have a stake in the outcomes, including teachers, parents, students, and the community, and allow them to assist in the creation of the vision by contributing their knowledge, skills, and positive attitude. Therefore, a clear vision of digital resources integration in schools that is shared by all members of the school community promotes effective use of these resources in the classroom.

5.3.2 ICT policy.

ICT policy has a vital role to play in the successful implementation of ICT into the teaching and learning environment. The existing education policy on ICT is imbedded in three documents namely; e-Government Strategy, National ICT Policy and Sessional Paper No. 1 of 2005 (A Policy Framework for Education, Training and Research). The study recommends the need to consolidate these documents into one. The overall objective of the consolidation will be to merge and integrate education policy on ICT including the scope, usage, administration and ways to address developed innovations (National ICT Policy, 2006). An ICT policy for schools should clearly identify the aims and objectives to be achieved when digital resources are integrated by teachers in their classroom teaching and learning.

5.3.3 Positive attitude towards integration of digital resources.

To implement the integration of digital resources in the classroom, teachers should feel confident and comfortable using these resources. Teachers must understand the value of digital resources in education to be able to benefit their students and to support meaningful learning (Marcinkiewicz, 1994). So changing teachers’ negative attitudes is essential for increasing their computer skills. Therefore, if teachers want to successfully integrate digital resources in their classes, they need to possess a positive attitude to the use of technology. Such an attitude is developed when teachers are sufficiently comfortable with technology and
are knowledgeable about its use (Afshari et al, 2009). In this connection, Mumtaz (2000) states that schools can go only so far to encourage ICT use; actual take-up depends largely on teachers’ personal feelings, skills and attitudes. Even if teachers are provided with up-to-date technology and supportive networks, they may not be enthusiastic enough to use it in the classroom. Teachers need to be given the evidence that ICT can make their lessons more interesting, easier, more fun for them and their pupils, more enjoyable and more motivating. As ICT is a relatively new field in the Kenyan education systems, more in-depth research should be conducted related to integration of ICT into classroom situations, to show that ICT can make their lessons more interesting, easier and efficient.

5.3.4 ICT training and support.

Use of digital resources in education has been changing rapidly as a result of technological change. Many educators have been reluctant to follow the technology-led changes. The use of digital resources in a school is dependent on the successful exploitation of the educators in exploring the potential of ICT by developing new pedagogical approaches to using these resources in the classroom. It is clear that if educators are expected to exploit the full potential of digital resources in the classroom educators must be trained in both how and when to use digital resources effectively in their classroom teaching and learning. Lack of adequate training and support has been consistently reported (Mumtaz, 2000) as a factor affecting teachers’ ICT use. The results of this study reported similar findings. It is clear that there is a need for the schools to continue to provide high levels of ICT training and support for staff. The study recommends that if provision is made for increased ICT training within the schools, teacher confidence using ICT may improve.
5.3.5 Teacher professional development.

Teachers' professional development is a key factor to successful integration of digital resources into classroom teaching. Sandholtz & Reilly (2004) claim that teachers' technology skills are a strong determinant of ICT integration, but they are not conditions for effective use of technology in the classroom. They argue that training programs that concentrate on ICT pedagogical training instead of technical issues and effective technical support, help teachers apply technologies in teaching and learning. Teachers may adopt and integrate digital resources into their teaching when training programs concentrate on subject matter, values and the technology. Clearly, it is imperative to allow teacher trainees to apply digital resources in their programs when in school in order to be able to use the technology to supplement their teaching activities.

5.3.6 Availability of ICT hardware and software.

One of the key findings of this study is that access and availability of digital resources does positively affect teachers' ICT use. Lack of computers (both hardware and software) and other ICT-supported tools in the classroom can seriously limit the use of it by a teacher. Limited resources results in lack of computer integration, which in turn results in lack of sufficient computer experience for both pupils and teachers. The stakeholders and school authorities need to be provided with adequate facilities and resources for effective integration of digital resources.
5.4 Recommendations of the Study.

The following recommendations were made based on the findings of the study.

5.4.1 Recommendations for Action.

1. The study established inadequate facilities in the schools. The study recommends the continued support by the Ministry of Education to equip schools with facilities/infrastructure such as providing ICT friendly classrooms and installation of Internet. This will ensure that schools are supplied with an extra resource base other than books for teaching and learning and in turn improve their integration in the process of teaching and learning.

2. Kenyan Teacher Training curriculum should train teacher trainees on how to use ICT in their classrooms by being engaged in the process of ICT-integrated training. Further, develop tutors’ ICT skills and promote ICT-pedagogy integration in their teaching by providing ICT-based training environments where active discussion can take place in relation to technology and pedagogy.

3. Kenya Institute of Curriculum Development (KICD), the body responsible for developing curriculum materials should develop and supply to secondary schools with relevant digital resources in science subjects areas to ensure effective access and quality of the materials. When planning the curriculum, KICD should ensure that the digital resources are in harmony with the current syllabus.

4. The Ministry of Education should develop a clear ICT policy on integration of ICTs in teaching and learning that which would give the scope, usage, administration and ways to address developed innovations. It is form this roadmap where schools would clearly identify the aims and objectives to be achieved when digital resources are integrated by teachers in their classroom teaching and learning.
5.4.2 Recommendations for further research.

Finally, the researcher recommends that the study be made the background for further research as follows:

a) Since school principals are the managers at school level, they play a major role in the implementation of the integration of digital resources in teaching and learning environment. A study to examine Principals’ attitudes and personal beliefs’ on teachers’ ICT use would further compliment and enrich the gains made in this study.

b) The status and extent of use of information and communication technology in Management of these resources need to be examined in detail.

c) That continuous evaluation of the use of digital resources within schools be recorded and analyzed on a regular basis to facilitate development of integration of these resources.
REFERENCES.


APPENDIX A

ICT Integration Questionnaire for Teachers.

INTRODUCTION.

Dear respondent,

This questionnaire is meant to collect data for a research titled: *Factors influencing integration of digital resources in science teaching and learning in Secondary schools of Murang’a County-Kenya*. You have been selected as one of the respondents and, if you consent to participate, you are kindly requested to be sincere with your answers. Please note that any information you give will be treated with utmost confidentiality and privacy. Additionally, the information will be used for academic purposes only.

Thank you for your cooperation.

1. Please tick (✓) the box that best represents your main teaching subjects:
   - (a) Biology
   - (b) Physics
   - (c) Chemistry

2. Please tick (✓) the box that best represents your age:
   - (a) 20-30yrs
   - (b) 31-40yrs
   - (c) 41-50yrs
   - (d) 51yrs and above

3. Please tick (✓) the box to identify your sex:
   - (a) Male:
   - (b) Female:

4. Please tick (✓) the box that best represents your number of years of teaching experience:
   - (a) 1-5yrs
   - (b) 6-10yrs
   - (c) 11-15yrs
   - (d) 16-20yrs
   - (e) 21-25yrs
   - (f) 26-30yrs
   - (g) Over 30yrs
5. Please tick (√) the box that best represents the level of computer training you have undertaken

(a) No formal training
(b) Basic introduction course
(c) Intermediate course
(d) International Computer Driving Licence (ICDL)
(e) Other
Please specify __________________________

6. Do you have access to a computer at home?

(a) Yes ☐ (b) No ☐

7. Do you have access to the Internet at home?

(a) Yes ☐ (b) No ☐

(If “Yes” please specify the type of Internet connection)

(a) Dial-up connection (using phone line)
(b) Broadband
(c) Mobile Broadband

8. Which of the following ICT tools are easily accessible in the classroom? (Please tick (√) the box)

(a) Computer
(b) Printer
(c) Internet access
(d) Data projector
(e) Digital camera
(f) Digital video camera
(g) Scanner
(h) Other
Please specify __________________________
9. How often do you use the following ICT tools in your teaching? (Please tick (√) the box)

<table>
<thead>
<tr>
<th>Tool</th>
<th>Never</th>
<th>Seldom</th>
<th>Sometimes</th>
<th>Often</th>
<th>Very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Computer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Printer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Data projector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) Digital camera</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e) Digital video camera</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f) Scanner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(g) Interactive Whiteboard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. How often do you use the following ICT software applications in your teaching? (Please tick √ the box)

<table>
<thead>
<tr>
<th>Application</th>
<th>Never</th>
<th>Seldom</th>
<th>Sometimes</th>
<th>Often</th>
<th>Very Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Microsoft Word</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Microsoft Excel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Microsoft Powerpoint</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) Internet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e) Email</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f) Digital photo editing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(g) Digital video editing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(h) Music editing /downloading</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Computer Aided Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11. How often do you use digital resources for the following tasks in your teaching? (Please tick (√) the box)

<table>
<thead>
<tr>
<th>Task</th>
<th>Never</th>
<th>Seldom</th>
<th>Sometimes</th>
<th>Often</th>
<th>Very Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Downloading</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Music editing</td>
<td></td>
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<tr>
<td>(c) Internet downloading</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(a) Creating Quizzes</td>
<td>Never</td>
<td>Seldom</td>
<td>Sometimes</td>
<td>Often</td>
<td>Very Often</td>
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<tr>
<td>(b) Creating Wordsearches</td>
<td></td>
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<tr>
<td>(c) Creating Powerpoint presentations</td>
<td></td>
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<tr>
<td>(d) Downloaded video clips</td>
<td></td>
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<tr>
<td>(e) Sending / Receiving Email</td>
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<tr>
<td>(f) Preparing Exam materials (e.g. papers / marking schemes)</td>
<td></td>
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<tr>
<td>(g) Maintaining student records</td>
<td></td>
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<tr>
<td>(h) Completing project work</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>(i) Preparing content for class</td>
<td></td>
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<td></td>
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<tr>
<td>(j) Preparing worksheets / handouts</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(k) Contacting other teachers - sharing ideas / resources</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

12. Please tick (√) the teaching group that you use digital resources with:

- (a) Form ones
- (b) Form twos
- (c) Form threes
- (d) Form fours
- (e) I don’t use digital resources in my teaching

13. Please tick (√) to the nearest Figure how long you spend using digital resources in school on an average day:

- (a) I never use digital resources in school
- (b) Up to 20 mins
- (c) Up to 40 mins
- (d) Up to 1 hr
- (e) Up to 2 hrs
- (f) Other - please specify __________________________
14. Please complete the following by placing a tick (√) in one space only, as follows:

<table>
<thead>
<tr>
<th>SA = strongly agree</th>
<th>A= agree</th>
<th>NA = neither agree nor disagree</th>
<th>D = disagree</th>
<th>SD = strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) I have a positive attitude towards using digital resources in the classroom</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
<tr>
<td>(b) I feel competent and confident using digital resources in the classroom</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
<tr>
<td>(c) I believe the school has very good ICT facilities</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
<tr>
<td>(d) My use of computers has increased since commencing employment in this school</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
<tr>
<td>(e) The level of ICT support in this school is satisfactory</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
<tr>
<td>(f) The provision of ICT training in this school has been satisfactory</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
<tr>
<td>(g) The maintenance of ICT equipment in this school is satisfactory</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
<tr>
<td>(h) Further Staff ICT training should be provided</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
<tr>
<td>(i) The computer room booking system in this school is satisfactory</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
<tr>
<td>(j) I get frustrated using digital resources in the classroom</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
<tr>
<td>(k) Using digital resources in the classroom takes up too much time</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
<tr>
<td>(l) Students learn more when you use digital resources in the classroom</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
<tr>
<td>(m) Students learn less when you use digital resources in the classroom</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
<tr>
<td>(n) I would like to use more digital resources in my classroom</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
<tr>
<td>(o) I believe the management in this school support teachers using digital resources</td>
<td>(SA)</td>
<td>(A)</td>
<td>(NA)</td>
<td>(D)</td>
</tr>
</tbody>
</table>

15. Please tick (✓) which of the following do you believe are barriers to teachers integrating digital resources in the classroom

(a) Not enough time to learn how to use digital resources
(b) Not enough time to prepare digital resources for class use
(c) No time allocated to discuss / share resources in subject areas
(d) Sufficient ICT training has not been provided
(e) Management do not view ICT as a priority
(f) Lack of confidence using ICT
(g) Lack of technical support using digital resources in the class
APPENDIX B
Semi-Structured Interview Questions to Teachers.

1. Do you feel your use of digital resources has changed since joining this school? Explain

2. Have you undertaken any ICT training?

3. What skills would you like to learn?

4. Do you believe it is good to incorporate digital resources into the teaching and learning in the classroom?

5. Do you believe you have adequate digital resources in your classroom?

6. Do you believe digital resources enhance your teaching/classroom presence?

7. What do you believe are the main benefits to using digital resources? E.g. preparing for class / tests / engaging students etc

8. What do you believe are the problems with using digital resources in the classroom?

9. Do you feel you receive enough ICT assistance in this school? Explain

10. Would you use computers more for preparing for class / in class as a presentation tool, as an administrative tool e.g. attendance records or do you have students in a computer lab working on computers?

11. Do you believe teachers are resistant to change / introducing something new into their classroom?

12. Do you / have you used any specific science subject software? Did you find it useful? Was it developed for the Kenyan market? Are there any digital resources you would recommend for your subject area?

13. Do you feel confident using digital resources in your classroom?

14. Do you believe that there has possibly been too much emphasis on having this new technology and not enough emphasis on how to use it in the classroom?

15. Do you believe by integrating digital resources in the classroom, teachers are more professional?
## APPENDIX C

### Observation Checklist.

<table>
<thead>
<tr>
<th>Digital Resources</th>
<th>Available</th>
<th>Not Available</th>
<th>In Good Working Condition</th>
<th>Often Utilized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audiotape</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Videotape</td>
<td></td>
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<tr>
<td>Computer Based Learning</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Interactive Video (Disc And Tape)</td>
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</tr>
<tr>
<td>Internet-Based Access To World-Wide Web (WWW) Resources</td>
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<tr>
<td>Interactive Multimedia Online</td>
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</tbody>
</table>

Remarks:

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APPENDIX D

Research authorization letter from National Commission of Science, Technology and Innovation.

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471
2241346,310571,2210420
Fax:+254-20-318245,318249
Email:secretary@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

Ref. No. 1

NACOSTI/P/14/3759/3893

Richard Githinji Gakime
Kenyatta University
P.O. Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on “Factors influencing integration of digital resources in science teaching and learning in secondary schools in Muranga County, Kenya,” I am pleased to inform you that you have been authorized to undertake research in Murang’a County for a period ending 12th June, 2015.

You are advised to report to the County Commissioner and the County Director of Education, Murang’a County before embarking on the research project.

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

DR. S. K. LANGAT, OGW
FOR: SECRETARY/CEO

Copy to:
The County Commissioner
Murang’a County.

The County Director of Education
Murang’a County.
APPENDIX E

Research Permit from National Commission of Science, Technology and Innovation.

THIS IS TO CERTIFY THAT:

MR. RICHARD GITHINJI GAKIME
of KENYATTA UNIVERSITY, 0-10200
Muranga, has been permitted to conduct research in Muranga County

on the topic: "FACTORS INFLUENCING INTEGRATION OF DIGITAL RESOURCES IN SCIENCE TEACHING AND LEARNING IN SECONDARY SCHOOLS OF MURANGA COUNTY, KENYA"

for the period ending:

12th June, 2015

Permit No.: NACOSTI/P/14/3759/3893
Date Of Issue: 3rd December, 2014
Fee Recieved: Ksh. 1000

National Commission for Science, Technology and Innovation

Signature

Secretary
National Commission for Science, Technology & Innovation

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APPENDIX F

Research authorization letter from Director of Education, Murang’a County.

MINISTRY OF EDUCATION SCIENCE AND TECHNOLOGY

COUNTY DIRECTOR OF EDUCATION
MURANG’A
P.O. BOX 118 - 10200
MURANG’A
13th December 2014

HGL/CTY/GEN/64/VOL.1/161

The respective Principals
Secondary Schools
Murang’a County

RE: RESEARCH AUTHORIZATION

The office is in receipt of the letter requested by the secretary (CEO), of National Commission for Science and Technology and Innovation vide ref, NACOSTI/P/14/2799/3893 dated 3rd Dec. 2014 to allow Mr. Richard Githinji Gakime to conduct research on "Factors influencing integration of digital resources in science teaching and learning in secondary schools of Murang’a County - Kenya".

This office grants permission for the above exercise on condition that the bearer of the letter, Mr. Githinji first liaises with the respective administration to ensure that normal instructional programmes are not interrupted during the process.

Upon completion of the same, this office expects a copy of the research findings for its resource centre.

The research period expires by 12th June 2015.

GEORGE OCHIENG

For County Director of Education, Murang’a

Cr.

The secretary, NACOSTI

The County Commissioner, Murang’a
APPENDIX G

Research authorization letter from County Commissioner, Murang’a County.

REPUBLIC OF KENYA

THE PRESIDENCY
MINISTRY OF INTERIOR AND CO-ORDINATION OF NATIONAL GOVERNMENT

Telephone: 060-2030467
Email: cmuranga@gmail.com

When replying please quote

COUNTY COMMISSIONER
MURANG’A COUNTY
P. O. BOX 7-10200
MURANG’A

REF.NO.PUB.24/11/VOL.1/96

22nd December, 2014

Richard Githinji Gakime
Kenyatta University
P.O Box 43844- 00100
Nairobi

RE: RESEARCH AUTHORIZATION

In reference to a letter NACOSTI/P/14/3759/3893 dated 3rd December, 2014 from the National Commission for Science, Technology and Innovation regarding the above subject, You are hereby authorized to carry out research on “factors influencing integration of digital resources in science teaching and learning in secondary schools in Murang’a County” for a period ending 12th June, 2015.

Benson M. Kamau
For: COUNTY COMMISSIONER
MURANG’A COUNTY
APPENDIX H

Murang’a County Map.