READINESS OF PUBLIC PRIMARY SCHOOLS FOR UPTAKE AND INTEGRATION OF LAPTOP COMPUTERS IN HOMA BAY COUNTY, KENYA

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2020

DECLARATION

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DEDICATION

This thesis is dedicated to God the almighty for everything that enabled me to reach this far. The thesis is also dedicated to my late father Jacob Omito Lul and loving mother, Gaudencia Omito, for their unwavering support all through my educational and social life. To my loving wife Melda and the two little boys, Chris and Benedict, your contributions and perseverance throughout the study period was indispensable.

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LIST OF ABBREVIATIONS AND ACRONYMS

AIDS	Acquired Immuno Deficiency Syndrome
CAL	Computer Assisted Learning
CIA	Computer Assisted Instruction
CML	Computer Mediated Learning
CSO	Curriculum Support Officer
DE	Distance Education
DLP	Digital Literacy Programme
ICT	Information Communication Technology
ICTA	Information Communication Technology Authority
IMM	Interactive Multi Media
IT	Information Technology
EFA	Education For All
E-LEARNING	Electronic Learning
HIV	Human Immuno Virus
KCPE	Kenya Certificate of Primary Education
KCSE	Kenya Certificate of Secondary Education
KESSP	Kenya Education Sector Support Programme
KICD	Kenya Institute of Curriculum Development
KIE	Kenya Institute of Education
LDD	Learner Digital Device
MDGs	Millennium Development Goals
MOE	Ministry of Education

NACOSTI	National Council for Science and Technology
NARC	National Alliance Rainbow Coalition
NMMU	Nelson Mandela Metropolitan University
OLPC	One Laptop Per Child
SPSS	Statistical Package for Social Sciences
TAM	Technology Acceptance Model
TDD	Teacher Digital Device
TSC	Teachers Service Commission
TV	Television
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPE	Universal Primary Education
UPS	Uninterrupted Power Supply
U.S	United States
VOK	Voice of Kenya
W.B.T	Web Based Training
WWW	World Wide Web

ABSTRACT

The purpose of this study was to investigate the readiness of public primary schools for uptake and integration of laptop computers for teaching and learning in Homa Bay County, Kenya.This followed the rise in use of web 2.0 technologies and the commitment of the Government of Kenya to give laptop computers to all standard one pupils in Kenya by 2014.The objectives of the study were to: investigate the availability of institutional ICT infrastructures in schools for laptop computer uptake, examine the adequacy of teachers' computer capacity in readiness for laptop computers integration, determine teachers' awareness of the digital content to be integrated in laptop computer uses, establish the attitude of the teachers towards the uptake and integration of laptop computer, and analyze the contribution of independent variables of the study to uptake and integration. The study was premised on systems theory. A mixed method cross sectional survey design was used for the study. Data was collected through questionnaires, observation checklists, interview schedules and document analysis. The study population was 8261 consisting of 845 public primary schools, 6529 teachers, 845 head teachers and 42 Curriculum Support Officers (CSOs). The population was stratified into six sub-counties and then simple random sampling technique was used to come up with proportional sample sizes in each of the six sub-counties of Homa Bay. A sample size of 85 schools, 362 teachers, 85 head teachers, 56 teachers in schools with Digital Literacy Programme (DLP) devices and 9 CSOs were used for the study. 12 sample teachers and 6 head teachers were also interviewed. Both content and construct validity were ascertained by the subject experts, while the internal consistency reliability alpha (α) values obtained were: 0.725, 0.962, 0.9535 and 0.709 for CSO questionnaires, teachers' questionnaires, head teachers' questionnaires and observation checklists respectively. Descriptive data for objectives 1, 2, 3 and 4 were analyzed by use of percentages, mean scores and frequencies while inferential statistics for objective 5 was analyzed using multiple regression analysis with the support of SPSS version 20 at $p \leq 0.05$.Interview data were organized into major themes and reported in quotes and percentages alongside the findings from quantitative data. The study findings showed that the average readiness for institutional ICT infrastructures in all sampled schools stood at 29.8% which the study interpreted to mean inadequacy for uptake of laptop computers. However, 74.8% sample schools had sources of power, 90.0% had power sockets and 79.9% had storage facilities that were funded by the government. The average institutional ICT infrastructures were also inequitably distributed in the six sub-counties. The findings showed low teacher computer capacity for teachers (2.10) and head teachers (2.48) who did not attend DLP training but was higher for teachers (3.42) who were DLP trained and for the teachers (3.68) who were already teaching using DLP devices in schools that had received the DLP devices. Majority of the sampled teachers (22.9%) were aware of the general digital content such as video, audio, images, texts and graphics but were not adequately proficient in manipulation skills such as drawing (6.8%), simulation (1.7%) and basic arithmetic (6.2%).Sample teachers had positive attitude on usefulness (3.61) of laptop computers for teaching and learning, but indicated that laptop computers were not easy to use (3.11). The multiple regression analysis showed that teachers' attitude both statistically (0.04, $p \leq 0.05$) and positively contributed (8.0 %) to uptake and integration of laptop computers. It was recommended that DLP be anchored in a country's ICT policy framework and extended to other levels of education in Kenya.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

The aim of this study was to investigate the readiness of public primary schools for uptake and integration of laptop computers for teaching and learning in Homa Bay County, Kenya. The study has been driven by the fact that Kenya is among the developing countries in the world whose effort to close the digital gap in public primary schools was wanting. To bridge the gap, the Government of the Republic of Kenya since 2013 has been struggling to launch laptop computers in primary school level one in all Kenyan public primary schools, but the critical question was, were Kenyan public primary schools ready for the uptake and integration of laptop computers for learning? (Sharples & Moldéus, 2014).

The thesis has been organized into five chapters. Chapter one primarily gives the general introduction to the study; chapter two captures the review of related literature to the study. Research design and methodology is discussed in chapter three. Chapter four presents findings and discussion of the research findings. The last chapter summarises the findings, gives conclusions, posts recommendations and suggests areas that need further research.

Chapter one discusses the following components: Background to the study, followed by the statement of the problem, purpose of the study, objectives and research questions. The significance, limitations, delimitations and basic assumptions of the study are also explored in this chapter. Finally, operational definitions of significant terms, organization of the study, theoretical and conceptual framework of the study end the chapter.

1.1.1 Background to the study

Globally, many academicians are embracing the utilization of web 2.0 technologies in teaching and learning. However, with the erratic power supply; poor internet connectivity and poor ICT infrastructure in African countries, it is difficult to know whether the academia have adopted the utilization of Information Communication and Technology (ICT) in teaching and learning (Okello-Obura & Ssekitto, 2015). The world is increasingly becoming complex and the shift towards technological adoption is on the rise, and more so driven by complexity and change in teaching and learning styles which are based on powerful and ubiquitous information technology (Reddy & Manjulika, 2002). In that respect, schools are challenged to prepare young people to navigate and prosper in this world, with technology as an ally rather than an obstacle (Silvernail, Pinkham, Wintle, Walker & Bartlett, 2011). Such technologies, which include computers, are necessary tools for learning institutions of the 21st century.

Technologies used in learning institutions are varied and are collectively known as Information Communication and Technology (ICT). ICT refers to any device or application, encompassing radio, television, cellular phones, satellite systems, computers and their peripheral devices (Lloyd, 2005). These peripheral devices connect a communicating system such as computers to add functionality. ICTs are proving to be powerful and have the ability to integrate multimedia into simple educational applications (Reddy & Manjulika, 2002). Laptop computers, on the other hand, are personal computers that can easily be carried and used in a variety of locations. Laptop computers are designed to have all functionality of desktop computers, which means they can generally run the same software and open the same types of files as desktop computers.

1.1.2 Information, Communication and Technologies in education

Quality in education cannot improve by itself. It requires reforms in teacher training, improvement in facilities and infrastructure in schools, teachers' motivation and change in style of teaching that make it attractive to students (Kumar, 2008). ICT is seen as a global revolution, that is, the scope of the digital world that is comparable to that of the physical world; from online gaming and online dating to e-learning and e-business. At the same time, size of the involvement in the digital world is phenomenal and its growth is dramatic and should not be ignored (Lim, Zhao, Tondeur, Chai & Tsai, 2013). In education, computers are used for creating, accessing, gathering, manipulating and presenting or communicating information. Such education roles are played by the computer hardware and software applications such as Microsoft Office, connectivity to the internet by local networking infrastructure, audio conferencing, video-conferencing and teleconferencing (Lloyd, 2005). Such roles have enhanced quality and productivity in the education sector.

The history of the use of computers in education is relatively short (Paas, 2008). Before 1979, computers existed primarily in tertiary level educational institutions. Once invented, the computer evolves naturally into the personal computer (PC) as its present most visible form, alongside its mutually supportive forms such as minicomputers with a notable progress that is inevitable, revolutionary and unstoppable (Mahoney, 2005). In the eighties, microcomputers began to be distributed to schools, and teachers began to grapple with the question of how to use computers for education rather than simply educating learners about computing (Paas, 2008). The present ICTs have been improved in terms of physical size and interactivity to allow communication from wherever people are to others thousands of kilometers away. A good example is the television and online tools that permit us to see

what is happening on the other side of the planet synchronously, while the web on the other hand supports immediate access to, and exchange of information, opinions and shared interests anytime anywhere (Arora & Chawla, 2014).

ICTs have made inroads in several educational learning institutions all over the world (Reddy & Manjulika, 2002). In one way, ICTs are influencing many aspects of human life such as the way human beings interact, work, move and relate. A good example is the increase in the use of 2.0 technologies in the social fabric (Okello-Obura & Ssekitto, 2015). The society, therefore, expect schools to aptly respond by adopting tailored technology such as laptop computers for teaching and learning. As such, the potential of ICTs in increasing access and improving relevance and quality of education in developing countries are seen to be on the rise (Mikre, 2011).

In the United Kingdom, since the introduction of Education Reform Act of 1988 (OFSTED, 2011), computer education has been compulsory for all pupils from 5 to 16 years in many schools. A good example was Key Stage 1 learning where it was statutory to teach English, Mathematics and science using computers. At other key stages of learning in the United Kingdom, there were statutory requirements for teachers to use computers to teach all statutory subjects. However, such concerted effort to popularize the use of computers did not yield much. Many primary schools in the United Kingdom still showed a much slower uptake of computers compared to secondary schools because of smaller budgets, limited ICT expertise among the teachers, and weaker purchasing power. The United Kingdom also lacked a viable government policy on the use of ICT, and as such schools were expected to set their own ICT strategy and implementation plans (e-Learning Foundation, 2013).

In Africa, a notable and remarkable move to introduce computers in schools was observed in all corners of the continent. In South Africa, for example, Plessis and Webb (2012) found that many schools had minimal resources as a residual result of the South African apartheid policy prior to 1994. In addition, these schools were located in areas that lacked basic infrastructure and other ICT resources such as electricity. The inability of these South African schools to adequately utilize twenty computers that were donated to each school to support ICT training exposed low levels of computer uptake. Plessis and Webb (2012) concluded that despite the fact that South African schools were provided with computers and teacher training, several first and second order barriers such as insufficient ICT resources for the large classes that had to be taught, lack of project leadership within the schools, negative attitudes and the need for ongoing training and support for teachers still existed.

In Zimbabwe, the e-school project conceptualized primary schools to have the following ICT system for each school (UNESCO-KFIT Team, 2018, p.5): 15 laptops (for the students) at an average ratio of 2 students per 1 laptop, 1 laptop (for the tutor) with class management software, 1 wireless router, 1 Mobile Laptop Cart used for safekeeping, transportation and charging of the laptops, 1 overhead projector and 1 projector screen. The Kenyan One Laptop Per Child program (OLPC) was seen by this study as an improved version of the ICT system of Zimbabwe because each child was to be provided with a laptop computer for learning.

Rwanda was among the East African countries that were envisioned to become a middle-income economy by the year 2020.The Rwandan Government viewed Information and Communication Technology (ICT) as a key tool for transforming the economy, with the

education sector playing an important role in developing the necessary human resources (Republic of Rwanda, 2015). Since the year 2000, there has been a big push to introduce computers into Rwandan schools and integrate ICT in the education curriculum through a range of initiatives (Rubagiza, Were & Sutherland, 2011). In 2006, Rwanda began the task of integrating ICT in education by giving one laptop computer to every primary school (Sharples & Moldéus, 2014). In 2014, Rwanda attained the ratio of one computer against fifteen students in primary schools which the Ministry of Education in Kenya observed to be a head of computer penetration in Africa (Kenya. MoE, 2006, p.1). Over 200,000 laptop computers were distributed to 410 primary schools which gave access to 20% of students in primary 4, 5, and 6. Rwanda also engaged in the training of over 10,000 head teachers and classroom teachers for the successful uptake of laptop computers (Republic of Rwanda, 2015).

Kenya has witnessed significant growth in the ICT sector as demonstrated by the number of telephone lines, mobile phones, Internet Service Providers (ISPs), the number of Internet users, broadcasting stations, and market share of each one of them (Kenya. Ministry of Information & Communications, 2006). In the education sector, ICT has actively evolved in both primary and secondary schools for a very long time in Kenya. One aspect of such ICT was radio broadcasts to schools that started in 1960 as a department of the Ministry of Education (Asiago, et al., 2014). Radio broadcast to schools which relied on portable radios and dry cells batteries as its source of power was one of the strategies for improving the standards of education, increasing access to educational content, and extending educational opportunities beyond the schools through distance learning. However, Kenya had no clear cut procedures in the usage of ICT in its institutions and this

led to the development and introduction of an elaborated ICT integration framework in 2006 that was in line with the Millennium Development Goals' declaration of the year 2000 that basic education should be free and compulsory for all by 2015 (Way, 2015).

The realization of ICT intentions as expressed in the Kenya National ICT Strategy for Education and Training policy document of 2006 was to equip educational institutions with digital equipment to stimulate integration of ICT in education and support initiatives that could provide digital equipment to these institutions, with priority to secondary and primary schools (Hennessy, et al.,2010). Provision of affordable infrastructure to facilitate dissemination of knowledge and skills through the use of computers and other digital equipment was seen as a corner stone in promotion of e-learning in Kenyan schools (Kenya. Ministry of Information & Communications, 2006). In that respect, the ICT policy framework was supposed to define and give answers to critical questions raised during planning, implementation and evaluation of ICT integration in schools.

Based on such a policy framework, computer usage for teaching and learning in Kenyan schools should not be considered a luxury. E-learning needed to be prioritized for the growth of both teachers and learners in the knowledge economy. Primarily desktop computers were used for gathering, processing and disseminating information. However, laptop computers became popular versions of desktop computers with the full functionality of desktop computing and the portability which allowed users to carry them anywhere (Mathevula & Uwizeyimana, 2014). In secondary schools in Kenya, the Nepad e-school program that was initiated with the support of the e-commission to facilitate the integration of ICT in Africa specialized in the delivery of digital content. In this program, six

secondary schools in Kenya benefited. These were: Menengai, Chavakali, Maranda, Isiolo, Mumbi and Wajir Secondary Schools out of the 80 schools in 15 African countries which were sampled to be beneficiaries (Nyagowa, Ocholla & Mutula, 2012). Primary schools were not adequately considered in the Nepad e-school program in Kenya.

Before 2014, primary schools in Kenya experienced inconsistent and inequitable distribution of computers by the government and other stakeholders in education. Compared to tertiary institutions, primary schools in Kenya had the highest student to computer ratio standing at 250 students against 1 computer (Kenya. MoE, 2006; UNESCO Institute for Statistics, 2012). This was far much below the 15 students to 1 computer which was observed as a norm ratio in most developed countries (Kenya. MoE, 2006, P.1).

Just before the launch of Digital Literacy Programme (DLP) in Kenyan public primary schools, Mingaine (2013) observed that even a few schools that had computers were not effectively adopting and using them to support teaching, learning and management as intended because of lack of computing resources, inadequate teacher training on ICT usage and integration, poor teacher attitude towards computer use and lack of computer rooms. But after the launch of DLP in Kenyan public primary schools in 2013 (Republic of Kenya, 2015), most public primary schools, especially in the rural areas of Kenya, made a shift in learning paradigm as power supply and ICTs started finding their ways into primary schools.

Before the introduction of DLP in schools, face to face teaching with hard copy textbooks used as the main source of educational content dominated the classroom work in many primary schools in Kenya. Teaching and learning were largely organized a long subject

content and written around hard copy textbooks. That is, school teachers were teaching using print media with learning activities designed to test the achievement of content objectives (Noor-Ul-Amin, 2013). However, with the introduction of ICT as a tool for teaching and learning, teaching strategy shifted and posted a great challenge that called for attitude change to many primary school teachers. Teachers had no option but to struggle to remain relevant by embarking on ICT training and integration of the digital content. The Kenya Institute of Curriculum Development (KICD) and book publishers on the other hand jointly begun conversion of hard copy books into digital content in classes one and two in 2013 (Kenya. DLP Secretariat, 2016, p.17).

1.1.3 Laptop computers in public primary schools in Kenya

The introduction of laptop computers in Kenyan schools was seen as an evolution in the field of education. It was a methodological shift in teaching and learning. That is, the hard copy contents contained in books were digitalized in full range of media such as graphics, sounds, still and moving pictures that were necessary to primary school education (Kenya. DLP Secretariat, 2016). For the school teachers, laptop computer which is a form of ICT was proving to be more powerful when compared to the previous technologies such as radio and television and because of its ability to combine a variety of components such as printed text, audio/ video and graphics in single packages that is portable.

The objective of any laptop computer learning program is to provide all students with equal or equitable access to technology by increasing their ability to participate in self-directed learning as they access the software applications needed to learn at a time and location that works best with their schedules (Percival & Percival, 2009, p.5). In line with such an objective, laptop computers could have been the best offer for primary schools in

Kenya because of their capability to reach many dispersed pupils whose schools lacked steady power sources, computer laboratories and classrooms for instruction.

The Government of Kenya in 2013 launched a one laptop computer per child project in class one in all public primary schools in Kenya. The One Laptop Per Child (OLPC) was later named Digital Literacy Programme (DLP) (Kenya. DLP Secretariat, 2016). The project was slated to kick off in January 2014 but did not (Sharples & Moldéus, 2014). However, in May 2016 during the roll-out, the policy shifted from laptops to tablets due to cost implications **(**Wanzala, & Nyamai, 2018). The introduction of laptop computers to primary schools was also in line with the recommendations of Kenyan ICT policy framework that advocated for full integration of ICT in all educational institutions by the use of appropriate digital equipment with the aim of attaining vision 2030 (Kenya. MoE, 2006).

As at February 2015, Kenya had 22,175 public primary schools which were expected to receive and use digital equipment (Republic of Kenya, 2015).To show the government's commitment on laptop computer project, a total of 62,500 teachers were reported to have been trained by August 2015 (Republic of Kenya, 2015).The training program selected 3 teachers from each school to attend 5-day trainings, after which the trained teachers were expected to return to their schools to train their colleagues. Another level of commitment towards the success of school laptop computer program was the rural electrification in which the government committed to have connected 19,000 primary schools as at June 2015. Additionally, storage facilities for the laptop computers in all primary schools in Kenya had been improved at a cost of Kshs. 1.27 Million ($ 14,111USD) (Republic of

Kenya, 2015).The available literature did not disclose teachers' attitude towards the project. It was also silent on the provision of laptop computers for each school for school based training of teachers who did not attend the ICT integration training (Sharples & Moldéus, 2014).Such challenges were noted by the study as a threat to a smooth uptake and integration of ICTs in schools since teacher computer capacity was an essential package of DLP. Prior computer skills of teachers could boost their attitude toward computers and their intent to use them in classrooms for teaching. This is because teacher's positive attitude is believed to be the power that can drive innovation in education to success (Raman, Malik, & Sofian, 2015).

DLP which was managed by Information and Communication Technology Authority (ICTA) of Kenya drew guidelines that gave all the beneficiary schools specifications on the required ICT infrastructure, teacher capacity and digital content development for the DLP project. Teachers' previous computer training and work experience was not a requirement for such training. In support, a number of researches in ICT utilization in education did not show any significant difference between male and female teachers in computer knowledge and practice in education (Raman, Malik, & Sofian, 2015). However, in Africa, differences in computer literacy levels have been noted in some parts of the continent (Tella & Mutula, 2008).

For e-readiness, each public school in Kenya was expected to be connected to electricity either from the national grid or solar; have a storage facility or cabinet which should be metallic or concrete with a burglar proof door; have at least 2 classroom teachers and a head teacher trained in ICT integration; and have classrooms with tables, desks, burglar

proof doors and windows, projection surface and a dust proof floor (Kenya. DLP Secretariat, 2016, pp. 9-10). In addition, each DLP school in Kenya was supposed to be provided with four types of digital devices: Teacher Digital Device (TDD), Learner Digital Device (LDD), digital content server and wireless router (Kenya. DLP Secretariat, 2016, p.20). For smooth uptake and integration of ICT in schools, such guidelines and DLP devices were necessary to help in early preparations ahead of the launch of DLP in all public primary schools in Kenya.

Homa Bay County where this research was carried out was among the 47 counties that were targeted for DLP in Kenya. Its schools are among the 19000 public primary schools reported by the Government of Kenya to have been connected to electricity and had teachers trained on ICT integration. The county also received funds from the national government for the electrical wiring and construction of computer safes (Republic of Kenya, 2015). According to unconfirmed reports from ICT Authority in Homa Bay County, a number of things had been put in place in public primary schools in readiness for the launch of DLP. The statistics obtained from ICT Authority in Homa Bay County indicated that a majority of the schools at least had 3 DLP trained teachers and electricity had been connected to 85.8% of the schools in the county. Some 4% of the public primary schools in Homa Bay County had also been connected to solar power. On the safety of the digital devices in schools, the ICT Authority reported that 93.3% of all public primary schools in Homa Bay County had at least a storage cabinet for the DLP devices. 551 public primary schools had also received DLP devices from the government (Kenya. ICTA, 2016). Media reports also indicated that the timelines for the DLP showed that the Kenya Institute of Curriculum Development (KICD) should have developed the Standard One

content and converted the same into a universal platform by December 2015 (Oduor, 2015).

Interestingly in February 2019, the government announced the change of policy from one child-one laptop to the construction of computer laboratories in each school for ICT integration (Wanzala, 2019). The change in policy did not recall the already distributed DLP devices in schools because the same would be used in computer laboratories. The point of document analysis, therefore, was to establish if the official statistics that were issued by the ICT Authority in Homa Bay and the media reports reflected the reality on the ground and whether DLP was already integrated in teaching and learning in Homa Bay County.

In conclusion, successful e-pedagogy depends on effective e-facilitation, which can be made difficult or possible by various factors, depending on the level of preparedness of implementers (Mulwa & Kyalo, 2013). Creating space and infrastructure in classrooms for computers and peripherals such as printers, network connections, projectors and large monitors initiate a rethinking process by the teacher, leading to re-evaluation of classroom environment that can support optimum learning (Eadie, 2001).

1.2 Statement of the problem

The study examined the readiness of public primary schools for uptake and integration of laptop computers for teaching and learning in Homa Bay County, Kenya. According to ICT Authority in Kenya a model e-ready school was expected to have metered power connection to either the national grid or solar power, secure and well ventilated storage cabinets, adequate charging ports, flat and wide desks that are enough for all the pupils, a

dust proof classroom, lockable doors and windows in a room where the digital devices are stored, and at least 2 teachers and a head teacher trained on DLP in each school. Such an ideal ICT environment is necessary for successful uptake and integration of laptop computers in an institution. In addition, teachers needed to embrace technology in teaching and learning.

In Kenya, as reported under the background of this study, the government was committed to provide class one learners with laptop computers in public primary schools by 2013. Some of the reviewed literature in this research showed that there was an existing National ICT Policy in Kenya from the year 2006 that provided a road map for full integration of ICT in all Kenyan educational institutions. Notably, the development of the digital content and the radio broadcast to schools were in progress at the Kenya Institute of Curriculum Development (KICD). According to the Republic of Kenya (2015), some 62, 500 primary school teachers had been trained for five days and over 19,000 primary schools had also been connected to electricity.The storage facilities for these laptop computers in all public primary schools had also been improved by the Government of Kenya at a cost of Kshs. 1.27 Million ($ 14,111 USD). A number of public primary schools had also received Digital Learning Programme (DLP) devices in readiness for the uptake and integration of laptop computers for teaching and learning.

In response to the ideal and the Kenyan situation as discussed above, there appeared a need to find out whether the preparations that had been put in place met the required readiness threshold on the following grounds: DLP teachers were reported to have been trained for five days. The study was interested to establish whether the five day DLP training was

adequate for teachers whose ICT training backgrounds were unclear since many primary school teachers in active service in Kenya trained before the introduction of ICT policy of 2006 in teacher training colleges. The DLP trained teachers were also expected to train other teachers on laptop computers uptake and integration in their respective schools, a situation which this research was out to either confirm or dispute. Electrification of schools was reported by the Government of Kenya to have been done in most schools. Part of this research was out to establish whether the percentage of power connections in public primary schools reflected the position of the government on the same. Computer rooms and safes had also been renovated by the government but it was not clear to this research whether the computer rooms and safes were available in the schools under study. A number of schools had also received DLP devices but it was unknown for this study whether these schools had started teaching and learning using the devices. The reviewed literature in this research was also silent on teachers' attitude and awareness of the digital content being prepared by KICD. Therefore, there seemed to be a knowledge gap that needed investigation by this research on the readiness for uptake and integration of laptop computers in public primary schools in Homa Bay County.

1.3 Purpose of the study

The purpose of this study was to investigate the readiness of public primary schools for uptake and integration of laptop computers for teaching and learning in Homa Bay County, Kenya.

1.4 Objectives of the study

The specific objectives of this study were to:

1. Investigate the presence of institutional ICT infrastructure in schools for uptake of laptop computers
2. Examine the adequacy of teachers' computer capacity in readiness for integration of laptop computers
3. Determine teachers' awareness of the digital content to be integrated by laptop computers
4. Establish the attitude of teachers towards uptake and integration of laptop computers for teaching and learning
5. To analyze the contribution of independent variables of the study to uptake and integration of laptop computers for teaching and learning

1.5 Research questions

The following research questions guided the study:

1. Are there appropriate institutional ICT infrastructure for uptake of laptop computers in public schools?

2. What capacity do teachers have for using laptop computer for teaching and learning in relation to their training?

3. What is the teachers' level of awareness of the digital content to be delivered to learners by use of laptop computer?

4. What are the teachers' attitudes towards laptop computer uptake and integration in public primary schools?

5. What is the contribution of independent variables of the study to uptake and integration of laptop computers for teaching and learning?

1.6 Significance of the study

The government through the Ministry of Education would use the findings of this study to assess the level of success in the implementation of the ICT policy of 2006 which required full integration of ICTs in all learning institutions in Kenya with the aim of meeting the goals of vision 2030. The findings of this research would aid the government to establish successes, failures and areas that need improvement particularly on the necessary school infrastructures, effectiveness of teacher trainings, teachers' knowledge of digital content and the attitudes of the teachers during and after the uptake and integration of the DLP. Such information would be necessary for future planning, budgeting and action.

Kenya Institute of Curriculum Development (KICD) which was responsible for content development for Kenyan schools could utilize the findings of this research to assist in the reorganisation of the digital content to make it simpler and easy to use by all categories of teachers. Furthermore, KICD could use the research findings to identify particular areas of the digital content skills that are not well mastered by teachers and offer tailored training. The delivery of digital content to schools as reflected in this study could suggest to the KICD to either change content deployment model or improve the existing deployment model to serve all regions of Kenya.

Teachers would benefit greatly since teacher preparation such as schemes of work, lesson plans and progress records would be prepared and updated within the shortest time with the assistance of the right technology. Knowledge gained from DLP training and practice using computers in schools could be useful to teachers outside the school time since they might actively utilize the knowledge in the social spectrum to participate in 2.0 web

technologies such as Facebook, email and e-trade. This would minimise technophobia in the teaching fraternity.

1.7 Scope of the study

The study was conducted in public primary schools in Homa Bay County in Kenya. As shown in Appendix 9 of this study, Homa Bay County is made up of six sub-counties namely: Homa Bay, Rachuonyo North, Rachuonyo South, Mbita, Suba and Ndhiwa. Each sub-county had its number of schools, head teachers and teachers in different proportions. Within each sub-county were Curriculum Support Officers (CSOs) who were in charge of a number of schools, head teachers and teachers. CSOs were employees and agents of the Teachers Service Commission (TSC) of Kenya which was also the teachers' and head teachers' employer. The study particularly was assessing the readiness of schools in Homa Bay County for the uptake and integration of laptop computers owing to the fact that preparations for Digital Literacy Programme (DLP) were on-going in public primary schools in Kenya. Homa Bay County was a beneficiary of such a programme. Only teachers, head teachers, CSOs and schools participated in this study. The researcher selected Homa Bay County for the study because it was one of the 47 counties in Kenya that was set to benefit from DLP. The county was unique because some of its sub-counties such as Mbita and Suba were hardship zones.

1.8 Limitations of the study

Homa Bay County had a total of 845 schools of which 85 sample schools were studied. The study considered the sample representative. However, at the time of this research, the government was on-going with the distribution of DLP devices and connection of electricity to more schools that had not received electricity in the county. There was no

well documented pattern for the study to rely on. The study could not, therefore, exactly assess the levels of improvement in ICT readiness in specific sub-counties of Homa Bay that received DLP devices and were connected to electricity after data collection.

It was also noted that this study was not extended to private schools. Private school pupils in Kenya followed the same syllabus and sat the same examinations with their counterparts in public primary schools. Without the inputs of the private schools in this research, the findings could not be generalized to private schools in the county.

Attitude is a construct that is ever changing. Teachers' attitude towards DLP could change due to the fact that the period of study after data collection took some time span for data analysis and reporting. In support, Alfashari, Bakar, Luan, Samah and Fooi (2009) added that attitude of the people towards technology uptake might be unpredictable especially in developing countries where most people did not grow up with technology.

1.9 Delimitation of the study

The study was carried out in public primary schools in Homa Bay County because initially the government was only interested in the roll out of DLP in public primary schools. The researcher had control over the number of research instruments to use and the response rate. The researcher decided on questionnaires, observation checklists and interview schedules to be used as research instruments for the study.

The researcher dictated the response rate by ensuring that there was a follow up of questionnaires that were in the field. The sample respondents were only drawn from the following sub-counties of Homa Bay County: Homa Bay, Rachuonyo North, Rachuonyo South, Suba, Mbita and Ndhiwa sub-counties of Homa Bay County. The researcher also

identified variables of the study and analyzed data based on the suitability and appropriateness of the data analysis tools to the research variables.

1.10 Basic Assumptions

The research was undertaken on the following assumptions:

i. The Government of Kenya was committed to fund and sustain the DLP in public primary schools.

ii. The respondents honestly would give accurate and valid responses.

iii. Public primary schools had a policy framework to guide the integration of ICT in public primary schools.

iv. DLP trained teachers trained others and would possess knowledge and skills gained after training.

v. The government had developed appropriate DLP infrastructure for schools in Homa Bay County.

1.11 Organization of the study

The study is organized into five chapters. Chapter one consists of the background to the study, statement of the problem, purpose of the study, objectives of the study, research questions, research hypothesis, significance of the study, limitations of study, delimitations of the study, basic assumptions, organization of the study, theoretical framework, conceptual framework and definitions of significant terms as used in the study. Chapter two covers literature review organised into concepts of readiness, uptake and integration, institutional ICT infrastructures, teacher computer capacity, teachers' awareness of the digital content, teachers' attitude and contributions of independent variables (institutional ICT infrastructures, teachers' computer capacity, teachers' awareness of the digital content

and teachers' attitudes) to uptake and integration of laptop computer model. Chapter three discusses the research design and methodology which includes: research design, target population, sample and sampling procedure, instrument validity, instrument reliability, data collection procedures, and data analysis techniques. Chapter four displays data analysis process and tools, description and discussions of findings. Chapter five presents summary of the findings, conclusions, recommendations and recommendations for further research.

1.12 Theoretical framework

Readiness for uptake and integration of laptop computers in public primary schools was premised on systems theory. The school as a system is regularly bombarded with suggestions for reforms whereby changes in management and learning in institutions are more particularly rapid in terms of technological adoption and changes (Wilson & Peterson, 2006). According to Exter, Hur, Koh and Wong (2004), an educational systems theory is described by the relationships among its components (teachers, attitudes, content, and contexts) and the relationship this system has with its environment. When changes are made in an educational system, one or more of these relationships may be affected. The changes in an educational system may be an addition or removal or replacement of an entire or part of a subsystem. In this research, it was noted that normal teaching and learning in classroom using hard copy text book technology was rapidly being replaced by digital content that required laptop computers to be used for teaching and learning. This automatically called for an adjustment in the entire school subsystems. The school being considered as a complete system, therefore, needed to incorporate DLP as a subsystem

within the system of a school. Any malfunction to the technology as a subsystem of a school is a set back to the overall system of a school.

In this study, the introduction of DLP in a school system was expected to alter the ways of teaching and learning, administration and delivery of content and hence, the entire school environment. Content delivery which this study considered as a subsystem of a school was quickly changing from hard copy textbooks to digital content. Computer illiterate teachers and the technophobes that were used to the traditional techniques of teaching and learning were being forced to train and use computers in classrooms. The school environment was expected to reduce spaces for book stores and instead come up with strong rooms (safes) for keeping the laptop computers and other ICT infrastructures. Going by Rogers's diffusion of innovations theory, the school system needed to be adequately prepared to cope with technological compatibility, complexity, trialability and observability among the teachers, students, environment and administrators (Kee, Omar & Mohamed, 2012).

1.13 Conceptual framework

Conceptual framework shows the organization and the arrangement of variables that were used in the study. In this particular study, the independent variables were readiness in the following areas: institutional ICT infrastructures, teachers' computer capacity, teachers' awareness of the digital content and the attitudes of the teachers. The dependent variable was uptake and integration of laptop computers. In between was the ICT policy as a moderating variable.

ICT institutional infrastructures are those necessary facilities that were required to provide conducive environment and support for the launch of laptop computer program in schools.

ICT infrastructure variables studied included the availability/absence of the following facilities in public primary schools: computer store/safe, computer room chairs, carpeted floor, internet, power sockets, chargers for computers, electric power, power generator, solar power, Uninterrupted Power Supply (UPS), computer laboratory attendant and computer room policy document. Without institutional ICT infrastructures, the digital learning project could stall since a number of devices needed to be kept safe and supplied with electricity.

On the other hand, teachers needed to embrace technology in schools hence the need to assess teachers' attitudes. The feelings of the teachers towards the laptop computer project needed to be known particularly on how they perceive laptop computers in terms of its usefulness and ease of use in teaching and learning. Positive attitude for the teachers meant that the teachers welcome the launch and integration of technology for teaching and learning. Negative attitude, on the other hand meant that teachers were either being forced or did not see any contribution of laptop computers to teaching and learning. In such a scenario any attempt by the government to launch and integrate laptop computers was destined to fail.

But even if teachers' attitude were positive, manipulation of digital equipment needed computer skills. To enhance integration of laptop computers in schools, teachers' computer training was inevitable. Teachers' computer capacity involved the establishment of teachers' computer skills that the study believed were necessary for integration of laptop computer. The skills were centered on the expected computer competencies that were necessary for learning content creation and delivery to learners. Teachers could also use

the gained computer skills to configure pupils' tablets, retrieve the already installed contents from KICD and relay the same content to learners through their tablets and projectors. The teachers' computer skills were tested in the following areas: rotation of images, creation of Microsoft Word documents, creation of Microsoft Excel documents, drawing and labeling diagrams, use of power point to present lessons, saving content in external disks, animation, use of browser to navigate World Wide Web (WWW), sending and receiving e-mails and printing documents.

The training on computer skills was necessary for the manipulation of the digital content. Teachers needed to be exposed to the digital content is a soft copy content which the KICD converted from the hard copy materials that were used for teaching and learning in schools. In primary schools in Kenya, teaching and learning contents were mostly organized in hard copy textbooks. Teachers were using textbooks to teach and learners equally were also using textbooks to learn. Under the DLP, teachers were expected to use laptop computers to teach as learners were confined to tablets to learn. It, therefore, called for the teachers' awareness of the digital contents and formats. Such awareness was necessary for speedy training of teachers on digital content and delivery of digital content to learners.

The independent variables of the study could lead to the launch and integration of digital learning in schools in such a way that teachers are actively engaged in teaching and learning using laptop computers or any other digital technology but an ICT policy framework in a school was necessary for regulating every component of the DLP. In this study, DLP would need ICT policy for ICT infrastructures, DLP devices, teacher training and the digital content. ICT policy has been used in this study as a moderating variable.

The moderation of independent variables for the study was necessary because in a case where the ICT policy was strictly followed, the level of uptake and integration could be boosted since some order could be followed in storing the DLP devices, assigning responsibilities to teachers in charge of DLP, strict adherence to safety measures when using DLP devices, maintenance of DLP devices and the condition of the DLP classrooms. McGrath (2006) added that policy raises a number of questions that needed to be answered in an organization: Who will coordinate these programs? Who will monitor or enforce participation? Who will train the teachers? Who will repair the DLP devices? The absence of such ICT policy could create disorder and ultimately shorten the life span for uptake and integration of laptop computers (e-Learning Foundation, 2013)

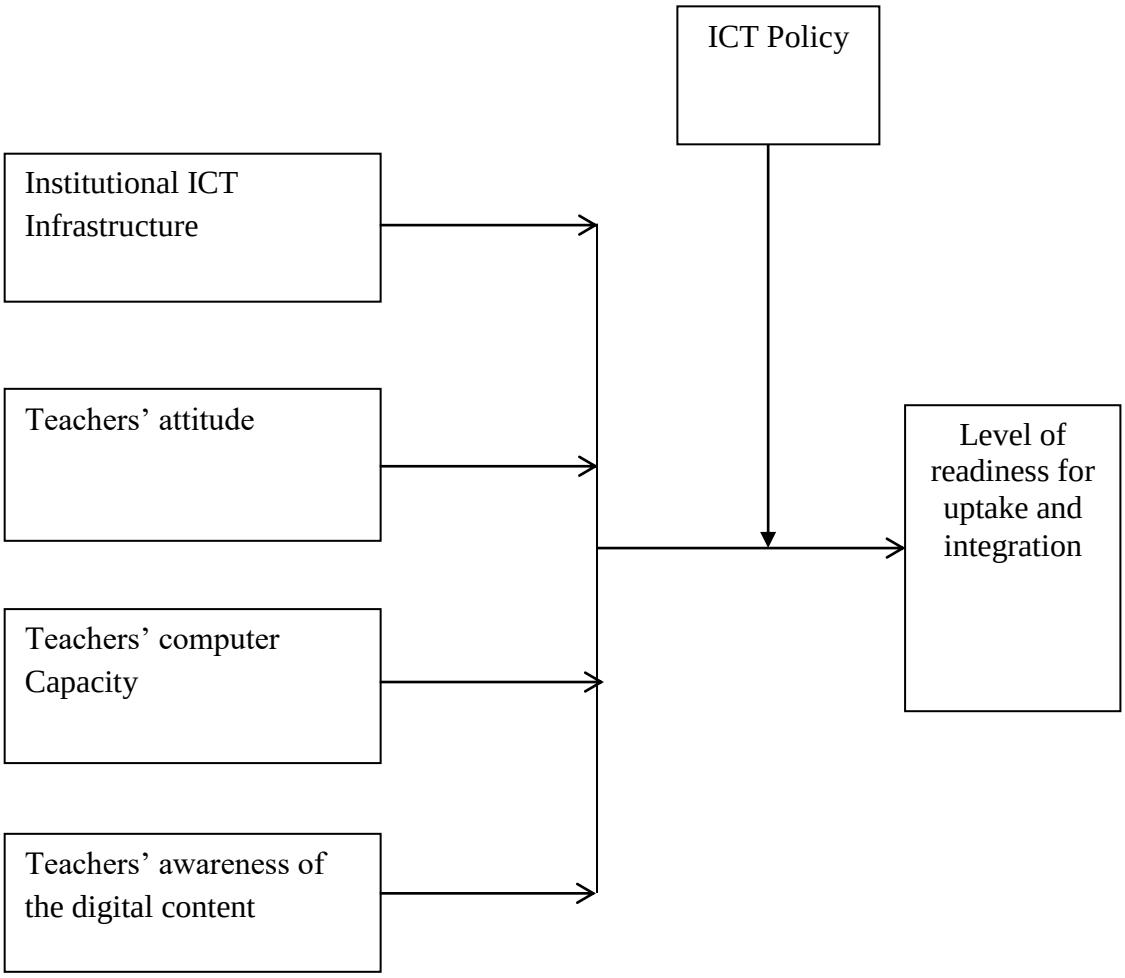

***Figure 1.1*: Conceptual framework**

1.14 Definition of significant terms

This section presented the definition of various the operational terms as used in the study. The operational terms were presented in alphabetical order.

Awareness of the digital content: This is knowledge of what constitutes a soft copy content that is used in teaching and learning using digital devices.

Digital Content: This is the body of knowledge prepared or stored in electronic format for use by use of an electronic device such as a laptop computer. In this study, it means the same thing as e-content.

Device: Any electronic gadget that can be used to support teaching and learning.

DLP devices: These are full package gadgets as prescribed by the Government of Kenya to be sent to each school for integration of ICT in such schools. These were Teacher Digital Device (laptop computers), Learner Digital Device (tablets), digital content server, projector and wireless routers.

ICT infrastructure: These are necessary facilities that are needed in place to support the use and utilization of ICT in a school for teaching and learning.

ICT readiness models: These are well laid ICT strategies or structures for successful DLP roll out. The model works like a system that must be in place for operations of the entire technological setup of an institution.

Integration: This is the incorporation of technology in the process of teaching and learning

E-Learning: Is teaching and learning that is supported by the use of an electronic device such as laptop computers**.** E-learning in this study involves acquisition and relaying digital content to pupils in schools by use of laptop computers. In this research e-learning is a component of ICT and has been used interchangeably to mean the same thing as ICT especially in relation to the use of computers and its peripherals for teaching and learning.

Uptake: Means kick off of DLP in a school. This included distribution and launching of electric power and other DLP components such as devices. In this study, uptake and adoption have been used interchangeably to mean the same thing.

Laptop computer integration: This is the incorporation of laptop computers in the curriculum by teachers and pupils in primary schools for teaching and learning purposes. The uptake changes to be integration the moment the aspects of technology is introduced into the teaching and learning process.

Perception: This is a mental image of an individual interpreted in the light of experience or encounter with something. In this research it is the teacher's mental interpretation on what laptop computers can do and how laptop computers can assist in teaching and learning in primary schools. Perception as used in this study leads to formation of an attitude.

Perceived ease of use of laptop computers: Is the degree to which a school teacher believes that using laptop computers would require free or very little effort in teaching and learning.

Perceived usefulness of laptop computers: Is the degree to which a school teacher believes that the merits of using technology outweigh its demerits in teaching and learning

Perceived e-content: This is the degree to which a person believes that digital content provided by KICD for standard one pupil in a laptop computer is as good as a textbook content and may be used by teachers and pupils for effective teaching and learning in schools

Perceived ICT policy: The degree to which a person believes that in any learning institution, there should be documented rules and regulations guiding the use of digital devices.

Readiness: In this study, it is the degree to which public primary schools are prepared for adoption of laptop computers for teaching and learning in Kenya.

Teacher attitude: In this study, attitudes are the teachers' feelings about application of ICT in teaching and learning. In this study attitudes are generated from perceptions.

Teacher computer capacity: Refer to teachers' abilities to perform specific computer skills or actions. Teacher' capacity has been used interchangeably to mean the same thing as teachers' technical competence or teachers' computer skills.

Technophobes: These are people who fear using or handling technologies. In this research, technophobes refer to primary school teachers in public primary schools who were manipulating DLP devices for the first time and feared breaking the equipment or disorganizing the KICD content in laptop computers.

Technophobia: This is the fear of handling new technologies by people.

Web 2.0: Refers to internet technologies such as emails, WhatsApp, twitter and Facebook.

1.15 Summary of the chapter

The chapter introduced the study by giving a detailed background of laptop computer program in some parts of the world and Kenya. The background of the study revealed the need for this study to bridge the digital gap in public primary schools in Kenya. The study noted the importance and impact attached to the use of web 2.0 technologies in teaching and learning. Research gaps in terms of less institutional ICT infrastructures, inadequate teacher computer training and unpredictable teacher attitude were witnessed in different parts of the world. The study was considered important in establishing successes and failures of (DLP). System theory was found suitable to guide the study. The conceptual framework and definition of operational terms ended the chapter.

The following chapter is the review of the related literature particularly on areas of institutional ICT infrastructure, teachers' computer capacity, teachers' awareness of the digital content and contributions of independent variables of the study (institutional ICT infrastructures, teachers' computer capacity, teachers' awareness of the digital content and teachers' attitudes) to the uptake and integration of laptop computer model. The concept of readiness, uptake and integration are also discussed.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

The objective of the literature review is to establish the theoretical and contextual foundation upon which this research was built. This chapter is organized into sub topical areas: concept of readiness, uptake and integration, institutional ICT infrastructures, teachers' computer capacity, teachers' awareness of the digital content, teachers' attitudes and contributions of independent variables of the study to the uptake and integration of laptop computer model. The chapter examines the theories and studies carried out in the areas above.

2.2 Concept of readiness, uptake and integration

The key concepts that formed independent and dependent variables of study were readiness, uptake and integration. Theoretical analysis of these variables was necessary in understandings the context in which they have been applied in this study.

2.2.1 Readiness for uptake and integration of laptop computers

Readiness definitions are varied and generally representative of their authors and the intended purpose of definition. According to Texas Early Learning Council (2011), readiness in a school set up should identify the foundational skills, facilities, content knowledge, and concepts that children may need especially when they are enrolled in an educational institution. In this context readiness distinguishes, reorganizes and confirms many necessary components in a unit such as facilities in an educational institution with the main aim of creating coherence in delivery of services to an institution. In support,

UNESCO Institute for Statistics (2015) defined readiness as a measure of the degree to which a country is prepared to partake in activities that are necessary for setting a stronger foundation for the benefit of the major actors in education. These actors in the education could be stakeholders such as the government, pupils, teachers and parents.

When referring to ICT readiness in an institution of learning, Kashorda and Waema (2014) described the concept of readiness as a measure of the preparedness of an institution to use ICT to enhance the quality of teaching and learning. Institutional readiness, therefore, required both teachers and students to have essential ICT skills in literacy and numeracy because the entry level for ICT integration is considered a foundation for success in all learning areas involving ICT uptake (Meiers, Knight & White, 2009). Gakuu (2007) referred to ICT readiness as teachers' attitudes towards ICT uptake.

However, a close look at the work of Dada (2006) as cited by UNESCO Institute for Statistics, (2012), e-readiness was also regarded as an assessment program intended to find out how institutions were prepared to approach the development of an e-learning program in an institution. In Kenya where this study was conducted, the government spent a lot of resources towards the uptake and integration of laptop computers in schools whose level of ICT preparedness were unclear, hence the need for this study.

For purposes of this research, DLP readiness constitutes preparations put in place ahead of the DLP launch (uptake) in schools to ensure DLP implementation at the school level was successful. The readiness areas that were proposed by the government were: sources of power, secure storage cabinets for DLP devices, teacher capacity and DLP classrooms (Kenya. DLP Secretariat, 2016, pp. 9-10).

The need for such prior preparation before the launch of DLP was necessary because the Kenyan situation could not be different to some parts of the world whereby barriers to ICT usage in educational institutions such as lack of effective policies, basic infrastructure (electricity, internet, computers and mobile devices), financing and teacher training were still eminent (Doshmanziari & Mostafavi, 2017).

2.2.2 Uptake of laptop computers

ICT uptake was used in this research to mean the spread and launch of DLP in public primary schools in Homa Bay County. Information and Communication Technologies (ICTs) and their necessary infrastructures are increasingly being launched for utilization in many organizations both internationally and locally (Nsibirano, 2009). In Australia, strong growth in ICT investment continued in the 1990s which resulted into 3% of the total market sector investment. It was noted that service industries (education inclusive) featured prominently in the uptake of computers whereby the finance and insurance sectors took over 25% share of the investment. The rapid growth of ICTs was linked to falling prices of equipment and internet, positive relationships between firm sizes and skills (Gretton, Gali, & Parham, 2002).

DLP uptake involved the distribution and usage of electricity, reception of computers in schools, installation of power sockets in schools, building of DLP classrooms and teachers' willingness to embrace technology in school (Kenya. DLP Secretariat, 2016). These facilities for DLP could also be used in schools for a number of ways besides actual teaching and learning. Electricity could provide light for the school and the community surrounding the school (Mulwa, et al., 2012). The power (electricity) uptake could take effect immediately power is commissioned by Kenya Power and Lighting Company.

Pupils could also start to use DLP classrooms, chairs and desks for learning using hard copy textbooks even before the launch of DLP in a school.

In a learning environment, uptake could involve assigning or exposing digital devices to pupils and teachers. The DLP devices could be used for other purposes such as playing online games, calculator and surfing which may not be part of teaching and learning in a school. However, when these devices are adopted for teaching and learning, integration comes in (Lyord, 2005). In this research ICT adoption, take up, growth and uptake were interchangeably used to mean the same thing.

2.2.3 Integration of laptop computers

In this study, integration means actual usage of technology such as a laptop computer to teach and learn. According to Lloyd (2005), the issue of concern is the identification of what actually constitutes integration in a learning institution. Baskin and Williams (2006) in their view highlighted different aspects of integration in a school set up (p.457):

i. Curriculum integration - how ICTs relate to school based curriculum goals and content.
ii. Spatial integration - how ICTs are embedded in classroom learning activities.
iii. Temporal integration - how ICT activity connects to established learning activities.
iv. Pedagogical integration - how ICT choices constructively align with teaching approaches.
v. Attitudinal integration - the extent to which ICTs are considered problematic by teachers and students.

But as observed by Massy and Zemsky (1995), as cited by Mulwa, Kyalo, Bowa, and Mboroki, (2012, p. 32), there are three levels of technology integration in school. The first level is the use of computers or technology for personal productivity, which involves

applications that permitted teachers and learners to perform familiar tasks faster and more effectively. At this point, technology does not alter the flow and presentation of the content. Computer literacy is necessary at this stage to assist teachers in leveraging productivity in their work place.

The second level of technology integration is the enrichment or add-ins which involves injecting into the "old" teaching and learning without changing the basic mode of instruction, that is, the use of e-mail in teaching and learning, website searches, use of videos, multi-media, simulation to enhance classroom presentation and homework assignment. Technology is adopted at this stage to enrich content. The third level is the paradigm shift which involves how the ministry of education and schools are ready to embrace teaching and learning activities using technology.

The aforementioned stages of technology integration could be important for DLP in Kenya. In the first scenario, teachers and learners just needed to uplift their technology literacy levels by engaging in ICT activities that do not necessarily support teaching and learning directly in a classroom set up but useful in preparedness for the launch of laptop computers especially in Kenyan schools (European Commission, 2001, p.27). The second level was expected to be covered by the training of DLP teachers whereby teachers were expected to source for additional content to enrich the already available content. On the other hand, the government has been struggling to integrate technology at the third level as identified by Mulwa, et al. (2012) where schools were expected to fully migrate to the digital platform. However, one of the challenges that could face integration of DLP devices in public primary school was that the Government of Kenya did not set and follow integration levels as expected in any learning set up but instead assumed that the 5 day ICT

training was adequate for ICT integration in public primary schools in Kenya (Republic of Kenya, 2015). ICT integration, if well executed, could determine the extent to which ICT could reach its full implementation in any institution of learning (Eke, 2011).

2.3 Institutional ICT infrastructures for laptop computers

ICT infrastructures as used in this research constitutes of a number of facilities that were required by public primary schools in Kenya for the uptake of laptop computer. These were: computer safes for storing of DLP devices, computer desks, sources of power, power sockets for charging laptop computers and tablets, laptop computer technical assistants, carpeted floors, internet, computer lab assistants, Uninterrupted Power Supply (UPS) for power backups and computer room policy document for guiding operations of DLP in a school.

Access to satisfactory ICT infrastructure is one of the most important factors that contribute to effective use of information technologies for teaching and learning in schools (European Commission, 2011, p.10). The absence of such infrastructures could impact negatively in the delivery of teaching and learning (UNESCO Institute for Statistics, 2014), however, the existence of up-to-date ICT resources, facilities and support in schools could be seen as a primary condition for the introduction of innovative teaching methods and use of interactive software and online materials (Mingaine, 2013). In support, Salehi and Salehi (2012) also cited insufficient technical supports at schools and little access to ICT as major barriers to ICT usage in the classroom.

2.3.1 Institutional ICT infrastructures in Africa and other parts of the world

The development of the ICT infrastructures in a developing country was observed to be dependent on the availability of a reliable source of power (Khan, Hasan & Clement, 2012). In this respect, ICT integration in education which is said to be considerably more recent, small-scaled and experimental can greatly be compromised without proper infrastructure in place (Kenya. MoE, 2006). As contained in many world conventions such as Millennium Summit of the year 2000 in New York, Jomtieng Conference of 1990, among others, the right to education is the right of every citizen (UNESCO, 2009). According to these world conventions for example, the Millennium Summit of the year 2000, the world needed to aim at attaining Universal Primary Education (UPE) by 2015 (Kenya. Ministry of Education, 2005). However, ICT was believed to have the capacity to meet these world goals of Education for All (EFA) because ICT was assumed to have a positive impact on learning with benefits that embrace pupils' learning and personal development at any time anywhere (European Commission, 2011).

The use of ICTs in education, therefore, became an essential element of the educational environment. But when accompanied by technological tools and infrastructure, it would ultimately become an increasingly ever-present reality in society thereby expanding the base to accommodate students, teachers and educational institutions in a manner that would result in optimization of the teaching-learning process (Hernandez, 2017).

According to Mulwa, et al. (2012), 'ICT infrastructure included connectivity to various networks (internet, intranet and mobile-telephone); sources and reliability of energy (UPS, electricity, standby generators); equipment (computers, radios, videos, television, LCD

projectors and software, e-learning laboratories furniture, stores and information storage facilities such as flash disks, CD-ROMs, DVDs)' (p.24.). However, it was acknowledged that some of these modern technologies evolved from early technologies such as calculators, TV sets, and voice recorders, among others which indicated the fast evolution of technologies in the world (Hernandez, 2017).

The invention of the internet, World Wide Web (WWW), has only been in existence since 1991 and so far, it has caused the biggest change in education and learning since the advent of the printed book which is a little over 500 years ago (Draves, 2000). The internet infrastructure has had a lot of impact on educational environments such as: schools, homes, offices, libraries and complemented in a greater proportion the teaching and learning in classrooms (Clark, 2001).

In recognition of the important role technology is playing in the field of education, Chickering and Ehrmann (1996, pp. 3-6) suggested seven principles that could improve technological infrastructure and access in educational programs. They observed that learning institutions have the ability to integrate emerging technologies for either synchronous or asynchronous modes by applying the seven principles regardless of delivery, technology infrastructure and access: encourage contact between students and faculty, develop reciprocity and cooperation among students, use active learning techniques, give prompt feedback, emphasize time on task, communicate high expectations and respect diverse talents and ways of learning.

In support of the seven principles, McGrath (2006) noted that the goal of any proposed ICT infrastructure should assist the trainers to become all round teachers. That is to say,

teachers should be in a position to use the right ICT resources to integrate technology in teaching and learning. DLP resources and training should be tailored to the seven principles stated above with the aim of making the integration process meaningful and productive to the school, teachers and learners in public primary schools in Kenya.

The findings of the research by the National Centre for Education and Statistics (1998) noted that discrimination was a major setback in uptake and integration in the United States of America whereby the provision of ICT infrastructures in the late 1990's had 84% of wealthier suburban schools enjoying the internet access while only 63% of schools with high percentage of poor students were connected. The Kenyan public primary schools were operating the same way as schools in the United States of America since many urban schools in Kenya were reported to be enjoying more ICT infrastructures than rural schools despite the fact that all schools in Kenya were following a similar curriculum for teaching and learning (Kenya. Ministry of Education, 2005, p.4).

In Africa, One Laptop Per Child (OLPC) project was launched in Ghana in 2005 by a non-profit organization that was seeking to provide laptop computers to children in poorer and more remote areas of the world (Hennessy, et al., 2010). The vision of this OLPC was to allow children who had no access to quality educational opportunities to use the laptop computers to access knowledge and provide them the opportunity to manage their own learning needs regardless of their physical location or financial limitations. However, it was met with a lot of criticisms. The Ghanaians argued that it was not logical for poor nations to over spend on laptop computers at the expense of text books, libraries, teachers and other educational resources used in schools (Buchele & Owusu-Aning, 2007).

A survey that was carried out by Eke in 2009 at the e-learning unit at University of Nigeria (Nsukka) also established that Africa was still behind in technology uptake because of poor access, networking and infrastructure. In the research, when respondents were asked about availability of computers in their places of work, 96 respondents which constituted 30% of the population indicated that there was more than one computer laboratory in their place of work, and as many as 30 (9%) people claimed that there was one laptop computer available per student or worker. At the other extreme, only 20 (6%) of respondents said that there were no laptop computers available where they worked, and only 14 (4%) commented that there was only one computer per class available (Eke, 2011). But other studies indicated that this situation in Nigeria could be improved by governments investing heavily in technology as was noted in Australia (Gretton, Gali, & Parham, 2002).

In Ethiopia, the government under the University Net Programme, improved the ICT infrastructures in universities and networked them to e-learning centres. In addition, schools under the School Net Programme also were networked via satellite (Reif, 2005). A similar case was witnessed in Namibia where ICT became a tool for teaching and learning in many learning institutions in both rural and urban areas (Cowan, 2005).

In 2003, a national ICT policy framework was put in place in Uganda (Hennessy, et al., 2010). The Ugandan ICT policy under strategy number two recognized the need for literacy improvement and human resource capacity building. To achieve this, Uganda rolled out ICT integration programs at all levels of education (Hennessy, et al., 2010). At primary school level, the policy aimed at encouraging schools that had acquired the technology to use them to support teaching, either by producing teaching materials or use

them with students in the actual dissemination of content in class. To set a good foundation for the upcoming teachers, the Ugandan ICT policy was also extended to teacher-training colleges to enable newly qualified teachers to get equipped to make use of computers as it became available. It was, however, noted that ICT policy needed full implementation since many teachers and students in Uganda still lacked computers and internet. The situation was said to be even worse in the rural areas, where the majority of Ugandans (about 80 per cent) lived without electricity and connectivity to the global information network. These communities were unable to reap the numerous benefits of ICT (Hennessy et al., 2010).

2.3.2 Institutional ICT infrastructure in Kenya

The One-Laptop-Per-Child (OLPC) project under the Jubilee's Digital Learning Programme in Kenya was meant, ostensibly, to entrench Information, Communication and Technology (ICT) in the teaching and learning process in primary schools **(**Wanzala & Nyamai, 2018**).** This followed the development and enactment of ICT policy framework of the year 2006 that spelt out the measures that institutions in Kenya should put in place to improve the general ICT infrastructures. In the policy document, the general access to computers was to improve from 150 students against one computer to an average of 15 students to one computer. The general infrastructure was also proposed in the ICT policy to improve by 80% in secondary schools and at least 10% in primary schools (Kenya. MoE, 2006). The Kenyan situation seemed to have improved greatly with the introduction of OLPC in public primary schools whereby over 19,000 public primary schools were said to have been connected to electricity and a number of computer stores were also built for all public primary schools (Kubania, 2014).

In a research conducted by IPSOS Synovate in Kenya (Kajilwa, 2017) in which a total of 2,507 people were surveyed in the whole country, it was found that despite the spirited input by the government to launch DLP in public primary schools, Kenyans felt that they needed more teachers to be employed instead of laptop computers. The research established that the government's effort to connect primary schools to electricity and distribute e-learning tablets did not impress Kenyans. According to the survey, when Kenyans were asked what they thought would 'most help' improve learning conditions in primary schools, only one per cent said tablets, one percent cited provision of bursaries to needy students while some other two percent connection of schools to electric power source. Ironically, 43 per cent, which was the majority of the respondents, mentioned more or better teachers as the only cure to the country's education sector. The Synovate research showed that Kenyans still valued the input of teachers even if laptop computers were introduced.

In addition, lack of proper infrastructure for DLP in Kenya, including storage rooms was also cited as a major challenge in schools. Laptop computers were reported to have been stolen prompting schools to take these gadgets to either the chiefs' camps or police stations for safe keeping (Standard Team, 2019). Such shortages and risks in schools had not been fully solved even after the government intervened in 2005 by establishing the Kenya Education Sector Support Programme (KESSP) to outline and implement strategies that would guide infrastructure development in public primary schools (Kenya. Ministry of Education, 2005, p.1). Research data revealed that from 2003, there was still a shortfall of 43,000 classrooms countrywide, and of the ones that were there, 32 per cent were found to be below standard. It was learnt that after eight years of the launch of KESSP, the reality

on the ground indicated that the infrastructures in public schools such as desks, classrooms and electricity were in short supply or non-existent in most learning institutions since some public primary schools still had classrooms that could not accommodate laptop computers simply because they were wall-less (Kubania, 2014). Furthermore, many classrooms in primary schools in Kenya lacked key facilities such as desks and were in pathetic conditions (Sharples & Moldéus, 2014, p. 43).

Several researches in this study were in agreement that a smooth uptake of ICT in a learning institution needed supportive infrastructures. However, the implementers of the DLP in Kenya should be prepared for a trial and error experience based on the fact that integration of ICT in developing countries in Africa are constantly met with barriers in learning institutions which are awfully neglected and unfit for ICT integration (Shimasaki, 2015). In concurrence, Omanga (2018) argued that many public primary schools in Kenya still remained congested with learners, horrendous facilities and untrained teachers, and as such the introduction of tablets to schools was somehow insulting and needed a lot of improvement.

2.4 Teachers' computer capacity

The philosophy behind projects such as One Laptop Per Child (OLPC) was to make computers available to children both at home and school so that the digital divide could be bridged (Meenakshi, 2013). However, learning should be directed whether it is face to face or online. Well trained teachers who are equipped with ICT skills should be tasked with the responsibility of helping students develop ICT skills in the classroom (European Commission, 2011). This is because teachers' roles had been seen to change as agents mandated with the responsibility of bridging the digital gap in schools to facilitators of

learning. Successful integration of ICT into the Kenyan education, therefore, depended to a large extent on the teacher computer skills and ability to handle online tools (Hernandez, 2017).

2.4.1 Teachers' computer capacity in Africa and other parts of the world

In Africa, the introduction of computers in primary and secondary schools is a recent phenomenon that needed capacity building (Mndzebele, 2013). For teachers in schools to cope with the growing trends in education, adequate training in ICT was inevitable. This called for policies that promoted broad access to skills and competencies, and especially ICT literacy among teachers. In support, Khan, Hasan, and Clement (2012), noted that within a few years, Information and Communication Technology (ICT) had turned out to be an effective educational technology which promotes dramatic changes in teaching and learning processes. The teachers' training and role in technology rich classrooms was more demanding than ever.

Mndzebele (2013) also adds that technology integration requires that teachers understand the technological tools themselves and know which tools would make learning easier for the students. Teachers, therefore, needed to have the basic technology skills and know-how on how to use technology for hardware and software for teaching. Otherwise, teachers were likely to meet problems in using the technology effectively in the classroom as was noted by the studies of Okello-Obura and Ssekitto (2015).

Tilya (2007) reiterated the need for prior ICT training for teachers before integration of ICT in schools. He argued that ICT literacy provides equal access to information and reduces information gap. Skills such as keyboard use, searching for information,

evaluation skills, word-processing, and presentation skills are vital in helping schools to integrate ICT in its operational procedures and even in specific subject areas. Greece, for example, offered both initial and in-service training for primary school teachers at three levels. The first level was training in basic computer skills. The second level involved incorporation of computer and ICT tools into the educational process, and lastly, trainees were familiarized with educational software (European Commission, 2001, p.27). Each level in one way or the other was aimed at enhancing the other. The study observed that the last level should be extended to include practical use of ICTs in Kenyan schools and not only familiarizing learners with educational software.

Tilya (2007) observed that teachers from different schools who had gone through the training process and had hands-on ICT experience helped their schools to understand the contribution of ICT to learning and could use different learning approaches. Training facilitators of DLP and providing them with the appropriate knowledge and skills could facilitate the integration of laptop computers in Kenyan schools.

In Kenya, the Ministry of Education facilitated the use of ICT as a tool for education in all institutions of learning in Kenya by giving a road map on the integration process (Kenya. MoE, 2006, p.9). However, the Kenyan DLP training was a single package computer training that lasted for 5 days and covered all the three levels of teacher training as opposed to what happened in Greece.

To motivate teachers and make training more meaningful, Sweden in its initiative to train 700,000 teachers both in primary and secondary schools offered all the teachers free computers to practice with when the training was over. The same was also witnessed in the

United Kingdom where a number of schemes were introduced to offer teachers subsidized or free computers for practice after the training (European Commission, 2001, p.27). The practice was slightly different in Kenya because their DLP trained teachers were not offered computers for further practice after the training (Sharples & Moldéus, 2014).

In South Africa, the Department of Education acknowledged that many teachers grew up in an environment that had less or no electronic technology available and thus found working with computers more difficult compared to the ICT literacy levels of their learners (South Africa. DoE, 2003, p.30). To remedy this, the department through the Standards for Professional Competency in ICT utilization proposed that computer capacity building process for active teachers should consider the following levels:

i. Entry – computer literate teachers who are able to use computers and teach learners to use computers.
ii. Adoption – Teachers who are able to use various technologies, including the computer, to support traditional management, administration, teaching and learning.
iii. Adaptation – Teachers who can use computers to enrich the curriculum and utilize integrated systems for management and administration.
iv. Appropriation – Teachers who can integrate computers into teaching and learning activities, and use integrated systems for management and administration within a community context.
v. Innovation – Teachers who are well prepared to develop entirely new learning environments that use computers as a flexible tool in such a way that learning becomes collaborative and interactive. Technology is integrated as a flexible tool for the whole development of the school.

On contrary, DLP in Kenya had no entry level for training. The requirement for that training was that some two teachers and a head teacher had to be sponsored by a school to participate in a 5 day teacher training (Republic of Kenya, 2015). But when compared to the South Africa's model, DLP training model assumed that all teachers who attended the training had same level of computer skills and did not cater for individual competencies.

In a study done through census drawn on 700 teachers from twenty-five purposefully selected private secondary schools in Ibadan, Oyo state, Nigeria, technical support in schools and teachers' lack of expertise in using computers were indicated as being the prominent factors hindering teacher's readiness and confidence in using computers during lessons. Even though, the results indicated that teachers perceived computers as being easier and very useful in teaching and learning, it was recommended that teacher training and professional development oriented policies should support computer-related teaching models that encourage both students and teachers to play an active role in teaching/learning activities (Tella, Toyobo, Adika & Adeyinka, 2007).

In Tanzania, Non-Governmental Organizations (NGOs) such as The Bright Education Trust Fund participated actively in the development of teacher capacity by teaching them how to use computers to improve both classroom teaching and administrative procedures in their respective schools. To achieve this, the NGOs opted to train teams of teachers within a school because it believed that teams of teachers could introduce revolutionary ideas within a school more effectively than single individuals (Tilya, 2007).

2.4.2 Teachers' computer capacity in Kenya

With the availability of web 2.0 technologies in Kenya, one would expect academic staff to adopt the use of DLP devices in teaching and learning given that the current generation of students is the IT savvy generation (Okello-Obura & Ssekitto, 2015). According to Hennessy et al. (2010) large-scale capacity building workshops for teachers was the way forward towards full integration of computers in schools in Kenya. They observed that teacher training should be built on strong computer structures that support ongoing professional development for teachers. The program, they said, ought to be consistent with the workshops for lecturers and pre-service teachers at teacher training colleges.

The use of ICT in teaching and learning has been witnessed in some institutions in Kenya. A study was conducted in Kajiado County in one of the secondary schools with a population of 535 students and 28 teachers. The sample size of 30 and 18 respectively for students and teachers was used for the study. A survey design with questionnaires was used to collect data alongside observation of teachers' lessons. The findings revealed that 77% of the teachers who were the majority could use computers to teach, research, plan and keep records (Kisirkoi, 2015).

In primary schools in Kenya, Sharples and Moldéus (2014) conducted a study on perception of schools in readiness for adoption of laptop computers in seven out of the more than twenty thousand schools which were set to receive laptop computers in Kenya by 2014. The study adopted multi-site case study design. Both quantitative and qualitative data were collected. The findings revealed that 60% of the teachers lacked adequate ICT

training. Teachers also feared that pupils were better equipped with ICT skills than they were and could easily challenge their authority in class (Okello-Obura & Ssekitto, 2015).

DLP lessons in Kenyan public primary schools were set to meet lesson delivery challenges during teaching and learning if teachers failed to gain and put into use the right computer skills because a number of teachers were still struggling to master the new gargets (Standard Team, 2019). This is because some teachers were reported to have spent more than 20 minutes in arranging the class while others experienced failure of devices to power on giving teachers hard time in putting DLP classes to order before the lessons would continue (Wanzala & Nyamai, 2018)**.**

2.5 Teachers' awareness of the digital content

In teaching and learning digital content is a soft copy content. ICTs such as videos, television and multimedia computer software that have the ability to combine digital contents such as text, sound, and color, moving images that could be used to provide challenging and authentic content that engage the learners in the learning process (Meenakshi, 2013). DLP content provided a foundation for teachers and learners that connect theory and practice that could cultivate their understanding of digital pedagogy and support their development of digital literacy skills (Nyaundi, 2018). Digital content readiness is a component of e-readiness. UNESCO Institute for Statistics (2015) defines e-readiness as a measure of the degree to which individuals are prepared to partake in electronic activities for purposes of learning or teaching and benefit from an ICT such as laptop computers in education.

Digital content could be synchronous or asynchronous (Reddy & Manjulika, 2002). Whereas, synchronous content requires simultaneous participation of teachers and learners in real time, asynchronous content is recorded and delivered later to students by use of an appropriate technology (Mitchell, 2009). School teachers in Kenya should, therefore, be exposed to both flexible real time and asynchronous ways by use of computers directly linked to KICD to deliver digital content and at least be assessed keenly to ensure that the technology used for teaching and learning are both supported at the dissemination and receiving ends of the digital content. That is, the point of teaching using technology and the point of reception by the learners in a classroom should be both dialogical and transactional (Moore, 1993).

2.5.1 Teachers' awareness of the digital content in Africa and other parts of the world

About ninety percent of the people in the world who were educated in the past learnt how to read, write and do arithmetic by means of traditional learning tools such as blackboards, textbooks and classrooms. However, with the advent of powerful information and communication tools, the traditional perspectives of education have been greatly disrupted (Van Lieshout, Egyedi, & Bijker, 2018, p. 3). Educational technology is a branch of ICT which is displayed inform of books, writing, telephone, television, photography and databases, and is sometimes organized into one single package called digital content (Omanga, 2018).

In the United States of America (U.S.A), digital platforms had proven to be more effective in the provision of many opportunities for teachers and students to practice typing, editing, capturing information and publishing anytime anywhere. The Pew Research Centre (2013) observed that digital platforms were effective in teaching a number of subjects in a school

set up. The Research Centre did an online survey of a non-probability sample of 2,462 middle high school teachers who were teaching in the U.S.A and found that 99% teachers could use digital platforms to teach writing, 86% could teach science and 78% could handle arithmetic (Pew Research Centre, 2013, p.20).

In comparison to the U.S.A., the developers of digital content such as Kenya Institute for Curriculum Development (KICD) in Kenya also needed to develop digital courses that constantly engage learners by giving them greater opportunities to manage their learning process. Already the KICD had, in conjunction with publishers, developed digital content for class one, two and three in all the five subjects taught in primary schools in Kenya and was ready for pre-loading to the computing devices (Kenya. DLP Secretariat, 2016, p.17; Republic of Kenya, 2015). Interactive animations, videos, audios, cartoons, exercises and quizzes have also been reported to have been included in the Kenyan DLP digital content by KICD to improve the learning experience (Oduor, 2015). In support, digital content could include text, simulations, animations, presentations, tutorials, collections, resources, subject and task-specific cognitive tools, references, assessments (quizzes/tests/exams), and readings (Burns, 2011), which could be integrated into graphics, audio, texts and videos into a single training package in a computer to form educational multimedia (Suryawanshi & Suryawanshi, 2015; Ciascai & Marchis, 2008).

In South Africa, some 52,000 educators from 820 schools who enrolled for the Intel® Teach Program that took place between 2003 and 2007 with the main aim of training teachers to incorporate the use of Information Technology (IT) in their teaching, successfully trained teachers to deliver online content (Hennessy, et al., 2010). This called

for readiness and awareness of the demands of an online education right from the preparation stage. Digital content should be similar in coverage and content as in traditional textbook courses currently used in Kenya. The DLP devices were preloaded with content and were supposed to be distributed to the learners in classes as per the numbers and streams (Kenya. DLP Secretariat, 2016, p.22). The main difference between the hard copy textbooks and the digital content is that digital content is organized in multiple formats, use a variety of activities, and accessible through a number of technologies to allow for customized learning experiences (Hope, 2006). Wanzala (2015) added that digital content for DLP includes interactive animations, videos and audio, cartoons, puppets exercises and quizzes aimed at helping pupils learn.

But the organization of such digital content should be highly interactive by allowing a range of levels of learning, learner entry points, and experiences (Burns, 2011). Information should be chunked and moved sequentially in various formats such as video, audio, images and texts from simple to complex, concrete to abstract, and general to specific. Where there is text, it should be clear, concise and simple (Commonwealth of Learning, 2008).

According to UNESCO Institute for Statistics (2015), Rwanda was the only country that appeared to be a notable exception in the African region in terms of teachers' awareness and usage of digital content by use of laptop computers in primary schools. Data from UNESCO Institute for Statistics (2015) showed that the learner-to-computer ratio in Rwanda was relatively low at 15:1 in the primary and secondary levels, but access to the internet remained a significant challenge for both teachers and learners to access digital

content. Fewer than 6% of primary schools and 18% of secondary schools were connected to the internet. A long side Rwanda, countries such as Nigeria, Ghana and Ethiopia also rolled out laptop computer programs in their respective countries in 2005 but failed to utilize the digital content due to bad political will (Hennessy, et al., 2010).

Content delivered to learners can be in the form of print, audio, visual, audio visual or multimedia (Van Lieshout, Egyedi, & Bijker, 2018, p. 4). Under the old correspondence model, print technology surrounded the whole area of teaching and learning. Print media which was the oldest form of content presentation was associated with the production of hard copies. Reddy and Manjulika (2002) stated that the development of print model started with two major events. In one instance, Moses received a set of instructions through two tablets of engraved stones on front and back sides by the finger of God at Mount Sinai. On other hand, the epistles (sacred) letters of St. Paul were sent to churches of God in Corinth, Galatia, Ephesus, Philippi, Colosse and Thessalonica to educate the people (Reddy & Manjulika, 2002, P.658).

According to Abdulraheem, Adisa and La'aro (2012), the developments in print media led to the establishment of multiplicity of media witnessed today. The introduction of multimedia magnified the possibility of on-demand access to content anytime, anywhere, on any digital device, as well as interactive user feedback, creative participation and community formation around the media content. In other words, the shortcomings of print media such as lack of interactivity could be improved by the fifth-generation intelligent flexible learning model, such as e-mail, which combines print, audio, and pictures into one

technology such as a computer which eliminates the constraints of time, space and interactivity (Njagi, 2013).

2.5.2 Teachers' awareness of the digital content in Kenya

The importance of digital content for various levels of education in Kenya was articulated in the Education Reform Framework (ERF) which was on education quality, delivery, governance and imparting of soft skills to learners (Oduor, 2015). Learners needed to be prepared for a successful adulthood in a world that is increasingly being saturated with digital technologies (Nyaundi, 2018).

According to Bates (2014) and Hennessy, et al. (2010), a non-interactive audio content began as early as 1920 when the British Broadcasting Corporation (BBC) began broadcasting educational radio programs for schools in the 1920s. The first adult education radio broadcast from the BBC in 1924 was a talk on 'Insects in Relation to Man'. This development was followed by the introduction of television for use in education in the 1970s which according to Bates (2014) was dominated by international agencies such as the World Bank and United Nations Educational, Scientific and Cultural Organization (UNESCO).

Television which could be used to pass audio visual content to learners quickly faded when its access in developing countries such as Kenya was limited due to lack of electricity, cost, security, resistance from local teachers, and absence of a local language for communities (Asiago, et al., 2014). These barriers minimized the use of video content in developing countries, but equally promoted the use of radio since most radios are portable and use dry cells as their source of energy.

Recorded audio programs that are offered asynchronously were available in Kenya from 1960 in the form of Radio Broadcast to Schools (Asiago, et al., 2014).The University of Nairobi in Kenya also practiced distance learning by use of recorded audio cassettes as carriers of digital content from 1986 which were offered to distance learners for distance education (Bowa, 2011).

Njagi (2013) identified models of educational content evolvement in four generations: first, the Correspondence Model based on print technology; second, the Multi-media Model based on print, audio and video technologies; third, the Tele-learning Model based on applications of telecommunication technologies to provide opportunities for synchronous communication; and fourth, the Flexible Learning Model based on online delivery via the internet by use of computers and other devices such as mobile phones. One advantage of the flexible learning model was that all components of the digital content format such as audio, audio visual and texts were inbuilt into one technology such as a laptop computer.

Meenakshi (2013) observes that educational multimedia constituted CDs, interactive games, flash and 3-D animation, slide-shows (like PowerPoint), video books and digital story-telling forms that imaginatively combined visuals with text and audio that could be delivered on a range of platforms. Interestingly Meenaski's interviews with the teachers established that the use of videos was the most effective ICT component in educational undertakings that required creativity during presentations. But Van Lieshout, Egyedi, and Bijker (2018) saw it differently by saying that teaching and learning is most effective by use of multimedia.

The implementation of digital content in many developing countries faced numerous challenges. On one side, teachers were clustered as digital immigrants (Berk, 2009). On the other hand, resistance from the teachers who feared being rendered jobless as technology take their places was also noted (Kimuge, 2017), lack of steady power sources (Hennessy, et al., 2010), high cost of laptop computers (Buchele, et al., 2007; Hennessy, et al., 2010) and insecurity of laptops in schools (Buchele, et al., 2007; Kenya. ICTA, 2016). However, it was noted that even with these challenges, teachers and learners needed to change to be digital natives (Berk, 2009). In Kenya, the commitment was eminent because the government allocated the ICT Ministry Sh13.4 billion in 2017 /2018 financial year for deployment of the laptops in schools, development of digital content, building capacity of teachers and establishment of computer laboratories (Wanzala, 2017).

Institutional readiness for uptake and integration of laptop computers, therefore, could require facilitators who were primary school teachers in public schools in Kenya to have essential knowledge of laptop computer skills in literacy and numeracy because the entry skills for any ICT driven studies is considered a foundation for its success (Meiers, Knight, & White, 2009). In practice, according to Dada (2006) as cited by UNESCO Institute for Statistics (2012), there should be an e-readiness assessment program mandated with the responsibility of investigating and making proposals on how schools or institutions should be prepared to adopt and use technology to digitalize teaching and learning.

In summary, school teachers needed to be exposed and trained thoroughly to implement digital content in class because the success of such implementation would be viewed as a product of the teachers' efforts. In support, Pew Research Centre (2013) also observed that

the digital tools that are used in teaching and learning needed the attention of the teachers in learning process simply because both technology and the instructor are as valuable as the pedagogy being employed in classrooms. Teacher training and professional growth in connection to the use of ICT in a learning institution should emphasis more on pedagogy rather than the computer technical competences (National College of Ireland, 2009). DLP content in Kenya was treated as source of entertainment for the pupils instead of being used as a learning tool (Wanzala & Nyamai, 2018).

2.6 Attitudes of teachers towards laptop computers uptake in schools

According to Bertia (2009), attitude indicates a certain degree of the possibility of adopting certain behaviors. He further notes that a favorable attitude shows a greater probability that learners and teachers would accept the new learning system, as a bad attitude could come as a result of lack of understanding, poor communication and absence of trust or conflicting agendas in appropriate use of technology. Attitude formation especially on the institution and participants is a major contributor to the success or failure of any learning program worldwide and more particularly in Africa where people did not grow up with technology (Afshari, Bakar, Luan, Samah, & Fooiet , 2009).

The technology used in classrooms should be seen as either a substitute or supplement of the physical teacher and, therefore, is expected to share some characteristics of the physical teacher (Reddy & Manjulika, 2002). Integration of technology should display no differences in consumer characteristics. Parker (2003) supported this by saying that the teachers and learners who are comfortable with technology and have a positive attitude towards it are more likely to succeed within a learning environment.

In addition, Shashaani (1994) argued that for positive attitude formation, prior knowledge of and experience with the use of technology is critical. This was supported by Woodrow (1991) who pointed out that awareness of both teachers and learners attitudes towards computers is a critical criterion in the evaluation of computer courses and in the development of computer-based curricula.

2.6.1 Attitude of teachers towards laptop computers uptake in schools in Africa and other parts of the world

Perception on usefulness and ease of use of computers were found to be significant contributors of uptake and integration of computers in Singapore. In a study conducted among the 239 pre-service teachers at the National Institute of Education revealed that teachers' perception that computers were useful ($b=0.46$, $P< 0.001$) and easy to use ($b=0.24$, $P< 0.001$) both positively contributed to the attitude of the teachers towards integration of computers in teaching and learning (Teo, Lee, & Chai, 2008; Oketch, 2013).In Kenya, DLP was new in the face of teachers, learners and parents. Every stakeholder in the DLP needed an assurance that DLP was both easy to use and useful compared to the traditional hard copy textbooks and chalk wall methods of teaching and learning.

Salehi and Salehi (2012) conducted a study to determine the attitude of secondary teachers towards the integration of ICT in schools in Iran. The survey design was used with the sample size being 30 secondary school teachers. When the respondents were asked about their personal experience with ICT, it was found that the majority of high school teachers, (70 %), considered themselves as confident users of ICT. However, the findings did not

mean that the teachers were integrating technology in class. To further investigate teachers' usage of ICT in classroom, it was found that the majority of them (76.6 %) never used ICT in the classroom or preferred to use it very little. The Iranian research position on underutilization of ICT in classroom seemed to make a lot sense in developing countries because many governments in these developing countries develop and implement ICT policies without getting the views of the intended ICT users and beneficiaries such as teachers and learners.

In a case study by Tella, Toyobo, Adika, and Adeyinka (2007) as cited by Hennessy, et al. (2010), some 700 Nigerian secondary school teachers' perception towards integration of ICT in teaching and learning was investigated. The findings revealed that teachers regarded ICT as very useful and was easier to use in teaching and learning. The case study recommended further professional development of ICT policies with the aim of coming up with ICT models that would encourage teachers and learners to play an active role in teaching and learning activities. But these ICT training models should also incorporate public awareness campaigns for ICT penetration in the social fabric.

In a study done in Malaysia to determine the attitude of teachers who were undergoing training at the university, it was found that prospective teachers overall computer attitude (M =3.99, SD = 0.37) was well above mid-point scale of (3.00). The study also realized that the mean average of perceived usefulness and ease of use of computers also stood higher at (M = 4.31, SD = 0.47) and (M = 3.44, SD = 0.36) respectively. The study had a sample size of 38 prospective teachers who responded on five-point likert scale of strongly disagree (1), disagree (2), neutral (3), agree (4) and strongly agree (5). It was concluded

that the prospective teachers had a very positive attitude towards computer use in classroom practice (Raman, Malik, & Sofian, 2015). In support, Ali Alamin and Elgabar (2014) observed that learning institutions did not only require a robust technical infrastructure to support the delivery of the courses, but more importantly, the complete acceptance of its major would-be users as well, which in the case of Malaysian study were prospective teachers at the university.

One of the most notable barriers to the effective diffusion of ICT in schools concerned the cultural and personal attitudes of teachers towards ICT (Afshari et al., 2009). Research showed that teachers' attitudes towards technologies could influence the effective use of technologies in teaching and learning (Paraskeva, Bouta, & Papagianna, 2008). In support, scholars of education such as Gakuu (2007); and Juma (2001 asserted that positive attitude towards ICT was necessary condition for the effective implementation of e-learning. At the same time, it was noted that developing countries still lacked sufficient awareness of ICTs and distance learning (Rhema, & Miliszewska, 2010). In Libya, for instance, Rhema and Miliszewska (2010) observed that the level of educational technology awareness and even basic computer skills is generally low among educators in all types of higher education institutions which, in essence, could lead to resistance in ICT adoption. They added that learners and teachers tend to feel anxious and even worried when engaging with technology because of their perceived sense of incompetence.

In another perspective, Sabzian and Gilakjani (2013) noted that technology resources alone could not guarantee teachers better instruction. They said that teachers should be convinced of the usefulness and benefits of these resources in improving teaching and

learning. In that respect, ICT uptake should not only be confined to training of teachers on computer skills, it should also aim at building teachers' confidence towards technology integration in education.

Their observations were in concurrence with Juma's (2001) who added that many people do not believe that quality education could be delivered through information technology. One reason for such negative attitude was technophobia. Ironically, Britain and Liber (1999) saw technophobes differently. They said technophobes see technology as the solution to all human problems. This idea that was refuted by Soong (2002) who said that the technophobes are resistant to change and their personal reasoning about computers is that use of computers may be a source of embarrassment because people in authority such as teachers may be challenged by the younger and inexperienced people in the society.

In Egypt, gender and work experience did not play a major role in teachers' attitude towards uptake and integration of computers in schools. In a study that involved 53 (45%) male and 65 (55%) female teachers in government secondary schools in Egypt, teachers were surveyed using questionnaires in which the findings showed that teachers' attitude towards computer at governmental schools was relatively high and that no significant gender differences existed among them. The same study also revealed no significant differences among teachers' attitude towards using computer at governmental schools in terms of work experience (Bakr, 2011). DLP training in Kenya did not emphasize on gender. Schools were not directed not to give gender priority when selecting participants for such training.

2.6.2 Attitude of teachers towards laptop computers uptake in schools in Kenya

According to Meenaksi (2013) and South African Department of Education (2003, p.29), many teachers were reluctant to use ICTs, especially computers and the internet. Some of the reasons for reluctance included poor software design, skepticism about the effectiveness of computers in improving learning outcomes, lack of administrative support, increased time and effort needed to learn the technology and how to use it for teaching, and the fear of losing their authority in the classroom as it becomes more learner-centered.

The Kenyan DLP scenario was similar. Teachers were trained on DLP but still their confidence to completely handle computers in class was questionable (Sharples & Moldéus, 2014). To be successful in computer use and integration, Khan et al. (2012) suggest that teachers needed to engage in conceptual change regarding their beliefs about the nature of learning that is supported by the use of computers, the specific roles of the students during the learning process, and their facilitation role as teachers. Therefore, successful use of laptop computers in the classroom largely depends on the teachers' attitudes and beliefs. Khan et al. (2012) added that less technologically capable teachers, who possess positive attitudes towards ICT, may require less effort and encouragement to learn the skills necessary for the implementation of ICT in their classrooms.

In a study that was done at the University of Nairobi to establish barriers for the uptake of e-learning among the teachers who were undergoing an in-service bachelor of education (arts) training, enthusiasm for using technology to teach and learn was found to be strong among the participants in educational process. This was evident especially among trainee teachers who had a special interest in computers as a technological tool for teaching and

learning (Omito, 2010). In the study, a total of 217 respondents who were mostly primary school teachers in Kenyan schools and at the same time were distance learners of the University of Nairobi were investigated. It was realized that 60 (27.65%) respondents found working with computers enjoyable despite the fact that they had very limited time to interact and learn with computers. The findings, however, were not in concurrence with the observations of Omanga (2018) who found that the duration for training DLP teachers in Kenya was too short to enable teachers who had no prior ICT training to train their colleagues and master the required ICT skills for teaching children in their schools. Omanga (2018) added that teachers looked more messed up in Kenya than before and as a result the tablets were kept under lock and key in schools as teachers continued with their traditional ways of teaching. DLP devices were used by learners for entertainment instead of educational purposes **(**Wanzala & Nyamai, 2018).

Sharples and Moldéus (2014) also conducted a study on the attitude of teachers on usefulness of laptop computers and perceived socio-economic context of laptop computers program in Kenya. Their study findings revealed that usefulness of the laptops overwhelmingly stood at 95%. 8% of the respondents found laptop computers easy to use while the other 60% mentioned inadequate resources especially desks in schools for DLP. Mixed reactions were realised on the general acceptance of DLP project. That is, it was high perception for the introduction of laptop computers in Kenya but a low one for adequacy of resources for the project. In their study a sample of 80 teachers were surveyed. Participant teachers came from 2 rural schools in the Nakuru region and 3 urban schools in Nairobi. Each school had between 20 and 40 teachers.

In summary, people react in different ways to different situations. Partly these reactions are learned and based on people's previous experiences. Some people associate positive emotions to new technology and others think of technology as a negative issue (Juutinen, Huovinen, & Yalaho, 2011).

2.7 Contribution of independent variables of the study to uptake and integration of laptop computers for teaching and learning

The e-readiness model could be a seen as well laid ICT component that is a picture of an ideal set up of successful e-learning program. In fact, teaching and learning that involve the use of ICT surpasses the simple handling of computers alone (European Commission, 2011). It requires a complete system with several components that supplements one another for the success of an educational program (Ouma, Awuor, & Kyambo, 2013).

In this study, the laptop computer model for DLP was made up of the following independent variables: institutional ICT infrastructure, ICT policy, teacher computer capacity, teachers' awareness of the digital content and teachers' attitude. For effective implementation of ICTs in education, proper structures, policies, execution and monitoring which in most cases are major constraints for many developing countries in Africa needed to be identified and put in place (Khan et al., 2012). This is because e-learning readiness assessment is considered key for organizations that are intending to use ICT for teaching and learning and as well the institutions that are already implementing ICT programs because when e-learning readiness assessment is well executed, it has the ability to identify gaps and provide solutions to such institutions (Đurek & Ređep, 2016).

In this respect, the newly launched DLP in Kenya needed to increase its chances of continuity after the launch by adopting some functional ICT model that is anchored on necessary readiness areas. Keegan (1996) argued that a vibrant and well-coordinated ICT framework in education has a multiplier effect throughout the education system. It lays a strong foundation for learning and as well provides students and teachers with a differentiated set of new skills that surpasses the traditional educational system that relied on the teacher and classroom set ups. Keegan advocated for hybrid models that are interactive and can support larger ICT systems such as the Kenyan DLP that targeted over twenty thousand public primary schools.

In concurrence with Keegan's argument, the Ghanaian Ministry of Education (2009) also defined e-readiness model as the ability of educational institutions to effectively use ICTs in fostering the achievement of educational and management objectives through the use of appropriate tools, processes and skilled human resources. The ministry observed that possible challenges in an organization could smartly be addressed by a well-designed ICT model by providing mitigation measures whenever it is necessary (Siers, 2014).

There are no universal models for all situations or learning conditions (Eke, 2011; Coopasami, Knight, & Pete, 2017). Models are tailor made depending on possible educational factors that affect learners' readiness and adoption of ICT at any given time. But the implementers of any ICT program needed to take caution that lack of appropriate theoretical or conceptual frameworks in various ICT readiness models dealing with the effectiveness of ICT systems could result in inconsistent results and leave the question of what constitutes the determining factors of effective delivery technology remains

unanswered (Masrom, 2007). E-learning readiness models should, therefore, reveal the impact of ICT on individual educational facilities that may require attention prior to implementation of an e-learning program (Coopasami, Knight, & Pete, 2017).

In response, Siers (2014) compared some main criteria of the e-readiness models such as technological infrastructure, content, policy, culture, standards, financial considerations and human resources, and concluded that most of the models included technical infrastructure readiness, content readiness, cultural readiness and financial resources, but none of the models included all ICT readiness criteria.

Demir and Yurdugü (2015) also added that models were effective but needed to be amended and applied in different ways. In their study that involved ten models to establish the readiness for learning institutions to adopt e-learning, it was learnt that 10 (100%) found ICT infrastructure to be necessary for e-readiness, 9 (90%) mentioned finance, 8 (80%) were for both content and human resource, 7 (70%) cited the institutions' culture, 5 (50%) revealed competency of technology usage and the remaining 5 (50%) of the models declared management and leadership to be important factors in e-learning uptake in learning institutions. The criterion for determining which components of the model were best placed to be incorporated in their reference model was 50% utilization of that component in various models.

Mosa, Naz'ri bin Mahrin, and Ibrrahim (2016) in their review of nine ICT models indicated that 10 (100%) of the models cited technology, 8 (80%) mentioned learners, 6 (60%) identified both content and resources, 5 (50%) revealed culture and awareness, 4 (40%) found equipment, 3 (30%) cited management, standards and institution, 2(20%)

registered acceptance of e-learning, pedagogy, human resources and financial implications. The remaining readiness areas such as security, laws, regulations and training procedures each rated 1 (10%) from the models.

2.7.1 Technology Acceptance Model

Technology Acceptance Model (TAM) was developed by Davis in 1989 (Mojtahed, Nunes, & Peng, 2011). TAM was built on the premise that a change in attitude was an important factor for adoption of an ICT readiness model. TAM was based on the perception of ease of use and usefulness which ultimately ended in either positive or negative attitude (Chuttur, 2009). According to Eke (2011), ICT adoption is hampered when there is an absence of improved technology model in any education system.

The technology acceptance model was made up of Perceived Usefulness and Perceived Ease of Use components. McGowan (2016) gave the definitions of perceived ease of use as the degree to which a person believes that using a particular system would be free of effort. On the other hand he defined perceived usefulness as the degree to which a person believes that using a particular system would enhance his or her job performance. He attributed his definitions to Davis who first came up with the idea in 1989.

In the Kenyan context, an attitude formation in the process of DLP launch was critical. Teachers, pupils and the entire public needed to develop a positive attitude based on the usefulness of the DLP project to the country. On the other hand, the stakeholders in the education system in Kenya, particularly the teachers and pupils, needed to be convinced that laptop computers and tablets would be easier to use compared to the traditional system of teaching that involved the use of chalk and black wall.

In support, Madar and Willis (2014) explained that perceived ease of use influences perceived usefulness of technology and these together influence teachers' and learners' intention to use an ICT system because Technology Acceptance Model (TAM) was more specific on information system usage for applying the concepts of ease of use and usefulness. Besides, TAM was said to be more parsimonious and robust in various information system applications (Chen, Li & Li, 2011).

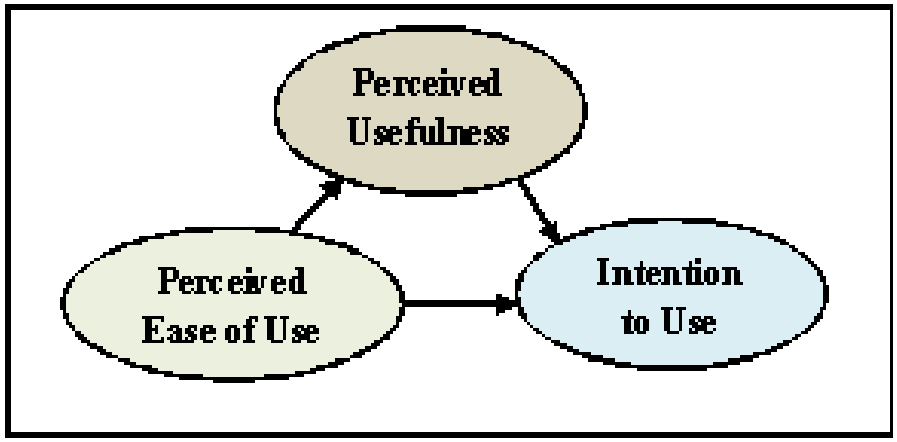

Figure 2.1: **Davis ICT readiness model**

Source: Davies (1989)

According to Mojtahed et al. (2011), TAM's was effective in many sectors of the economy. This was based on their research that was based on an International Telecommunication Union that was expected to reach 4.5 billion mobile phone subscribers all over the world by 2012. Unfortunately, only 75 million which was equivalent to 1.6% responded with United Kingdom reporting that only 33% of the people were comfortable with their products. This was a great problem and, therefore, their question was: *What are the factors that influence the intension of UK citizens to use mobile banking services?* They decided that their research design would follow the original design of TAM as was

proposed by Davis in 1989, hence, perception on ease of use and usefulness and only added a few elements. The results were then correlated by use of SPSS. A total of 290 questionnaires out of the sample size of 350 participants were used for data analysis. The regression test analysis results revealed that as the value of perceived risk increased the intention to use mobile banking declined but when perceived usefulness and perceived enjoyment of mobile banking were effectively marketed by the financial sector, users' intention to adopt mobile banking increased. Other scholars such as Chuttur (2009); and Holden and Karsh (2010) also established the effectiveness of TAM model in organizations.

In the DLP project of Kenya, risk factors could be breakages of DLP devices, politics surrounding the project, but above all the poor attitude of the teachers. But with proper campaigns and awareness on both usefulness and ease of use of technology (TAM), uptake and integration of DLP in Kenya could be improved.

While TAM Model was appreciated for its capacity and adequacy in assessment of ICT readiness, an improvement of some of its weaknesses was necessary. It did not consider other components of ICT system such as pedagogy, governance and curriculum design, which instead Madar and Willis (2014) modified to be called Funnel model. More so, TAM was also said to be incomplete due to its limitation to user interface or technology usability. A modification of TAM according to this research was necessary to improve the level of uptake and integration of DLP in Kenya.

Coopasami, Knight, and Pete (2017) also observed that TAM did not capture all areas of readiness for uptake of e-learning. They observed that although Chapnick Readiness

Model of the year 2000 did not stress much on attitude, it included areas such as: psychological readiness, sociological readiness, environmental readiness, human resource readiness, financial readiness, technological skill readiness, equipment readiness and content readiness. In their study on the effectiveness of Chapnick Readiness Model, Coopasami et al. (2017) at Durban University of Technology, a sample size of 101 students were realized. The research design used was quasi-experimental time series analysis whereby students who were studying Bachelor of Nursing Science degree acted as their own controls and filled questionnaires before any intervention measures were administered. The main purpose of the control was to assess the level of e-readiness before and after the intervention. The students were given intervention and issued with the same questionnaires to fill after the intervention. The results showed that the summed score for all eight elements used to assess psychological readiness improved from 54% to 64% after the participants were exposed to the intervention. On computer technical skills readiness, no change was observed in the overall score on all ten elements used to assess technological readiness, that is, from 69% in the pre-assessment to 68% in the post-assessment phase. The respondents attributed this to lack of mastery of computer skills after the training. Finally, on equipment readiness, before the intervention, only 59% of the participants felt that they had the necessary and suitable equipment to allow them to pursue e-learning effectively. Equipment readiness dropped to 39% after the intervention due to students' realization that they did not have the right equipment required for effective e-learning. The ICT model used rated the program not ready and needed re-evaluation.

The Kenyan DLP training looked similar to the technology and equipment readiness components of Chapnick Readiness Model results at Durban University of Technology in

the sense that teachers were trained for DLP for 5 days but the five days may not have been enough for elementary teachers to master the required computer skills, most of whom had never handled computers, let alone a brightly colored tablet (Omanga, 2018).

2.7.2 e-readiness model for Digital Literacy Programme

In Kenya, modelling a system for uptake and integration of laptop computers was witnessed in the study by Sharples and Moldéus (2014). The model was basically based on attitude and adopted the TAM's model. The model was used as a mirror for DLP in Kenya at the initial stages of development as shown in figure 2.2.

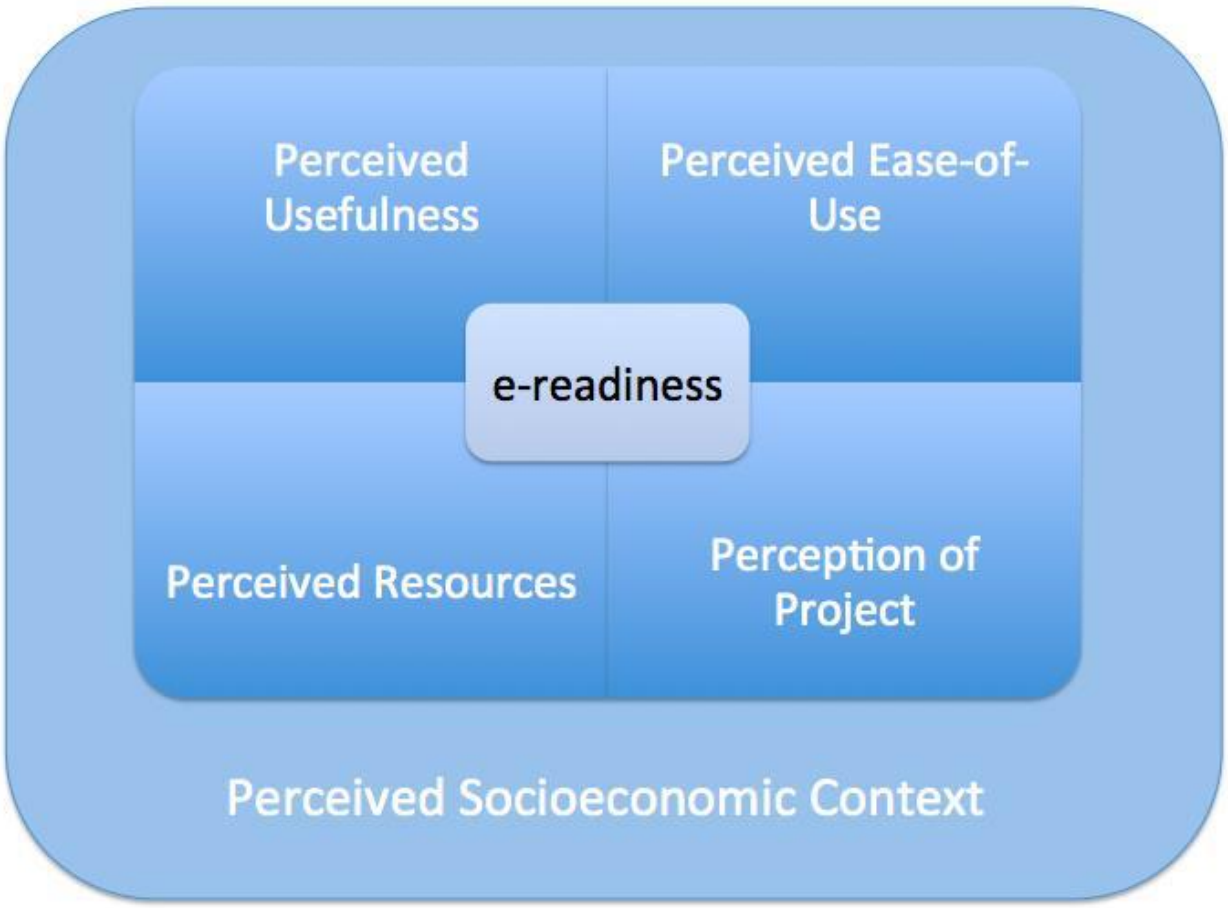

***Figure 2.2*: E-learning readiness model**

Source: Sharples and Moldéus (2014)

In Sharples and Moldéus (2014) model, both the governance and perceived socioeconomic contexts of DLP were analysed. The perceived socio-economic context merely captured the perceptions of the stakeholders particularly on ease of use and usefulness of laptop computers. Perceptions were also studied in relations to stakeholders' feelings on the laptop computer project and project resources. When compared to TAM's model (Mojtahed et al. (2011), Sharples and Moldéus (2014) e-learning model in figure 2.2 extended e-learning readiness levels beyond the users' attitude towards technology to the needed resources for e-learning and governance. However, models will continuously be revised and tailored to suit any program (Eke, 2011).

In conclusion, ICT readiness model is an evaluation tool which could be used to measure the current state of ICT utilization and penetration levels in learning institutions. The research findings from different ICT models showed that ICT models display successful utilization and adoption of ICTs in learning institutions. This is because a well-designed model provides frameworks and critical indicators of success of a program (Chanyagorn, & Kungwannarongkun, 2011).

2.7.3 Summary of existing gaps in the literature

The chapter has explored literature review on the key concepts of the study namely: readiness, uptake and integration. The literature under sub topical areas of ICT infrastructures, teachers' computer capacity, teachers' awareness of the digital content, teachers' attitude and contributions of independent variables of the study (Institutional ICT infrastructure, ICT policy, teacher computer capacity, teachers' awareness of the digital

content and teachers' attitude) to uptake and integration of laptop computer model were also reviewed to establish the existing gaps.

It was noted that the literature on the readiness of schools for adoption of technology in Homa Bay County were scanty. The reviewed literature did not show completeness and confidence of institutions in different parts of the world in embracing digital learning and, therefore, needed heavy investment (Gretton, Gali, & Parham, 2002). The literature revealed unequal uptake and integration of ICT in different points of the world with no standard regulations and models (Afshari et al., 2009; Doshmanziari & Mostafari, 2017; Eke, 2011; Salehi & Salehi, 2012). To bridge such gaps, there is a need carryout prior assessment of the ICT environment to establish the facts on the ground. The next chapter discusses the research design and methodology of the study.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

The research design and methodology chapter outlines the following areas: research design, target population, sampling and sampling procedures, research instruments, instrument validity, instrument reliability, data collection procedures and data analysis.

3.2 Research design

The research design for this study was cross-sectional survey. Cross sectional study entails the collection of data on more than one case at a single point in time in connection with more than two variables which are examined to detect patterns of association (Nsibirano, 2009). In this case, the study collected both quantitative and qualitative data concurrently then compared to see if there was a convergence or difference in their results after data analysis (Creswell, 2011, p.213). Survey designs are suitable for questionnaires or structured interviews for data collection with the intent of generalizing the outcome of the study (Creswell, 2011, p.12).Cross sectional survey was suitable for this research because it examined schools, teachers, head teachers and Curriculum Support Officers (CSOs) whom the research considered different in their roles but shared the characteristic of being under the education sector in Kenya (Tolmie, Muijs, & McAteer, 2011).

The research methodology for this research was mixed methods approach which involved the collection of both quantitative and qualitative data concurrently with the aim of strengthening the outcome of each other and giving priority to both forms of data for a better understanding and analysis of the research problem under study (Creswell & Clark,

2011, p.5).

3.3 Location of study

Homa Bay County is situated in western part of Kenya. It is one of the 47 counties in Kenya. Homa Bay County covers an area of 3,183.3 square kilometers. Geographically, it borders Migori to the South, Kisii and Nyamira to the East, and Kericho and Kisumu to the North East (Kenya. County Government of Homa Bay, 2019). The county has an approximate population of 1.2 million people (Kenya. KNBS, 2019). Educationally, the county had six sub-counties of Homa Bay, Rachuonyo North, Rachuonyo South, Mbita, Suba and Ndhiwa with its headquarters based in Homa Bay town. Suba and Mbita sub-counties of Homa Bay were listed as hardship zones. The study of public primary schools in both hardship and normal zones was necessary to generate non-skewed information on the level of preparedness of schools in Homa Bay County to adopt e-learning. Homa Bay was picked for study because no details of a similar study were recorded to have been done in that county at the time of this study. The geographical map of the county is shown in Appendix 9.

3.4 Population of the study

The population for this study was 8,261 (Kenya. MoE, 2014). From this population, there were 845 head teachers, 845 public primary schools, 6529 teachers and 42 Curriculum Support Officers (CSOs). The population also consisted of 551 teachers in 551 public primary schools that were already supplied with DLP devices in Homa Bay County. These teachers were part of the population of 6529 teachers because they were also drawn from the 845 public primary schools in the county. The teachers and head teachers who were interviewed were drawn from the population of 6529 teachers and 845 head teachers in

public primary schools in Homa Bay County. The population under study was stratified into 6 sub counties: Mbita, Homa Bay, Rachuonyo North, Rachuonyo South, Suba and Ndhiwa.

Table 3.1. Population of the study

Sub-County	Schools N	Teachers N	Head teachers N	CSOs N
Homa Bay	172	1482	172	9
Rachuonyo North	167	1172	167	9
Rachuonyo South	159	1318	159	9
Suba	89	625	89	4
Mbita	109	727	109	5
Ndhiwa	149	1205	149	6
Total	845	6529	845	42

Source: MoE, 2014.

Public primary schools were chosen for this study because they were the recipients of DLP. Again, public primary schools were the places of learning for children who were targeted for DLP. Teachers, head teachers and CSOs were employed to serve public primary schools. These schools provided a platform for the uptake and integration of laptop computers.

Head teachers were chosen for this research because they were curriculum managers in their respective schools. Laptop computer uptake and integration in primary schools was under their direct supervision and management. Head teachers were also classroom teachers and, therefore, were participants in the usage of DLP devices for teaching and learning purposes.

Curriculum Support Officers (CSOs) were needed as respondents because they were

treated by this study as informed specialists (Anyona, 2009). The Ministry of Education in Kenya had trained some CSOs on laptop computer integration and mandated them to assist in the implementation of DLP in their respective educational zones. CSOs were also in charge of curriculum interpretation and implementation at the zone levels. An educational zone was an administrative unit created by the Teachers Service Commission of Kenya in charge of a group of schools in some region/county in Kenya, for example 20 schools.

Teachers were selected as participants in this research by virtue of being the curriculum implementers and instructors at the primary school level. They were the ones who were supposed to engage learners directly in teaching and learning using laptop computers in classrooms. The teachers who were not trained on laptop computer and its integration were expected to be trained by the teachers who had attended DLP training by the government. Teachers handling DLP classes were picked for this research because they were the actual implementers of the program. They were the ones who were integrating content in public primary schools using DLP devices.

3.5 Sampling procedure

To obtain representative sample sizes, the total sample sizes in each category, for example, for teachers (362), schools (85), head teachers (85), CSOs (9), teachers' interviewed (12), head teachers' interviewed (6) and teachers schools with DLP devices (56) were (the stratified to come up with proportional sample sizes in each category of the respondents in the six sub-counties in Homa Bay County based on the teacher population of each sub-county. In each sub-county, simple random sampling was used to pick the respondents. All categories of the respondents were sampled as shown in table 3.2.

Table 3.2. Sample size summary

Sub-county	Schools n	Teachers n	Teachers in schools with DLP devices n	Head teachers n	CSOs n	Teachers interviewed n	Head teachers interviewed n
Homa Bay	17	82	11	17	2	2	1
R. North	17	65	11	17	2	2	1
R. South	16	73	05	16	2	2	1
Suba	9	35	9	9	1	2	1
Mbita	11	40	10	11	1	2	1
Ndhiwa	15	67	10	15	1	2	1
Total	85	362	56	85	09	12	6
(% of N)	(10.0%)	(5.5%)	(10.0%)	(10.0%)	(21.4%)	(0.2%)	(0.7%)

3.5.1 Sampling procedure for teachers

The sample size for teachers was determined using confidence level approach (Kothari & Garg, 2014); Where; **N** is the population (6529); **n** is the required sample size; **p** and **q** are the proportion of the targeted population (0.5); **E** is the accuracy of sample proportions (0.05), **Z** is standard deviation at a given confidence level of 95% (1.96). Using the available information, the sample size was determined:

$$n = \frac{6529*1.96^2(0.5*0.5)}{((0.05^2(6529-1) +1.96^2*0.5*0.5))}$$

$$= 362.8650$$

Based on the formula above, the study settled on a total of 362 teachers in the county of study. The 362 teachers were required for purposes of generating quantitative data by use of questionnaires in the whole county depending on the numerical strength of teachers in

each sub-county. The sample teachers (362) were stratified into six sub-counties of Homa Bay whereby in each sub-county, the sampled teachers were randomly picked.

3.5.2 Sampling procedure for teachers in schools with Digital Literacy Programme devices

Digital Literacy Programme (DLP) devices were necessary for ICT integration in public primary schools. A total of 551 public primary schools in Homa County had received DLP devices ready for integration (Kenya. ICTA, 2016). Based on the fact that the number of public primary schools already supplied with DLP devices was high, the researcher relied on the findings of Gay & Diehl (1992) who recommended 10% as sample size in cases of high populations. In this study, the population of 551 public primary schools which already had been supplied by DLP devices was considered to be large by study, hence 10% of the population as a sample size was appropriate. Some 56 teachers in schools that already had been supplied with DLP devices were picked. The sampling of these schools with DLP devices was necessary to establish the percentage of schools which were utilizing the DLP devices for teaching and learning.

On the other hand, the research was also interested in finding out reasons that made some schools with DLP devices not to use them for teaching and learning despite the fact that DLP devices were already in their schools. The 56 sample teachers were randomly picked from 56 schools that had DLP devices. These 56 sample teachers were not part of the 362 teachers who were sampled for questionnaires. Each school had one chance for a teacher who was teaching with DLP devices.

3.5.3 Sampling procedure for Curriculum Support Officers

Out of 42 Curriculum Support Officers (CSOs), a sample size of 9 was selected representing 21%. According to Gay and Diehl (1992), when the population sample is small, 20% of the population would be representative.

Each sub-county was sampled based on the number of CSOs within the sub-county. The sample size per sub-county was based on the percentage of their representation. For example, sub-counties with 9 CSOs had a sample size of 2. The percentages of representation were based on the numerical strength of CSOs in each sub-county. In this case, the CSOs were stratified according to sub-counties and within each sub-county the study picked a sample by simple random sampling technique.

3.5.4 Sampling procedure for schools and head teachers

The researcher sampled 85 out of a population of 845 schools which was 10% of the representation of the population of schools in Homa Bay County. The fact that the number of head teachers was equivalent to the number of public primary schools in the county led the researcher to also pick 10% of 845 head teachers which gave the sample size of 85 head teachers. According to Singh (2010) a sample size of between 10-20 % is reasonable and adequate in descriptive research. The sampled schools and head teachers were then stratified into sub-counties of Homa Bay followed by simple random sampling based on each sub-county's numerical strength of schools and head teachers.

3.5.5 Sampling procedure for interview schedules

To come up with the appropriate sample size for interviews for teachers and head teachers, populations for teachers and head teachers were separately stratified into 6 sub-counties of

Homa Bay. The same teachers' population of 6529 and the head teacher' populations of 845 in Homa Bay County were used to come up with the sample size for interview schedules.

In each sub-county, the study randomly picked one head teacher and two teachers for an interview. The teachers and head teachers were picked randomly for the interviews regardless of whether they had undergone DLP training or not. This was because all teachers in public primary schools were expected to be ready for DLP. Identities of interview participants were recorded to ensure that they did respond to questionnaires. Interviews were to help in data triangulation and resolve unclear information on the area of research that could not be gleaned from the questionnaires and observation schedules, thus filling in the gaps and strengthening the information in the study. According to Mason (2010) the number of participants that should be interviewed for a PhD case study should range between 1 and 95.

3.6 Research instruments

Since the research design was survey, the researcher developed three sets of research tools: questionnaires, observation checklists and interview schedules. Questionnaires were for public primary school teachers, public primary school head teachers and Curriculum Support Officers (CSOs). An observation checklist was used by the study to check areas of ICT infrastructure readiness in schools and explore teachers' computer capacity in schools which had received DLP devices. Interview schedules were used to generate data from both teachers and head teachers on their readiness in terms of schools' ICT infrastructures, computer literacy, awareness of digital content and attitudes. The data generated were to

assist in strengthening findings of the study.

3.6.1 Questionnaires for teachers

The questionnaires for teachers aimed at enumerating data on the following areas: The first section (Section A) generated demographic information of teachers which included sex, age, sub-county, number of years in service as a teacher and the highest academic and professional qualifications. The general demographic information was only necessary to the study for general understanding of the respondents but did not form part of the objectives of this study. The second section (Section B) tested teachers' attitude based on their perception on ease of use and usefulness of laptop computers. The study used a five-point likert scale whereby (Strongly Disagree (D) =1, Disagree (D) =2, Undecided (U) =3, Agree (A) =4, Strongly Agree (SA) =5 to generate data. The third section of the teachers' questionnaire (Section C) was on teacher computer capacity and was intended to collect data using a five-point likert scale: Not at all=1, Not so well= 2, Okay=3, Well=4 and Very well =5. Section D of the teachers' questionnaire was designed to gather data on different components of the digital content, different skills that were needed to manipulate digital content, barriers facing the implementation of digital content and finally, the digital equipment that could be recommended for the delivery of the digital content apart from laptop computers. The last question for the teachers' questionnaire was testing the teachers' general readiness for the uptake and integration of laptop computers.

Questionnaires were appropriate for this study because the anonymity of the respondents that was guaranteed increased the likelihood that responses given were genuine and reflected opinions held by the respondents. Questionnaires were also reliable because they gathered a lot of information and required little time to be filled. Most public primary

schools in Kenya were understaffed and only needed research instruments like questionnaires that could take a teacher a few minutes to respond to. The research instrument is attached in this study as Appendix 2.

3.6.2 Questionnaires for head teachers

The head teachers' questionnaire was divided into four sections. The first section (Section A) generated general demographic information such as age, years of service as a head teacher and gender. The general demographic information generated was only necessary for general understanding of the respondents but did not form part of the objectives of this study. In section B, information on head teachers' attitudes on their perception on the need for ICT policy document was scored using a five-point likert scale: Strongly Disagree (D) =1, Disagree (D) =2, Undecided (U)=3, Agree (A)=4 and Strongly Agree (SA)=5. Section C generated data on head teachers' computer capacity using a five-point likert scale: Not at all=1, Not so well= 2, Okay=3, Well=4 and Very well =5. Section D of the head teachers' questionnaire gathered data on the head teachers' awareness of the digital content. Questionnaires were appropriate for the head teachers because they reduced bias in responses as compared to interview schedules where responses could be influenced by the researcher's lack of proper interview skills. The head teachers' questionnaire also assisted in establishing the general readiness for uptake and integration of laptop computers in their schools as perceived by them as curriculum oversight officers in the schools. The research instrument (head teachers' questionnaire) is attached as Appendix 3 in this study.

3.6.3 Questionnaires for Curriculum Support Officers

CSOs'questionnaire was also divided in two sections: The first section (Section A) enumerated data on demographic information such as gender, age, sub-county, years of

service as a Curriculum Support Officer (CSO), and the highest academic and professional qualifications. Again, in this case, the general demographic information was only necessary for general understanding of the respondents but did not form part of the objectives of this study. Because CSOs were in charge of teachers' advisory on curriculum matters in their zones, Section B of the CSOs' questionnaire generated data on their perception of the digital content as was prepared by Kenya Institute of Curriculum Development (KICD) and utilized in public primary schools in Kenya and the general readiness for uptake and integration of ICT in school. Questionnaires were appropriate for CSOs because they were field officers, hence could hardly be found in their offices. Questionnaires could be left for them in their offices to answer at their own free time and thereafter the CSOs could make an appointment with the researcher to collect the already filled questionnaires at later date. The research instrument for CSOs is attached in this study as Appendix 4.

3.6.4 Observation checklist on schools' ICT infrastructure

The observation checklist was important for this research because the study needed to verify the availability or absence of the required ICT facilities and infrastructures that were necessary for the uptake of laptop computers in schools. The checklist enabled the researcher or research assistant to make his or her own observations and make recordings without misinformation as sometimes witnessed in many dishonest respondents, particularly for questionnaires and interview schedules, who would deliberately give false or inaccurate information (KIM, 2009). In this case, the researcher or research assistants were able to get detailed information on the required ICT infrastructures of each of the sample schools.

The researcher or research assistants observed ICT infrastructure such as availability of computer storage facility, computer room chairs, power generator, power sockets, laptop computer technical assistant, internet, solar power, carpeted floors, electric power, uninterrupted power supply, laptop computer classroom laboratory attendant and laptop computer room policy document. The researcher or research assistants recorded the observations using a checklist as shown in the attached Appendix 5 of this study. The head teacher being the overall leader and the key gatekeeper of the school assisted the researcher or research assistants in making such observations.

3.6.5 Observation checklist for teachers in schools with Digital Literacy Programme devices

In schools that were teaching using DLP devices, selected areas of the much needed skills for laptop integration in public primary schools such as rotation of images, creation of new word documents using Microsoft Excel and Microsoft Word, drawing and labelling diagrams, use of power point, saving contents to an external disk, animation, browsing using Mozilla or Explorer, sending and receiving e-mails, and printing documents from laptop computers were observed by the study. The study observed these computer skill areas because teachers needed knowledge and practical skills with laptop computers before and during the integration process. Teachers in the sample schools with DLP devices were observed when either teaching practically or using laptop computers. The observation schedule gave the study the opportunity to establish the actual level of computer competence as the sample teachers were observed as they manipulated laptop computers in the presence of the researcher or research assistants.

The observation schedule was structured in such a way that in schools that had received DLP devices and were not utilizing them, the observer could only generate data on the preliminary section (Section A) up to number six which basically generated information on whether the school had received DLP devices or not, whether the teachers in that school had received DLP training or not and the main reasons for not utilizing DLP devices for teaching and learning. The researcher or research assistants, in these particular cases, were to make no observation on computer competence because no integration of laptop computers was going on in such schools. The need for preliminary section (section A) was to assist in guiding the researcher or research assistants in generating accurate and uniform information in schools that had not started using laptop computers. Section B was basically an observation schedule for the sample teachers in schools that were integrating laptop computers in teaching and learning.The research instrument is attached to this study as Appendix 6.

3.6.6 Interview schedules

The interview schedule was used as a research instrument for both sample teachers and head teachers. The interview schedule had seven open ended questions touching on the key variables of the study such as ICT infrastructures, teachers' computer capacity, teachers' awareness of digital content and teachers' attitudes towards uptake and integration of laptop computers in public primary schools in Homa Bay County. The study used same questions for interview schedules of both sample teachers and head teachers because the study was on readiness of teachers for the uptake and integration of laptop computers. Sample head teachers were also regarded by this study as curriculum heads in a school and also classroom teachers in their respective schools.

To accurately gather information on readiness for the uptake and integration of laptop computers, it was necessary to triangulate interview data with other sets of data received from other research instruments such as questionnaires and observation checklists. In support, Feeney, Grace and Brandt (2001) said that interview schedules allow one to gather a wide variety of data in a shorter amount of time than could be accomplished with other research instruments such as questionnaires, and at the same time it is suitable for a homogeneous group such as teachers and head teachers for this study because they are directly involved in teaching in primary schools in Kenya. The interview schedule as a research instrument is attached in this study as Appendix 7.

3.6.7 Document analysis

Document analysis was used in this study to help the researcher in data triangulation. In particular, descriptive statistics especially percentages were used to analyze number of power connections and laptop computer storage facilities in all public primary schools in Homa Bay County. An average mean as a measure of central tendency was used to work out the number of teachers per school who had attended DLP training. The study also analyzed several online and hard copy daily newspapers reports, press statements and information from the website of Kenya ICT Authority to do a comparison with the outcome the research findings. Such reports formed part of the literature review of this study. It was through the analysis of the existing documents that revealed the number of schools that had received DLP devices and the number of reported theft cases in such schools. Document analysis was important because the researcher had the opportunity to do careful examination of documents and their contents in order to draw conclusions based

on the researchers' primary data and the secondary information provided (Bloor & Wood, 2006)

3.7 Pilot study

Piloting is a smaller version of the main study in terms of data collection and analysis. The purpose for piloting is to find out in advance the existence of any flaws in the measuring instruments that may directly or indirectly affect the outcome of the main study (Srinivasan & Lohith, 2017). The responsiveness and applicability of such instruments in a pilot study are checked by the validity and reliability of the research instruments. In this study, research instruments such as questionnaires, observation checklists and interview schedules were piloted and a documented report that captured both reliability and validity of the research instruments was drawn. Both the researcher and the research assistants participated in the pilot study. However, interviews during the pilot and main study were solely conducted by the researcher. The pilot study for this research which constituted of 36 teachers, 6 teachers in schools with DLP devices, 8 schools and 8 head teachers was based on 10% of the sample size of respondents for questionnaires and observation checklist in each category (Connelly, 2008; Hertzog, 2008). All participants in the pilot study were randomly selected. Care was taken to ensure that those who had participated in piloting were excluded for the main study. A head teacher and one teacher from the six sub-counties of Homa Bay were also randomly selected for interviews. Piloting was done to test the suitability of data analysis tools and to clean up the research instruments of any ambiguous, repetitive and irrelevant questions.

3.7.1 Validation

After piloting validation is done to determine the accuracy and meaningfulness of inferences which are based on the piloting results (Mugenda & Mugenda, 2003, p.99). Content validity was used by the researcher to ensure the content of the research instruments used were aligned to the research objectives and precisely measured what they were intended to measure. The research instruments whose content were subjected to content validity included questionnaires, observation checklists and interview schedules. To ensure content validity, the content of the instruments of this study captured the background information and reviewed literature which was organised on the main independent variables. This was done by the researcher with the help of the research supervisors who were subject experts in the area of study.

Construct validity was also adopted by the study to test the convergence or divergence of the results from quantitative data (questionnaires and observation checklists) and interview schedules which were two different instruments measuring the same thing (Creswell, 2012). In this case the construct validity showed convergence. The results were based on the pilot study report.

In the pilot study, respondents were asked to answer questions from the questionnaires and interview schedules. A blank piece of paper was attached to the questionnaire on which the respondents were to give their comments about the instrument. The researcher scrutinized the comments systematically to make necessary corrections in the questionnaires to make them measure accurately what each questionnaire was intended to measure. Confusing and ambiguous questions from the pilot study were either modified or removed. Generated data

from the checklist during piloting were checked by the researcher and subject matter specialists to ensure consistency of items in the instruments. In the case of interview schedules, the questions and responses from the respondents during pilot study were scrutinised by the researcher and supervisors to ascertain their accuracy in answering the research questions according to objectives of the study. Formatting and merging of interview questions were done to minimise repetition.

Improvements in all instruments of the study were done before going to the field for the main study to ensure that mistakes and challenges realized during piloting were minimised. The data generated from the pilot study were used to develop a pilot study report and did not form part of the data for main study data.

3.7.2 Reliability

The study carried out both quantitative and qualitative reliability test for data generated by questionnaires, observation checklists and interview schedules. Reliability tested the consistency and dependability of the research instruments.

3.7.2.1 Reliability coefficients for quantitative data

For this research, internal consistency reliability was used. Internal consistency reliability assesses the consistency of results across items within a test. Cronbach's alpha (α), which is usually interpreted as the mean of all possible split-half coefficients was used. Cronbach's alpha (α) uses Statistical Package for Social Sciences (SPSS) to work out all the means of possible split halves of items in questionnaires. The higher the alpha is, the more reliable the test is. One advantage of Cronbach's alpha (α) was that it gave the coefficient values of reliability for both raw items and revised items. For this particular study, the reliability

coefficients of all quantitative research instruments used were above 0.7. The research instruments whose reliability coefficients were found included teachers' questionnaires (0.96), head teachers' questionnaires (0.95), CSOs questionnaires (0.73) and observation checklist on ICT infrastructure (0.71).

The comments from the teachers and head teachers from the pilot study that the aspect of ICT integration was missing in the study instruments led to the development of observation checklist on teacher computer capacity particularly for teachers who were in schools that had already received DLP devices. The study adopted the already piloted questions from the teachers' and head teachers' questionnaires to observe teachers practically as they manipulate laptop computers around specific computer skills such as rotation of images, creation of new word documents using Microsoft Excel and Microsoft Word, drawing and labelling tables, use of power point, saving contents to an external disk, animation, browsing using Mozilla or Explorer, sending and receiving e-mails, and printing a document from laptop computers.

Table 3.3. Reliability coefficients for data collection instruments

Research instrument	Reliability coefficient
Teachers' questionnaires	0.96
Head teachers' questionnaires	0.95
CSOs questionnaires	0.73
Observation checklists (ICT infrastructure)	0.71

3.7.2.2 Reliability of interview schedule

The interview schedule as a research instrument for this study relied on qualitative reliability whereby transcripts were checked in order to avoid obvious mistakes (Creswell, 2011, p.190). To ensure reliability of the interview questions, piloting was done. During piloting, the researcher noted challenges such as inability to operate the recorder

effectively and consistently when questioning the respondents. These challenges were effectively addressed by seeking for further training from experts of sound recorders who orientated the researcher on how to handle a digital recorder before recording, during recording and after recording. The training boosted the researcher's initial knowledge on operation of the digital recorder before piloting. The challenges that were witnessed during piloting such as quality of sound, inability to manage recorder properly and positioning of the respondent were effectively eliminated during the main study.

The researcher also checked the transcripts during the analysis of pilot study interviews and eliminated obvious mistakes that were made during piloting such as exposure of respondent's identity. Interview questions that elicited similar responses from the respondents during piloting were merged and this helped in avoiding unnecessary repetitions during the main study.

3.8 Data collection procedures

Before proceeding to collect data for the study, an introductory letter was obtained from the Dean, School of Graduate Studies, Rongo University to request for issuance of research authorisation permit from the National Commission for Science and Technology Innovation (NACOSTI). The permit enabled the researcher to collect both qualitative and quantitative data from the respondents in Homa Bay County. The research assistants who participated in data collection were trained and posted to different sub-counties of Homa Bay County.

The administration of research data collection instruments was done by the researcher and trained research assistants both at the pilot and main study. The research assistants were six

in number and had a minimum qualification of Kenya Certificate of Secondary Education (K.C.S.E). The research assistants were trained by the researcher on ethical values of research such as observing confidentiality and anonymity of the respondents. They were also given the time frame and return rate target of over 90%. The researcher cautioned the research assistants against fictitious data. The research assistants were also trained on how to interpret the research questions in each research instrument in case the respondents needed some assistance.

The six research assistants were only assigned the duty of collecting data from sample schools, teachers and head teachers using questionnaires and observation checklists. The researcher on the other hand did all the interviews and also participated in data collection using questionnaires from teachers, head teachers and CSOs. The researcher only visited a few schools in Homa Bay Sub-County for data collection using teachers' questionnaires and observation checklists. The researcher or research assistants visited the schools for data collection between 8.00 am and 5.00 pm which were the official working hours for schools.

Upon entry into a sample school for data collection, the researcher or research assistants had to see the head of the institution for permission. The filling of the teachers' questionnaires was instant when respondents were available and took them between 10 to 20 minutes. The researcher or research assistants gave support where necessary but did not assist respondents to give answers.

On administration of research instruments, separate questionnaires were administered by the study to the sample primary school head teachers and teachers in their respective

schools. 362 questionnaires were distributed to sample teachers in 85 randomly sampled schools in different sub-counties based on the teacher population strength in each sub-county. Each of the 85 schools received an average of 4 questionnaires. The remaining 22 questionnaires were randomly distributed to schools in the six sub-counties of Homa Bay. That is, schools that received the remaining 22 questionnaires received 5 questionnaires instead of 4. These schools with the remaining questionnaires were also randomly picked but remained within the 85 sampled schools. For the head teachers' questionnaires, the 85 sampled schools at least had a head teacher to fill a questionnaire.

The study administered questionnaires to the 9 sample Curriculum Support Officers (CSOs) in their offices situated in different sub-counties of Homa County. For CSOs questionnaires, the researcher visited their offices situated in different sub-counties. For the CSOs who could not fill the questionnaires instantly because they were either busy or not present in their offices were called by the researcher to let them know that a questionnaire was left for them to fill in their offices and would be collected after two weeks. The CSO's questionnaire took between 5 to 10 minutes to fill.

The researcher and the research assistants also made independent observations in 85 sample schools on ICT infrastructures with the guidance of school authorities. Observation checklists for ICT infrastructures and teachers in schools that had received DLP devices took an average of 20 minutes to record and were conducted by either the researcher or research assistants inside the school compounds.

Any teacher who was assigned to handle targeted DLP classes in each of the 56 sampled schools spread in different sub-counties that already had received DLP devices was

observed and results recorded by either the researcher or research assistants. The researcher or the research assistants observed the teachers' capacity to operate and effectively use laptop computers for teaching and learning. Each sample teacher was given a DLP laptop computer to manipulate particular computer skills that were required by the study as the researcher or research assistants observed and did recordings in a checklist.

The researcher arranged for the interviews at the interviewee's convenience. 2 head teachers were interviewed in their schools' offices and the remaining 4 were interviewed at their homes of residence. 2 teachers were interviewed in the CSO's office, 3 teachers in their homes while the remaining 7 teachers were interviewed at their stations of work. The researcher did all the recordings and transcriptions of data collected. The interview period took between 7 and 10 minutes.

In summary, data was collected by use of questionnaires from 362 and 85 sample teachers and head teachers respectively. 85 sample schools and 56 sample teachers in schools that had already received DLP devices were also observed for presence of the necessary ICT infrastructures and teacher's computer capacity respectively. Interviews were conducted with 6 head teachers and 12 teachers in Homa Bay County.

3.9 Data analysis techniques

The researcher used a number of statistical methods to analyse the collected data. Data was analyzed both qualitatively and quantitatively. Quantitative data was analyzed by use of both descriptive and inferential statistics.

For the research objective number one, the researcher used mean, frequencies, percentages and summations to analyze the presence or absence of a number of ICT infrastructures that

were necessary for the uptake and integration of laptop computer in public primary schools in Kenya. Data for this objective were also presented in tables.

For objective number two that measured teachers' computer capacity, descriptive statistics were also used. Tables were used for data presentation. The average means realized from this study were compared to the e-learning readiness level of 3.41 (Aydin & Tasci, 2005). The e-readiness point of 3.41 was based on the piloted research instruments of Aydin and Tasci (2005). The study modified such instruments to suit this research. The mean results were then interpreted as follows: 1.0-2.6, meant that the organization was not ready and needed a lot of work before the kickoff of e-learning; 2.6-3.4, explained that the organization was not ready, but needed some work before the launch of e-learning; 3.41 was the expected level of e-readiness and showed that the organization could launch e-learning without hesitation; 3.4-4.2, demonstrated that the organization was ready and only needed a few improvements; and lastly 4.2-5.0 was a category of an organization that was ready and comfortable to start e-learning. Any findings for this objective whose mean average was above 3.41 showed that teachers' computer capacity level was adequate for the launch of DLP.

Objective number three which determined the teachers' awareness of the various digital content that were to be delivered to pupils by use of DLP devices, the researcher again used descriptive statistics such as frequencies, percentages and summations for data analysis. Presentation of data was done in tables.

The objective number four measured teachers' attitudes. Descriptive statistics were used. Tables were used to exhibit data. The research results were again compared to the e-

learning readiness level of 3.41 (Aydin & Tasci, 2005). In this case too, the e-readiness point of 3.41 which was based on the piloted research instruments of Aydin and Tasci (2005) was used. The research instruments which were based on a five-point likert scale were modified to suit this research. The average mean results were then interpreted as follows: 1.0-2.6, meant that the organization was not ready and needed a lot of work before the kickoff of e-learning; 2.6-3.4, explained that the organization was not ready, but needed some work before the launch of e-learning; 3.4, was the expected level of e-readiness and showed that the organization could launch e-learning without hesitation; 3.4-4.2, demonstrated that the organization was ready and only needed a few improvements; and lastly 4.2-5.0 was a category that showed that an organization was ready and could launch e-learning. The research findings that were found to be above the mean average of 3.41 showed that teachers' attitude was positive and ready to embrace technology in teaching and learning.

For objective number five whose main aim was to analyze statistical contribution of independent variables (Institutional ICT infrastructures, teachers' computer capacity, teachers' awareness of the digital content and teachers' attitude) to the dependent variable (uptake and integration of laptop computer), multiple regression analysis was used such that the regression equation showed that:

$$Y= \alpha+ \beta_1X1 + \beta_2X2 + \beta_3X3+ \beta_4X4+\ldots+ e$$

Where Y= Uptake and integration of laptop computer readiness

X1= Teachers' computer capacity

X2= ICT policy

X3= Digital content awareness

X4=Teachers' attitude

X5= ICT infrastructure

e = Error (Either type I or type II error)

α = Constant

β = Beta

Statistical Package for Social Sciences (SPSS) version 20.0 was used to assist in data analysis.

Finally, interviews were recorded then transcribed with similar and relevant research information coded in major themes and reported in percentages, narratives and quotes to help strengthen results of quantitative data from observation checklists and questionnaires. To ensure that transcription captured all utterances as recorded, the researcher did not delegate this role to the research assistants (Jwan & On'gondo, 2011, p.104).

3.10 Ethical considerations

Ethical issues were considered in all components of this research. Among others, the following were observed: the researcher was permitted to collect data in public primary schools in Homa Bay County by the School of Post Graduate Studies of Rongo University and National Council for Science, Technology and Innovation (NACOSTI).

The researcher ensured that there were no fictitious data used for data analysis. The

response rate was not inflated to give inaccurate report. Confidentiality and anonymity of respondents were observed. That is, reported results did not include names of schools and respondents. Respect and professionalism were observed by both the researcher and the research assistants by ensuring that permission from heads of sample schools were sought before data collection. All respondents willingly participated in data. All source data and information were properly cited and referenced. Information received from respondents was only used for academic purposes.

3.11 Summary of the chapter

The chapter described the research design which was cross sectional survey. The population of the study was 8,261 consisting of teachers, head teachers, Curriculum Support Officers (CSOs) and teachers in schools with DLP devices. A total of 362 public primary school teachers, 56 teachers in schools with DLP devices, 85 sample schools, 85 head teachers in public primary schools and 9 CSOs were sampled for the study. In addition, 85 sample schools had their ICT infrastructure observed. Some 12 teachers and 6 head teachers in public primary schools were also interviewed. Piloting was done based on 10% of the sample size. One teacher and a head teacher were also used to pre-test interview schedules. The instruments were both found valid and reliable for the study. Data collection was done by the researcher and 6 trained research assistants. Both quantitative and qualitative data analysis techniques were used. Ethical considerations such as confidentiality and anonymity were observed. The following chapter presents results of analysis, discussions and interpretation of research findings.

CHAPTER FOUR

PRESENTATION, ANALYSIS, INTERPRETATION OF

RESEARCH FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter presents analysis of data, interpretation of findings and discussions of the study. Data was analyzed both quantitatively and qualitatively. Quantitative data was analyzed using both descriptive and inferential statistics. Descriptive statistics included percentages, means, frequencies and summations. Multiple regression analysis was used to show contributions of independent variables to uptake and integration of laptop computers for research objective number five. Qualitative data that emanated from interview schedules were analyzed by organizing them into main themes followed by open coding. Axial coding was used for creation of narratives and quotes out of the regrouped sub themes and converted into percentages.

The following research questions guided the study:

1. Are there appropriate institutional ICT infrastructure for uptake of laptop computers in public schools?
2. What capacity do teachers have for using laptop computer for teaching and learning in relation to their training?
3. What is the teachers' level of awareness of the digital content to be delivered to learners by use of laptop computer?
4. What are the teachers' attitudes towards laptop computer uptake and integration in public primary schools?

5. What is the contribution of independent variables of the study to uptake and integration of laptop computers for teaching and learning?

4.2 Response rate

After the successful administration of the various research instruments in line with their respective sample sizes, the response rate was as shown in Table 4.1. The response rate for teachers was 97.5%. The response rate for head teachers was 92.4%, while the response rate for Curriculum Support Officers (CSOs) stood at 88.9%. The response rate for observation checklists for teachers in schools with DLP devices and ICT infrastructures was 100%. Interviews were also successfully conducted with all sample respondents resulting in 100%.

Table 4.1. Response rate

Research Instrument	Sample size (n)	Response rate	Percentage
Teachers Questionnaires	362	353	97.5
Head teachers' questionnaires	85	79	92.4
CSO's Questionnaires	9	8	88.9
Observation Checklists (ICT Infrastructure)	85	85	100.0
Observation Checklist (Teacher's competence)	56	56	100.0
Interview Schedules	18	18	100.0

From Table 4.1, the response rate in all cases in this study was above 75%. This was adequate for data analysis. According to Fraenkel and Wallen (2009) the tenets of a good survey research is the high response rate as low response rates are considered a major threat to the usefulness and robustness of the data and results.

4.2.1 Response rate in terms of sub-counties

To establish response rate per sub-county, the researcher again categorized respondents based on the six sub-counties of Homa Bay. Response rate per sub-county was necessary for the researcher to establish the accuracy and reliability of analyzed data in each sub-county of Homa Bay. Response rate for teachers, head teachers and CSO's were worked out.

4.2.1.1 Response rate for teachers

Responses of teachers from the questionnaires were also stratified into the six sub-counties of Homa Bay County as shown in Table 4.2. A total of 353 (97.5%) teachers participated in the research and were represented in each sub-county according to the population strength of teachers in each sub-county. The response rates by sub-county ranged from 90.4% to 100% which was considered by the study as satisfactory.

Table 4.2: Response rate for teachers by sub-county

Sub-County	Sample size (n)	Response rate	Percent
Homa Bay	82	82	100.0
Mbita	40	40	100.0
R. North	65	65	100.0
R.South	73	66	90.4
Suba	35	33	94.3
Ndhiwa	67	67	100.0
Total	362	353	97.5

4.2.1.2 Response rate for head teachers

A total of 85 head teachers were sampled in the entire Homa Bay County. 79 out of 85 head teachers responded by filling in questionnaires and this represented 92.9 % of the

sample. The head teachers were further stratified into six sub-counties as shown in Table 4.3.

Table 4.3. Response rate for head teachers by sub-county

Sub- County	Sample size (n)	Response rate	Percent
Homa Bay	17	17	100.0
Mbita	11	10	90.9
R. North	17	14	82.4
R. South	16	16	100.0
Suba	9	9	100.0
Ndhiwa	15	13	86.7
Total	85	79	92.9

4.2.1.3 Response rate for Curriculum Support Officers

9 Curriculum Support Officers (CSOs) were sampled for the study. 8 CSOs out of 9, which represented 88.9% response rate, was realised.The responses were then stratified according to six sub-counties in relation to the population strength of CSOs in each sub-county as shown in Table 4.4.

Table 4.4. Response rate for Curriculum Support Officers by sub-county

Sub- County	Sample size (n)	Response rate	Percent
Homa Bay	2	2	100.0
Mbita	1	1	100.0
R. North	2	2	100.0
R.S outh	2	1	50.0
Ndhiwa	1	1	100.0
Suba	1	1	100.0
Total	9	8	88.9

4.3 Data screening

Data screening was done to both qualitative and quantitative data to ensure that only useful data for the study were analyzed. According to Creswell (2012), data cleaning is the process of inspecting data for missing scores and values that are outside the accepted range

(outliers). For qualitative data, responses that were outside the study area were excluded. Some of the screened and removed responses from the interview schedules were political in nature:

> Yaah! They ought to have introduced it earlier on which means they have delayed because they came up with the … they came up with the information on the laptop issue yet it was mainly for the campaign in order to get votes so that they can go to … they can go to parliament but they have delayed. It was started in early 19… 2013 but since then they have just brought back when election are nearing so which means they are not doing what they said so it is just being done in order to get votes then everything will be …(Teacher, Rachuonyo North).

Quantitative data from questionnaires and observation checklists were coded by the researcher and data entries made by a data entry clerk using SPSS version 20. To ensure clarity and completeness of data, data cleaning was done by the removal of the entire data from questionnaires that were not completely filled. In some instances when only very few questions remained unanswered in the questionnaires, they were treated as non-responses and were assigned a unique code (0) to avoid confusion during data analysis using SPSS. The unique code (0) assisted to establish non-response rates for specific questionnaire questions during data analysis. In support, Creswell (2012) says the researcher may clean the research data by either eliminating participants with missing scores and only include those participants with complete data or substitute numbers for missing data in the database for individuals.

4.4 Institutional Information Communication and Technology infrastructures

To establish the position of public primary schools in terms of the necessary ICT infrastructures, a total of 85 sample schools which were stratified into six sub-counties of Homa Bay were observed. The ICT Infrastructures for laptop computers in this study

comprised of the necessary facilities that the public primary schools under this research required for the launch and smooth usage of laptop computers for teaching and learning in schools. The study explored the availability of a number of facilities that were considered by the research as necessary for the uptake of laptop computers as expressed in objective one of this study. These were the availability of: computer safes, computer room chairs/desks, carpeted floors, internet, power sockets, laptop computer technical assistants, power generators, electric power, solar power, Uninterrupted Power Supply (UPS), computer laboratory attendants and computer room policy documents. The researcher or research assistants made direct observations and recorded availability or non-availability of the aforementioned ICT infrastructures in the sample schools as shown in Table 4.5.

Table 4.5: General ICT infrastructures in sampled primary schools

ICT Infrastructure	Available	Percent
Laptop computer safes	68	79.9
Computer room chairs	11	13.1
Carpeted floors	2	2.1
Internet	15	18.0
Power sockets	77	90.0
Laptop computer technician	14	17.6
Electric power	63	74.8
Power generators	5	5.6
Solar power	6	7.2
Uninterrupted power supply (UPS)	5	5.7
Laptop computer room attendant	19	22.0
ICT policy document	19	22.0
Average		29.8

n=85

The findings from Table 4.5 showed that 68 (79.9%) sample schools which were observed had at least a structure either built on the classroom wall or metallic box that they called laptop computer safes/store in their schools. 17 (20.1%) schools out of the 85 sample schools in the study had no laptop computer safes anywhere within their school compound.

When the researcher observed whether the designated DLP classrooms had appropriate chairs and desks for laptop computers, 11 (13.1%) sample schools had either made or purchased the required computer desks and chairs.74 (86.9%) sample schools still lacked appropriate furniture for handling laptop computers and tablets in their classrooms.

The nature of floors for the designated DLP classroom was observed to establish whether the classroom floors were carpeted to create dust free and safe environments for computer laptops and tablets. It was established that only 2 (2.1%) sample schools had their classroom floors carpeted. The majority of the sample schools, 83 (97.9 %), had no carpeted classroom floors.

Internet was a requirement for soft copy content display and delivery to learners by laptop computers. It was observed that 70 (72.0%) sample schools had no access to internet for teaching and learning. 15 (18.0 %) sample schools which already had received DLP devices, and particularly, wireless routers which had no internet service provider and, therefore, could not access the internet as was expected.

Laptop computers needed a source of power for running its programs. The sample schools observed indicated that 63 (74.8%) out of 85 sample schools had functional electric power, while 22 (25.2%) had no source of electric power. Only 5 (5.6%) sample schools observed had power generators as an alternative power supply in case of electric power blackout. The rest of the sample schools, 80 (94.4%), had no power backup generators. 6 (7.2 %) sample schools had solar power. A high number of sample schools, 79 (92.8 %), had no solar panels as either the main source of power or an alternative source of power for the schools during power blackouts. But when the researcher observed the power installation systems in DLP classrooms, it was established that 77 (90.0%) sample schools had power sockets on the walls of the designated laptop computer classrooms. 8 (10.0 %) sample schools had no power sockets placed anywhere on the walls of their designated laptop computer classrooms.

Uninterrupted Power Supply (UPS) was equally treated by this study as an alternative power source that could either be used to charge laptop computers or connect directly to laptop computers when either the laptop computer battery was faulty or during power blackouts. It was found that 5 (5.7%) sample schools, which had desktop computers before had UPSs. The remaining 80 (94.3%) sample schools had no UPSs.

For maintenance and repair of laptop computers, technical support either in school or at the county level was needed. The findings showed that 14 (17.6 %) sample schools had some people they believed could offer technical support informally. The remaining 71 (82.4%) sample schools did not know what to do with damaged and malfunctioning laptop computers.

As well, designated laptop computer classrooms needed somebody either employed by the school or government to look at the cleanliness of the classroom and safety of laptop computers in the school. It was observed that 19 (22.0%) sample schools had identified laptop computer classroom attendants. The majority of the sample schools, 66 (78.0%), had no idea of the necessity of computer classroom attendants.

Computer policy document was considered by the study as a requirement for any institution engaging in e-learning. As part of ICT infrastructure, computer room policy document could specify the day- to- day operations in a computer room. It could also outline the responsibilities of each personnel in an e-learning environment. It was observed that 19 (22.0 %) sample schools had some written guidelines which they considered as ICT policies while 66 (78.0%) which were the majority had no idea of ICT policies in their schools.

4.4.1 Institutional Information, Communication and Technology infrastructures in sub-counties

To further establish equity in distribution of the necessary ICT infrastructures, the study investigated the availability of ICT infrastructures in each six sub-counties of Homa Bay County which were under study. The six sub-counties were: Homa Bay, Mbita, Rachuonyo North, Rachuonyo South, Suba and Ndhiwa. The results were tabulated as shown in Table 4.6.

Table 4.6. ICT infrastructures in sub-counties

Sub-Counties	Homa Bay	Mbita	R. North	R. South	Suba	Ndhiwa	Average
ICT infrastructure	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Laptop computer safes	94.1	90.9	76.5	68.8	88.9	60.0	79.9
Computer room chairs	29.4	18.2	11.8	12.5	0.0	6.7	13.1
Carpeted floors	0.0	0.0	0.0	12.5	0.0	0.0	2.1
Internet	11.8	27.3	5.9	18.8	44.4	0.0	18.0
Power sockets	88.2	81.8	100.0	87.5	88.9	93.3	90.0
Laptop computer technician	0.0	18.2	17.6	25.0	44.4	0.0	17.6
Electric power	94.1	81.8	94.1	87.5	44.4	46.7	74.8
Power generators	5.9	9.1	5.9	12.5	0.0	0.0	5.6
Solar power	11.8	9.1	0.0	0.0	22.2	0.0	7.2
Uninterrupted power supply (UPS)	0.0	27.3	0.0	0.0	0.0	6.7	5.7
Laptop computer room attendant	0.0	45.5	29.4	12.5	44.4	0.0	22.0
ICT policy document	5.9	45.5	29.4	0.0	44.4	6.7	22.0
Average	28.4	37.9	30.9	28.1	35.2	18.3	29.8

n=85

The findings from Table 4.6 showed that 94.1% sample schools in Homa Bay Sub-County, 90.9% in Mbita Sub-County, 76.5% in Rachuonyo North Sub-County, 68.8% in

Rachuonyo South Sub-County, 88.9% of the sample schools in Suba Sub-County and 60.0% of the sample schools in Ndhiwa Sub-County had laptop computer safes or stores either built on the classroom walls or had a separately built metallic safe within the school compound. Based on the findings, Homa Bay Sub-County had the highest number of computer safes or stores available for laptop computer storage.

The study also observed the existence of suitable chairs and desks that could be used by learners to rest their tablets. 29.4% of sample schools in Homa Bay, 18.2% of sample schools in Mbita, 11.8% of sample schools in Rachuonyo North, 12.5% of sample schools in Rachuonyo South, no sample school in Suba and 6.7 % of sample schools in Ndhiwa had appropriate desks or tables to use for teaching and learning using laptop computers. The findings revealed that most schools in the entire county registered very low commitment to desks and tables for uptake of laptop computers in public primary schools in Homa Bay County.

The nature of the classroom floors that were expected to host laptop computers was also observed. For computers to function properly, they had to be in a dust free environment. Dust interferes with key pads and circulation of air in and out of the digital devices. Any blockage of air circulation would interfere with the safety of laptop computers. It was observed that the floors of all the sample schools that were sampled in the six sub-counties were not carpeted apart from a small percentage (12.5%) of the sample schools in Rachuonyo South Sub-County.

The availability of internet in all public schools in Homa Bay County was regarded by the study as important for content transmission and research by teachers and learners. It was

realized that 11.8% of the sample schools in Homa Bay, 27.3 % of sample schools in Mbita, 5.9 % of sample schools in Rachuonyo North, 18.8% of sample schools in Rachuonyo South, 44.4% of sample schools in Suba and no sample school in Ndhiwa had no source of internet connection.

Power sockets were necessary for charging laptop computers and tablets. It was revealed that 88.2% of sample schools in Homa Bay, 81.8% of sample schools in Mbita, all sample schools in Rachuonyo North (100.0%), 87.5% of sample schools in Rachuonyo South, 88.9% sample schools in Suba and 93.3% of sample schools in Ndhiwa had power sockets.

According to the study, each sample school studied needed a technician to take care of laptop computers and tablets' breakages or difficulties in operations. The study showed that the sample schools in Homa Bay and Ndhiwa sub-counties had nobody in mind that they could refer to incase of breakages or faults in laptop computers and tablets. 18.2% of sample schools in Mbita, 17.6% of sample schools in Rachuonyo North, 25% of sample schools in Rachuonyo South and 44.4% of the sample schools in Suba had identified some people they could rely on when the devices were faulty.

The requirement for any device that uses electricity to function is the source of power. It was established that 94.1% of sample schools in Homa Bay Sub-County, 81.8 % of sample schools in Mbita Sub-County, 94.1% of sample schools in Rachuonyo North Sub-County, 87.5% of sample schools in Rachuonyo South Sub-County, 44.4% of sample schools in Suba Sub-County and 46.7% of sample schools in Ndhiwa Sub-County had electricity generated by Kenya Power and Lighting Company. The findings noted that there was still an averagely low supply of electricity in both Suba and Ndhiwa sub-counties to sample

schools.

Apart from the electric power mentioned above, some other power backups were needed especially when electric power was not there. It was revealed that only 5.9% of the sample schools in Homa Bay , 9.1% sample schools in Mbita ,5.9% sample schools in Rachuonyo North and 12.5% sample schools in Rachuonyo South had power generators to use in case of prolonged power blackouts. Alternatively schools also needed to be equipped with solar panels to use either directly during the learning process or when there were power blackouts. The study found that 11.8% of sample schools in Homa Bay, 9.1% of sample schools in Mbita and 22.2% of sample schools in Suba had solar panels. The sample schools in the rest of the sub-counties of Homa Bay had no solar power.

Uninterrupted Power Supply (UPS) were necessary to cushion against abrupt power interruption especially when the laptop computer and tablet batteries were either low or not working. 27.3% of sample schools in Mbita and 6.7% of Suba had UPS. These sample schools with UPS had desktop computers in their schools. The rest of the sample schools in the remaining sub-counties had no UPS.

Apart from the teachers in school, a support staff in charge of laptop computers and tablets was a requirement according to this study. It was established that sample schools in two sub-counties of Homa Bay and Ndhiwa had no idea on the need to have a support staff for DLP. However, 45.5% of sample schools in Mbita, 29.4% of sample schools in Rachuonyo North, 12.5% of sample schools in Rachuonyo South and 44.4% of sample schools in Suba referred to their teachers as the classroom attendants for laptop computers in school. No sample school in all the sub-counties had specifically employed attendants for laptop

computers in their schools.

Finally, a document that could give direction on handling, repair and general usage of laptop computers and tablets needed to be available in each sample school. The study found that 5.9% of sample schools in Homa Bay, 45.5% of sample schools in Mbita, 29.4% of sample schools in Rachuonyo North, 44.4% of sample schools in Suba and 6.7% of sample schools in Ndhiwa had some guidelines on the handling of DLP devices.

4.4.2 Discussion

The general ICT infrastructures in public primary schools in Homa Bay County stood at 29.8% which this study considered to be low and needed to be improved. The research findings on ICT infrastructures in public primary schools in Homa Bay County showed that each sample public primary school in Homa Bay County had the knowledge of some ICT infrastructures required to support the paradigm shift in teaching and learning that involved the use of electronic devices. That is to say, respondents were aware of the Government of Kenya's initiative to migrate from hard copy books to digital learning platforms. But contrary to the expectations of the ICT Authority of Kenya that before DLP integration, each DLP school should have source of electricity, secure storage cabinets, flat surface desks, burglar proof doors and windows dust proof floors (Kenya. DLP Secretariat, 2016, pp. 9-10), the research findings revealed that the government selectively funded laptop computer storage facilities, electric power and installation power sockets in public primary schools and ignored other ICT infrastructural areas. The general ICT infrastructures for DLP remained inadequate in most sampled public schools in Homa Bay County. The findings were in line with European Commission (2011) revelation that access to ICT infrastructure was core to the establishment of any ICT program and the

absence of such infrastructures could negatively impact the delivery of teaching and learning in an institution.

To further triangulate data on ICT infrastructures in these sample schools, the study conducted oral interviews with a total of 6 head teachers and 12 assistant teachers in Homa Bay County with the main question asking for the adequacy of ICT infrastructures in their respective public primary schools. In their response, 18 (100%) respondents were in concurrence with the outcome of the observation checklist that there were inadequate ICT infrastructures in their respective schools. These research findings were also in line with Khan et al. (2012) who observed that lack of ICT resources is a major threat to the growth of ICT in the developing countries like Kenya. The study interviews also confirmed that the Government of Kenya was in touch with all public primary schools as far as laptop computer uptake was concerned. For example, the 18 (100%), sample respondents who were interviewed agreed to have some knowledge on the basic ICT infrastructures that were necessary for the uptake of laptop computers in schools such as a steady source of power for the digital equipment such as laptop computers.

Many sample schools that were observed by this study had at least a structure they were referring to as laptop computer safes in their schools. This was confirmation of the report issued by the Government of Kenya that all public primary schools in Kenya had been allocated Kshs. 1.27 Million ($ 14,111USD) for storage facilities (Republic of Kenya, 2015). It was true that the government disbursed funds to public primary schools to build storage facilities for DLP devices. However, the money which was disbursed to schools was not enough for storage facilities and installation of electricity in DLP classrooms in

many sample public primary schools in Homa Bay County thereby leaving 18 (21.1%) sample schools in the county unable to account for the funds since their schools had no storage facilities. Lack of storage facilities in some sample schools could also be linked to embezzlement of public funds by head teachers since the government did not provide an alternative list of schools that did not receive such funds in the country. When the study compared its findings of 79.9% availability of computer safes to that of ICT Authority (2016), 93.3%, and did not give any report whether the DLP classrooms had power sockets on the wall or not. The study observed that sample public primary schools in Homa Bay County were ready for DLP in terms of storage facilities for DLP devices.

However, it also came to the attention of the study that a number of storage facilities were incomplete and unsafe for use at the time of the study and posted a lot of security risks in primary schools (Kenya. ICTA, 2016, Standard Team, 2019). To confirm this, there were calls from all directions for teachers to improve on the security of DLP devices in their schools (Muriuki, 2017; Buchele, et al., 2007). The calls to secure schools for DLP was supported by ICT Authority in Homa Bay County which in its report had received six thefts and three attempted thefts reports from different schools in Homa Bay County. The study noted that there were difficulties of securing DLP devices because the situations of the classrooms where DLP devices were to be kept in many schools were pathetic and indeed some of these classrooms were wall-less (Kubania, 2014). On the other hand, there was completely no uniformity in the way laptop storage facilities were built and distributed in schools sampled. According to the Kenyan DLP Secretariat (2016), a secure storage cabinet should have had sufficient number of power sockets and power strips to charge

devices. The storage cabinet should have been either metallic or concrete with burglar proof doors.

The specifications for building storage cabinets were never followed since each school was allocated money without adequate information on construction. The outcome of such construction was that schools ended up constructing safes of their own designs. The only common thing that most schools observed was that the safes were built in designated rooms for standard one learners, a position that was refuted by ICT Authority in Homa Bay County in its report. The ICT Authority in Homa Bay County maintained that schools only needed an ICT room and not a classroom. Nevertheless, teachers' recognition of ICT rollout in schools proved that teachers were expected to be facilitators of DLP (National Centre for Education Statistics, 1998; Republic of Kenya, 2015; Sharples & Moldéus, 2014).

Some sub-counties registered higher percentages of installation of power sockets than others. Although the research findings were in concurrence with the ICT Authority of Homa Bay County that most schools had power sockets, their statistics differed slightly. That is, the ICT Authority of Homa Bay County recorded no information on power socket installations while the government at the national level indicated that all schools had complete wiring done (Republic of Kenya, 2015). However, the study findings only registered 77 (90. 0%) sockets in all sample schools. It was not very clear to the study why 8 (10.0 %) schools that were sampled were still lacking power sockets, yet the government had disbursed funds for the same to all public schools in the Republic of Kenya (Republic of Kenya, 2015).

The study also found that classrooms that were set to receive laptop computers and tablets did not have appropriate chairs and tables for laptop computers. The study observed that 86.9% sample schools had no properly designed laptop computer desks but the ones that were there were dilapidated and, in most cases, had more pupils than their seating capacity in many sample schools that had high population of pupils. These desks had tops that were narrow and not steady to host tablets for each pupil. Apart from being uncomfortable, laptop computers and tablets risked slipping and falling down on the floors during the learning process. The poor state of classrooms was in line with findings of Sharples and Moldéus (2014), Kubania (2014) and Omanga (2018) who noted that the state of infrastructures in public primary schools in Kenya were not conducive for DLP. The standard desks or tables used in class should have had flat surfaces (Kenya. DLP Secretariat, 2016, p.10). The majority of schools in all sub-counties of Homa Bay County registered fewer numbers of appropriate desks and tables for teaching and learning using laptop computers and tablets. The sub-county of Suba was hard hit as no sample school had appropriate desks or tables for laptop computers and tablets. The main reason mentioned by the respondents of Suba during the interview session was the inability of most public primary schools to buy or make the right furniture for laptop computers and tablets on their own. Lack of appropriate desks and chairs could grossly affect the uptake of laptop computers in Homa Bay County because many people view school infrastructural development as an activity that has been left in the hands of poor parents and communities and as such, public primary schools lacked classrooms to accommodate learners leave a lone desks and tables for DLP (Kubania, 2014).

In connection to classroom desks, the study revealed that only 2 (2.1%) schools in the county which were in Rachuonyo South Sub-County had the designated DLP classrooms carpeted. The rest of the sample schools in the remaining sub-counties of Homa Bay had no carpets on their floors at the time of the study. This was observed by the study as a threat to the life span of the laptop computers and tablets as dust from classroom floors could easily accumulate and cause overheating of laptop computers due to shortage of air circulation. It was noted by the study that a good number of classroom floors were cemented but still were dusty to host laptop computers and tablets. The carpeted floors were needed to provide cover for dusts and prevent breakages of tablets in case they slip and fall on the floor. The life span of laptop computers was also greatly compromised in a dusty environment. In support KESSP research data revealed that from 2003, Kenya still had a shortfall of 43,000 classrooms countrywide, and of the ones that were there, 32% were found to be below standard (Kenya. Ministry of Education, 2005, p.1).

63 (74.8%), which was the majority of the sample schools under study, had functional electric power. However, the study established that some of the remaining sample public primary schools without functioning electricity had power lines and electricity transformers at a close range for tapping. The outcome of the study proved that indeed the government had invested a lot of money for the provision of electricity to all public schools. The research outcome was in concurrence with the Government of Kenya's declaration that over 19,000 schools had been connected to the national power grid by 2015 (Republic of Kenya, 2015). The power connection statistics were further confirmed by comparing the nationwide connection as reported by the Government of Kenya 19000

(84.4 %) schools (Republic of Kenya, 2015), ICT Authority Homa Bay County 725 (85.8%) schools (Kenya. ICTA, 2016) and the study's findings that stood at 63 (74.8%).

However, there appeared also to be disparities in power distribution among the sub-counties of Homa Bay. For instance, Homa Bay and Rachuonyo North sub-counties had the highest number of connections at 94.1% each while Suba and Ndhiwa sub-counties registered the least connections at 44.4% and 46.7 % respectively of the schools. This report is in complete disagreement with the Government of Kenya report which showed that power connections in Suba stood at 78.4 % (Kenya. ICTA, 2016). The disparity agrees with the findings of National Centre for Education and Statistics (1998) revelation that there was discrimination in the provision of ICT infrastructure in the late 1990's where wealthier suburban schools enjoyed more facilities than poor schools in the United States of America.

The findings from interview schedules found that 12 (66.7%) respondents had electricity in their schools. Interestingly, Suba which had the least electric power connections had the highest number of solar power connections at 22.0% which was ahead of all other sub-counties of Homa Bay. The findings which were confirmed by ICT Authority of Homa Bay that had also put solar distribution in Suba at 16% which was higher than the rest of the sub-counties in Homa Bay. The inequitable distribution of power in Kenya was linked to the Rural Electrification Program that seemed to have also stratified regions in such a way that some regions were served ahead of others. In terms of laptop computer program, it meant that schools with the required infrastructures such as steady source(s) of power

were well ahead of others in uptake of e-learning (Hennessy et al., 2010; Hermandez, 2017; Kubania, 2014; Mulwa et al., 2012).

The availability of UPSs and power generators were found by the study to be very few across all the sub-counties of Homa Bay. The study observed that the stakeholders and the government underrated the role of power backups in a system that had unsteady supply of power (Mulwa et al., 2012). Although laptop computers and tablets had batteries that could take a minimum of 6 hours and a maximum of 30 hours, learning could severely be affected when the power blackouts took more than two days (Kenya. ICTA, 2016). In addition, other DLP devices such as projectors had no batteries and depended wholly on external power sources. A steady source of power was needed for any digital device to function optimally for the benefit of teaching and learning (Hannessy et al., 2010). But the participants and implementers of e-learning needed not over trust one source of power because there could be power surges or technical hitches in power system without notice (Khan et al., 2012). The UPS and power generators as alternative sources of power could be used to charge laptop computer batteries as well used directly during teaching and learning. The researcher noted no disparities in terms of availability of UPS and generators in sub-counties of Homa Bay since all the sub-counties registered very few cases of generators and UPS in schools.

Content delivery from KICD to learners through the use of Learner Digital Device (LDD) and Teacher Digital Device (TDD) could either be offline or online (Kenya. DLP Secretariat, 2016). The availability of internet and intranet in all public primary schools in Kenya was, therefore, a requirement to support online education. This is because schools

needed not to visit KICD physically for content for DLP. Also, teachers by use of browsers could source for additional teaching materials by use of the internet (Kenya. DLP Secretariat, 2016, pp. 19-20). However, the study only established that only a few schools in 5 sub-counties of Homa Bay County that had received the digital learning devices had been given inactive routers that could connect them to KICD for the digital content deployment. No internet service providers were available to be used by such routers. In addition, teachers appeared not to have adequate expertise in configuration of the servers to TDD and LDD because it needed advanced ICT skills (Kenya. DLP Secretariat, 2016, p.21). The provided DLP servers could only provide stored digital content from KICD instead of internet. Sample schools in Suba Sub-County showed no presence of such servers and routers simply because ICT Authority in Kenya was distributing these devices in phases. Internet was expected to expand the knowledge base of the teachers and learners by directly sourcing information from KICD and World Wide Web (WWW). In support, European Commission (2011) argued that modern education in class was beyond the use of computers alone. Both teachers and students needed to make good use of WWW. Mulwa et al. (2012) added that an organization should be ready for an online education by putting in place both intranet and internet. To further prove the impact of internet in teaching and learning, ICT Authority of Kenya demanded that teachers needed to either get digital contents directly from KICD or develop their own contents for usage using the DLP devices. And because internet was not available in 70 (82.0%) sample schools under study, readiness for the integration of DLP was greatly compromised. This was in line with Clark (2001) who observed that internet technology has shown a lot of impacts in an educational environment.

A computing environment should at least have somebody with know how to assist teachers and pupils when there is a breakdown or programming of the operating systems apart from simple provision of computer tutorials. The research revealed that all sample schools in both Homa Bay and Ndhiwa sub-counties had nobody in mind that they could refer to as either laptop computer assistant or technician. The remaining sub-counties registered very low percentages, but the people they were relying on as either technicians or laptop computer room attendants were simply teachers within their schools. This was dangerous to the uptake of laptop computers because faults and breakages of DLP devices could interfere with smooth learning (Wanzala & Nyamai, 2018). Technicians and ICT support staff were necessary in situations where teachers were not sure of connecting laptop computers to the tablets, servers and the projector. This is because connections of DLP devices needed advanced computer skills (Kenya. DLP Secretariat, 2016). In support, European Commission (2011) also noted that there is no meaningful e-learning without proper technical support.

In recognition of the role of technical staff, ICT Authority of Kenya gave contacts of Moi University, Jomo Kenyatta University and ICT Authority of Kenya as support contacts which actually were too far from sub-counties under study (Kenya. ICTA, 2016). In addition, the respondents were not advised accordingly on these contact organizations and had no specific contacts in case of challenges (Standard Team, 2019). The same statement was echoed by a teacher who was interviewed and said:

> And then we have machines which are going to breakdown, so far, nobody has told us how they are going to be replaced or is it that the individual said we are going to stay that way if the machine breaks…(Teacher, Mbita).

Computer room policy document was considered by this study as a key infrastructural document both at the national and school level. Such a crucial policy document was expected to define the management and functionality of digital devices in institutions. When the researcher/research assistants visited the sample schools for observations, 66 (78.0 %) schools had no knowledge of any ICT policy documents. That means, the ICT policy documents both from the national level to school level were not available in schools to give directions. McGrath (2006) supported by saying that policy guidelines must not be ignored because they raise a number of questions that need to be answered in an e-learning organization such as: Who will coordinate these programs? Who will monitor or enforce participation?

A few schools that claimed to have the ICT policy document showed some rudimentary documentation especially in their staff minutes book indicating the names of teachers in their schools who were allocated duties to be in charge of DLP in their schools. On the other hand, it was possible that some schools without the prior knowledge of the necessity of an ICT policy document could uptake and integrate laptop computers in their institutions without the ICT policy document in place. Without such a crucial document, the entire Digital Literacy Programme (DLP) could be messy based on the fact that institutions could not successfully work without regulations governing such issues as: how to procure, how to use, how to store and how to repair digital devices, among others (European Commission, 2011). In support, the Ministry of Education in Kenya in the year 2006 came up with an ICT policy document that laid the foundation for DLP and other ICT initiated projects in Kenya like the Nepad e-schools. In addition, East African countries had also developed their own ICT policy documents (Kenya. MoE, 2006;

Hennessy et al., 2010). In South Africa, for example, Plessis and Webb (2012) attributed low uptake of e-learning to the apartheid policy prior to 1994 that discriminated Africans.

4.5 Teachers' computer capacity

The study sought to establish the teachers' computer capacity to: rotate images, create documents using Microsoft Word and Excel, draw and label diagrams using computers, use of power point to present lessons, save contents to an external disk (flash disk), animate using a computer, access the internet using Mozilla or Internet explorer, send and receive e-mails, and finally print a document. The study also examined teachers' attendance of any computer training/computer literacy courses and whether the respondents had attended DLP training on uptake and integration of laptop computers or not. The need for computer training among the teachers was believed to be too demanding and there was need to let teachers learn how to use computers by experimenting with them (Tilya, 2007). It was generally acceptable that the e-learning competencies for teachers required tailored courses on the technical use of computers and other e-learning tools (Ouma, Awuor, & Kyambo, 2013). The competencies of the respondents were assessed using questionnaires, observation checklists and interview schedules.

4.5.1 Attendance of general computer training by teachers

Teachers were from different training backgrounds. Some had prior computer knowledge before DLP training while others did not have as shown in Table 4.7.

Table 4.7. Attendance of general computer training by teachers

Response	Frequency	Percent
Yes	199	56.4
No	153	43.3
Non-Response	1	0.3
Total	353	100.0

n=353

From the findings in Table 4.7, it is evident that majority of the respondents, 199 (56.4%), had undergone some computer training while the minority, 153 (43.3%) did not have any prior computer training. 1 (0.3%) respondent did not respond to this question.

4.5.2 Duration of computer training for teachers

The training duration was a critical area for success of laptop computers and tablets integration among the teachers and learners. Teachers were expected to use their computer competencies to successfully train pupils to use and learn with tablets.

Table 4.8. Duration of computer training for teachers

Training period	Frequency	Percentage
5 days	56	28.2
1 week	37	18.6
2 weeks	12	6.0
3 weeks	10	5.0
One month	22	11.1
More than one month	57	28.6
Non-Response	5	2.5
Total	199	100.0

n=199

The results from Table 4.8 shows that 13 (18.6%) respondents underwent one-week computer training, 12 (6.0%) respondents took three weeks to train, 22 (11.1%) respondents were trained for one month and 57(28.6%) respondents had trained for more

than one month. 5 (2.5%) respondents did not give their responses. The research revealed that 56 (28.2%) respondents had gone for five-day training. It was, therefore, revealed that majority of the teachers had acquired basics of computer training elsewhere and that these trainings lasted for more than one month.

4.5.3 Attendance of government's Digital Literacy Programme training

Digital Literacy Programme (DLP) training was a government sponsored training for teachers, head teachers and CSOs to equip them with necessary computer skills for launching digital learning in public primary schools.

Table 4.9. Attendance of Government of Kenya's training on ICT integration

Respondents	Yes	No	Non-Response	Total
Teachers**(n=353)**	109(30.9%)	216(61.2%)	28(7.9%)	353(100.0%)
Head teachers **(n=79)**	59(74.7%)	20(25.3%)	0(0%)	79(100.0%)
CSOs **(n=8)**	4(50.0%)	4(50.0%)	0(0.0%)	8(100.0%)

From Table 4.9, the findings show that 216 (61.2%) sample teachers, who were the majority, had not been offered DLP training by the government in Homa Bay County. The findings also showed that 109 (30.9%) sample teachers had been trained by the government, while the remaining 28 (7.9%) sample teachers failed to declare their position as either trained or untrained by the government. The number of sample head teachers who had been trained by the Government of Kenya at the time of this research stood at 59 (74.7%). 20 (25.3%) sample head teachers had not been trained by the government. 4 (50%) sample Curriculum Support Officers (CSOs) had been trained by the government while the remaining 4 (50%) sample CSOs had not been trained on DLP by the

government. Based on these findings, only half (50%) of sample CSOs had been trained on laptop computer integration in public primary schools in Homa Bay County.

4.5.4 Number of teachers trained on Digital Literacy Programme by the government per sub-county

To establish the levels of DLP teacher trainings based on each sub-county of Homa Bay, the study stratified teachers into six sub-counties as shown in Table 4.10.

Table 4.10. Number of teachers trained on DLP by the government per sub-county

Sub-County	Number trained %	Number untrained %	Non-Response %	Total %
Homa Bay	31(37.8%)	39(46.7%)	12(14.6%)	82(100.0%)
Mbita	21(52.5%)	19(47.5%)	0(0.0%)	40(100.0%)
R. North	11(16.9%)	48(73.8%)	6(9.2%)	65(100.0%)
R. South	21(31.8%)	38(57.6%)	7(10.6%)	66(100.0%)
Suba	10(30.3%)	20(60.6%)	3(9.1%)	33(100.0%)
Ndhiwa	15(22.4%)	52(77.6%)	0(0.0%)	67(100.0%)
Total	109(30.9%)	216(61.2%)	28(7.9%)	353(100.0%)

n=353

It was revealed as shown in Table 4.10 that out of the sample size of 82 teachers in Homa Bay Sub-County only 31 (37.5%) had been trained on DLP. In the Sub-County of Mbita, 21 (52.5%) sample teachers had been trained on DLP. Rachuonyo North Sub-County had only 11 (16.9%) out of 65 teachers of the sample teachers who had attended DLP training. On the other hand, Rachuonyo South Sub-County registered 21 (38.8%) sample teachers

who had been trained by the government on DLP. In Suba Sub-County, the number of sample teachers who had received DLP training was equally low standing at 10 (30.3%). 15 (22.4%) of the sample teachers in Ndhiwa Sub-County had been trained by the government on DLP. It was, therefore, noted that apart from Mbita Sub-County that registered more than half the number of sample teachers having been trained on DLP, the rest of the sub-counties of Homa Bay County registered low percentages of sample teachers trained on DLP.

4.5.5 Number of head teachers trained on Digital Literacy Programme by the government per sub-county

The head teachers were also part of the DLP training. The study grouped the head teachers in line with their sub-counties to establish the number that benefitted from DLP training as shown in Table 4.11.

Table 4.11: Number of head teachers trained on Digital Literacy Programme by the government per sub-county

Sub-County	Number trained %	Number untrained %	Total %
Homa Bay	13(76.5%)	4(23.5%)	17(100.0%)
Mbita	9(90.0%)	1(10%)	10(100.0%)
R. North	13(92.9%)	1(7.1%)	14(100.0%)
R. South	13(81.3%)	3(18.7%)	16(100.0%)
Suba	8(88.9%)	1(11.1%)	9(100.0%)
Ndhiwa	3(23.1%)	10(76.9%)	13(100.0%)
Total	59(74.7%)	20(25.3%)	79(100.0%)

n=79

The findings based on Table 4.11 above revealed impressive efforts by the Government of Kenya on the training of head teachers in Homa Bay County. Apart from Ndhiwa Sub-County that registered only 3 (23.1%) sample head teachers to have been trained on DLP, all the remaining sub-counties of Homa Bay recorded higher percentages. The leading sub-county was Rachuonyo North which recorded 13 (92.9%) trained sample head teachers. This was closely followed by Mbita Sub-County which had 9 (90.0%). Suba Sub-County registered 8 (88.9%) of the sample head teachers in that sub-county to have been trained on DLP. Rachuonyo South training of sample head teachers stood at 13 (81.3%) while, Homa Bay Sub-County had 13 (76.5%) of the total sample head teachers trained on DLP.

4.5.6 Number of teachers who were trained by Digital Literacy Programme trained teachers in schools

The teachers and head teachers who were trained on DLP were expected to train other teachers in their respective schools. Table 4.12 shows the number of schools that had their teachers trained by their colleagues after the DLP training.

Table 4.12. Number of teachers who were trained by DLP trained teachers in schools

Number of teachers trained by DLP teachers per school	Number of schools	Percent
0	35	44.3
1	3	3.8
2	20	25.3
3	7	8.9
4	9	11.4
5	0	0.0
6	2	2.5
7	1	1.3
8	1	1.3
9	0	0.0
10	1	1.3
Average		1.27

n=79

The study revealed that 35 (44.3%) sample schools had no teacher trained in their respective schools after the DLP training. 3 (3.8%) sample schools had one teacher trained, 20 (25.3%) sample schools had 2 teachers trained each, 7 (8.9%) sample schools claimed to have trained 3 teachers, 9 (11.4%) sample schools trained 4 teachers, 2 (2.5%) sample schools had 6 teachers trained and the remaining 3 sample schools each (1.3%) had 7, 8 and 10 teachers trained on DLP respectively.

4.5.7 Discussion

Computer training for the teaching staff was a very critical area of concern for the DLP in Kenya because teachers and head teachers were at the center stage of DLP implementation. Teachers and head teachers were the instructors in schools and their main mission in schools was to integrate technology in schools by introducing DLP devices and assisting learners to adopt them as tools of learning. In support, European Commission (2011) regarded teachers as key individuals charged with the responsibility of helping students develop ICT skills in the classrooms. Teachers' computer capacity needed to be thoroughly built so that their facilitation role in and out of classroom could be effective (Hernandez, 2017).

The findings of this research showed that the government's commitment in the roll out of ICT literacy in different learning institutions in Kenya was overwhelming because computer training for teachers in various learning institutions in Kenya started long before the idea of DLP in Kenyan primary schools was mooted (Kenya. MoE, 2006). This is because the research findings showed that 199 (56.4%), who were the majority of the respondents, had attended computer training at various institutions and not specifically the tailored DLP training that was offered by the Government of Kenya. In fact, the duration of training for majority of the teachers, 57 (28.6%), was found to have lasted for more than one month as opposed to the five-day DLP training. DLP training was launched in 2015 (Republic of Kenya, 2015). Notably, 109 (30.9%) sample teachers and 59 (74.7%) sample head teachers were offered specialized DLP training in Homa Bay County. The research findings differed with the national statistics which indicated that all head teachers (100.0%) and at least two other teachers in a public primary school had been trained on

DLP by August 2015 (Republic of Kenya, 2015). The training required no entry level for computer training for trainee teachers. The study observed that with the introduction of such training, a lot of emphasis needed to be put in computer training because the percentage, (56.4%), of the sample teachers who were computer literate at the time of this study was higher than the percentage, (30.9%), of the DLP trained sample teachers in Homa Bay County. This was a clear manifestation that the pace of DLP training was low and demanded quick remedy.

Ironically a higher proportion, 59 (74.7%), of the sample head teachers were reported by this study to have received DLP training. Even though the DLP trained head teachers were also classroom teachers, their roles in ICT integration process extended also to management of DLP in their respective schools and, therefore, there was no guarantee that the trained DLP head teachers would handle DLP in classrooms as compared to classroom teachers. On that note, the study expected more DLP trained teachers than head teachers. The study showed that such DLP training was necessary to jumpstart laptop computer integration in schools. In support, the Ministry of Education in Kenya was committed to facilitate ICT as a tool for education in all institutions of learning in Kenya by use of appropriate ICT infrastructures, teacher competencies and policies (Kenya. MoE, 2006, p.9).

The study also indicated that even though the 5-day DLP training offered to teachers by the government in 2015 was believed to be too short, it helped a lot to familiarize the teachers with the much-needed educational software (European Commission, 2001, p.27). In fact, it was important for some of the teachers who had the opportunity to touch and feel

computers for the first time in their lives. In concurrence, European Commission (2001) suggested that training should be done in phases and the very first one should only be a key opener to the world of ICT by exposing trainees to different ICT tools before actual training begins.

Generally, the study considered the Kenyan 5-day DLP training as a familiarizing phase of technology adoption awaiting actual training. In fact, respondents were interviewed not comfortable with the five-day DLP training claiming that the training period was not commensurate with the tasks that teachers were expected to perform in classrooms with DLP devices under their control. For instance during the interviews one respondent said:

> Two teachers and a head teacher were trained during ICT training but because of lack of exposure with these machines. I wonder whether they still have the knowledge. It is now two years. Those who were trained did not train others because there was no machine…(Teacher , Dhiwa).

Contrary to the views of the respondents, the study established that the 5 days training equally empowered a number of teachers and made a difference in computer skills rating between the teachers who attended and those who did not attend. The findings on the teachers' computer capacity especially the mean scores for teachers who were DLP trained (3.42) and those in schools that had received DLP devices (3.68) showed that they were more proficient in computer applications than their colleagues who did not attend such trainings (2.10). These revelations showed that the government succeeded in DLP training for teachers but were in contradiction with other researches' reports that only 8% of responding teachers felt adequately prepared to use laptops in their classrooms teachers because they feared that their learners were better equipped than them and could easily out smart them in class (Sharples & Moldéus 2014, pp.35- 43).

The expectation of the government was that only a few teachers would be DLP trained and these few would train others. The research findings showed 35 (44.3%) of the sample public primary schools in Homa Bay County had no teacher trained by their colleagues on DLP. The reasons that were cited by head teachers of sample schools whose DLP trained teachers failed to train other staff members were the absence of DLP devices in their respective schools for training others and the fact that the five day DLP training conducted by the Government of Kenya did not give enough skills that could be shared with other teachers in schools. European Commission (2001) suggested that for effective ICT integration, ICT trained teachers needed to be motivated after any meaningful training by either offering them computers for free as was witnessed in Sweden or subsidizing the cost of computers so that they are affordable to trainees as was done in the United Kingdom. In support, Tilya (2007) observed that teachers from different schools who had gone through the training process and had hands-on ICT experience helped their schools to understand the contribution of ICT to learning and could use different learning approaches in education.

The study showed that sub-counties of Homa Bay were not treated equally in terms of DLP trainings. There was lack of equity. The research noted that some sub-counties such as Ndhiwa in particular recorded as low as 15 (22.4%) and 3 (23.1%) for DLP trainings for sample teachers and head teachers respectively. It was not clear for the study for such disparity in DLP training because DLP training was a national affair and wholly sponsored by the government. More so, all counties in Kenya had all the relevant ministries and staff for DLP. The other sub-counties also equally registered varied numbers of both sample teachers and head teachers trained for DLP but still the numbers were low and not uniform.

The study observed that for successful implementation of DLP, the government needed to improve supervision to schools and conduct a thorough audit of DLP to ensure the starting point was same for all schools in Kenya. The findings, indeed, contradicted the Government of Kenya report that indicated that nearly all public primary schools in all regions of the Republic of Kenya had at least a head teacher and two other teachers trained on DLP by 2015 (Republic of Kenya, 2015).

4.5.8 Teachers' general computer capacity in Homa Bay County

Teachers' computer capacity tested teachers' ability to manipulate computers and effectively use the skills to deliver digital content. The study used a five-point likert scale to generate data. The means of each computer competency level was interpreted to show the level of readiness for computer integration in schools as shown in Table 4.13.

Table 4.13. E-learning readiness scale

Mean	Scale
1.0-2.6	Not ready, needs a lot of work
2.6-3.4	Not ready, needs some work
3.4-4.2	Ready, but needs a few improvement
4.2-5.0	Ready to go a head

Source: Aydin and Tasci (2005)

Table 4.14. Teachers' computer capacity in Homa Bay County

Code	Operation	Mean
C17	I can rotate an image	2.84
C18	I can create a new document using Microsoft word	3.03
C19	I can create a new document using Microsoft Excel	2.88
C20	I can draw and label diagrams using computers	2.60
C21	I can use power point to present my lesson	2.67
C22	I can save contents to an external disk	2.88
C23	I can animate using computers	2.43
C24	I can use a browser such as Mozilla or Explorer to navigate World Wide Web	2.67
C25	I know how to send and receive email messages	2.92
C26	I can print a document	3.03
Mean		2.80

n= 353

Based on a five-point likert scale where 1 stood for Not at all, 2 for Not so well, 3 for Okay, 4 for Well and 5 for Very well, the mean values for teachers' computer skills from C17 to C25 were worked out as shown in Table 4.14. It is evident that teachers were less proficient in rotating images (M_{elr}=3.41>M_{C17}=2.84), creating new documents using Microsoft Word (M_{elr}=3.14>M_{C18}=3.03), creating new documents using Microsoft Excel (M_{elr}=3.41>M_{C19}=2.88), drawing and labeling diagrams using computers (M_{elr}=3.41>M_{C20}=2.60), using power point to present lesson (M_{elr}=3.41>M_{C21}=2.67), saving contents to an external disk(flash disk) (M_{elr}=3.14>M_{C22}=2.88), animating using a computer (M_{elr}=3.41>M_{C23}=2.43), using browsers such as Mozilla or Explorer to navigate the World Wide Web (M_{elr}=3.41>M_{c24}=2.67), sending and receiving email messages (M_{elr}=3.41>M_{C25}=2.92), and printing documents (M_{elr}=3.41>M_{C26}=3.03).When the general mean (2.80) for all areas of ICT skills were measured against the set e-learning readiness scale of 3.41 (Aydin & Tasci, 2005), it indicated that teachers' computer capacity was low

and needed much improvement for them to be able to use information technology effectively for teaching.

4.5.9 Level of computer capacity for trained DLP teachers in sub-counties

A five-point likert scale was used to generate data on the level of teachers' skills in various computer applications based on each sub-county as shown in Table 4.1

Table 4.15. Level of computer capacity for trained DLP teachers in sub-counties

Operation	Homa Bay	Mbita	Rachuonyo North	Rachuonyo South	Suba	Ndhiwa	Average mean
I can rotate an image	3.74	4.00	3.00	3.14	3.40	3.33	3.42
I can create a new document using Microsoft word	3.90	3.71	3.18	3.43	3.90	3.67	3.63
I can create a new document using Microsoft Excel	3.68	3.76	2.73	3.19	3.50	3.73	3.43
I can draw and label diagrams using computers	3.42	3.43	3.36	2.95	3.40	2.47	3.17
I can use power point to present my lesson	3.65	3.38	3.36	3.19	2.90	3.67	3.36
I can save contents to an external disk	3.94	3.67	3.45	3.05	3.20	3.73	3.50
I can animate using computers	3.06	3.52	3.45	2.71	3.20	2.40	3.06
I can use a browser such as Mozilla or Explorer to navigate World Wide Web	3.68	3.29	3.55	2.57	3.00	3.60	3.28
I know how to send and receive email messages	3.71	3.67	3.45	3.33	3.30	4.13	3.60
I can print a document	4.06	3.81	3.73	3.14	3.80	3.67	3.70
Mean	3.69	3.62	3.33	3.07	3.36	3.44	3.42

n=109

The data as shown in table 4.15 indicates that the computer capacity for teachers who attended DLP training was adequate for the launch of DLP in public primary schools in Kenya. That is, the teachers' computer capacity stood at 3.42 which was greater than the expected readiness level of 3.41. It is observed that sub-counties of Homa Bay (3.69), Mbita (3.62) and Ndhiwa (3.44) reported higher mastery levels of computer skills and could start teaching using digital devices. On the other hand, Rachuonyo North (3.33),

Rachuonyo South (3.07) and Suba (3.36) reported a good level of computer skills mastery level but was slightly below the e-learning readiness level of 3.41.

4.5.10 Level of computer capacity for untrained Digital Literacy Programme teachers in sub-counties

The level of teachers' computer capacity was tested using a five-point likert scale to generate data on various computer applications based on each sub-county as shown in Table 4.16.

Table 4.16. Level of computer capacity for untrained DLP teachers in the sub-counties

Operation	Homa Bay	Mbita	Rachuonyo North	Rachuonyo South	Suba	Ndhiwa	Average mean
I can rotate an image	2.59	2.68	3.08	2.26	2.55	1.77	2.49
I can create a new document using Microsoft word	2.72	3.32	3.02	2.42	2.60	2.46	2.76
I can create a new document using Microsoft Excel	2.69	2.95	3.08	2.18	2.50	2.25	2.61
I can draw and label diagrams using computers	2.41	2.63	3.04	1.84	2.25	1.62	2.30
I can use power point to present my lesson	2.33	2.53	3.04	1.92	2.05	1.98	2.31
I can save contents to an external disk	2.77	2.74	3.08	2.11	2.15	2.21	2.51
I can animate using computers	2.23	2.32	2.85	1.84	1.50	1.58	2.05
I can use a browser such as Mozilla or Explorer to navigate World Wide Web	2.21	2.47	2.96	2.03	1.80	2.25	2.29
I know how to send and receive email messages	2.62	2.68	3.10	2.29	2.40	2.27	2.56
I can print a document	2.85	2.84	3.35	2.34	2.40	2.21	2.67
Mean	2.54	2.72	3.06	2.12	2.22	2.06	2.10

n=216

The results from table 4.16 shows that teachers who did not attend DLP training registered a mean of 2.10 which was considered by the study as low when compared to e-learning readiness level of 3.41. All the sub-counties of Homa Bay recorded low computer capacity: Homa Bay (2.54), Mbita (2.72), Rachuonyo North (3.06), Rachuonyo South (2.12), Suba (2.22) and Ndhiwa (2.06).

4.5.11 Head teachers' general computer capacity in Homa Bay County

Because head teachers were also classroom teachers, they were expected to use laptop computers in classrooms to teach just like other teachers in school. The study used of a well-constructed five-point likert scale possessing the same statements of ICT readiness skills that were tested on teachers (Table 4.16) to establish the head teachers' capacity to handle and manage computers in classrooms.

Table 4.17. Head teachers' general computer capacity in Homa Bay County

Code	Operation	Mean
H15	I can rotate an image	2.82
H16	I can create a new document using Microsoft word	2.81
H17	I can create a new document using Microsoft Excel	2.61
H18	I can draw and label diagrams using computers	2.18
H19	I can use power point to present my lesson	2.37
H20	I can save contents to an external disk	2.73
H21	I can animate using a computer	2.27
H22	I can use a browser such as Mozilla or Explorer to navigate World Wide Web	2.59
H23	I know how to send and receive email messages	2.87
H24	I can print a document	2.86
Mean		2.61

n= 79

The calculations of average means for table 4.17 were generated on a five-point likert scale where 1 stood for Not at all, 2 for Not so well, 3 for Okay, 4 for Well and 5 for Very well. It is shown that head teachers were not proficient in rotating images (M_{elr}=3.41>M_{H15}=2.82), creating new documents using Microsoft Word (M_{elr}=3.14>M_{H16}=2.81), creating new documents using Microsoft Excel (M_{elr}=3.14>M_{H17}=2.61), drawing and labeling diagrams using computers (M_{elr}=3.41>M_{H18}=2.18), using power point to present lesson (M_{elr}=3.41>M_{H19}=2.37), saving contents to an external disk(flash disk) (M_{elr}=3.14>M_{H20}=2.73), animating using a computer (M_{elr}=3.41>M_{H21}=2.27), using browsers such as Mozilla or Explorer to navigate

the World Wide Web (M_{elr}=3.41>M_{H22}=2.59), sending and receiving email messages (M_{elr}=3.41>M_{H23}=2.87), and finally printing documents (M_{elr}=3.41>M_{H24}=2.86). When the general mean (2.61) for all areas of ICT skills were measured against the set e-learning readiness scale of 3.41(Aydin & Tasci, 2005), head teachers had low readiness levels of their computer skills. The scale suggested that much work still needed to be done to improve their computer literacy skills for effecting integration of laptop computers in public primary schools.

4.5.12 Level of computer capacity for trained Digital Literacy Programme head teachers in the sub-counties

Head teachers were trained on DLP. A five-point likert scale was used to generate information on their level of mastery of the required computer skills for DLP as shown in Table 4.18.

Table 4.18. Level of computer capacity for trained DLP head teachers in sub-counties

Operation	Homa Bay	Mbita	Rachuonyo North	Rachuonyo South	Suba	Ndhiwa	Average mean
I can rotate an image	3.08	2.89	2.92	3.15	2.63	2.67	2.89
I can create a new document using Microsoft word	3.23	2.67	3.23	3.00	2.75	2.67	2.93
I can create a new document using Microsoft Excel	2.85	2.33	3.15	3.15	2.38	2.33	2.70
I can draw and label diagrams using computers	2.38	2.00	2.77	2.38	1.88	2.00	2.24
I can use power point to present my lesson	2.69	2.33	2.85	2.46	1.63	2.67	2.44
I can save contents to an external disk	2.85	2.56	2.69	2.92	2.88	3.33	2.89
I can animate using computers	2.31	2.22	2.54	2.69	1.88	3.67	2.55
I can use a browser such as Mozilla or Explorer to navigate World Wide Web	2.77	2.56	2.69	2.69	2.38	3.33	2.74
I know how to send and receive email messages	3.00	2.78	3.08	3.00	2.63	3.33	2.97
I can print a document	3.15	2.56	2.77	2.85	3.13	3.33	2.97
Mean	2.83	2.49	2.87	2.83	2.42	2.93	2.73

n=59

Based on sub-counties, the head teachers who received DLP training recorded a mean of 2.73 which did not meet the threshold of e-learning readiness level of 3.41.The sub-counties of Homa Bay (2.83), Mbita (2.49), Rachuonyo North (2.87), Rachuonyo South (2.83), Suba (2.42) and Ndhiwa (2.93) registered low levels of computer capacity for trained DLP head teachers.

4.5.13 Level of computer capacity for untrained Digital Literacy Programme head teachers in the sub-counties

The study established that some 20 (25.3%) sample head teachers had not been trained on DLP in Homa Bay County. A five-point likert scale was used to gather information on the level of computer skills that they possessed as shown in Table 4.19.

Table 4.19. Level of computer capacity for untrained DLP head teachers in sub-counties

Operation	Homa Bay	Mbita	Rachuonyo North	Rachuonyo South	Suba	Ndhiwa	Average mean
I can rotate an image	2.75	5.00	2.00	2.33	5.00	1.90	3.16
I can create a new document using Microsoft word	2.75	2.00	2.00	1.33	2.00	2.40	2.08
I can create a new document using Microsoft Excel	2.75	3.00	2.00	1.67	2.00	1.70	2.19
I can draw and label diagrams using computers	2.25	4.00	2.00	1.67	1.00	1.40	2.05
I can use power point to present my lesson	2.25	5.00	3.00	1.00	1.00	2.00	2.38
I can save contents to an external disk	2.75	4.00	3.00	3.00	2.00	2.10	2.81
I can animate using computers	1.50	2.00	3.00	2.67	1.00	1.50	1.91
I can use a browser such as Mozilla or Explorer to navigate World Wide Web	2.00	3.00	3.00	2.00	2.00	2.50	2.42
I know how to send and receive email messages	2.50	5.00	3.00	1.67	1.00	2.90	2.68
I can print a document	2.75	4.00	3.00	2.33	4.00	2.50	3.10
Mean	2.43	3.70	2.60	1.97	2.10	2.09	2.48

n=20

The research findings in table 4.19 indicates that 20 (25.3%) sample head teachers who had not been trained on DLP registered a mean score of 2.48 in terms of the necessary computer skills that were needed for the launch of DLP in their respective schools. The study noted that 2.48 was far below the expected mean score of 3.41 and, therefore, this category of head teachers could start using DLP devices but still needed a lot of training in computer usage.

In line with sub-counties, Homa Bay scored 2.43, Mbita attained 3.70, Rachuonyo North had 2.60, Rachuonyo South realized 1.97, Suba recorded 2.10 and Ndhiwa registered 2.09. No sub-county in Homa Bay County had untrained sample DLP head teachers who could launch e-learning in their respective schools successfully without additional training and practice on the required computer skills.

4.5.14 Discussion

The general level of computer capacity for 353 sample teachers and 79 sample head teachers both trained and untrained in public primary schools in Homa Bay County registered was 2.80 and 2.61 respectively. When these findings were compared to the expected e-readiness level of 3.41 (Aydin & Tasci, 2005), the study found sample teachers and head teachers not ready and needed further training before integration of laptop computer in Kenya. The study noted that teachers' computer capacity was vital even for other ICT related teaching packages such as preparation of teaching documents such as schemes of work. In support, Mndzebele (2013) observed that the introduction of computers in primary and secondary schools is a recent phenomenon that needed adequate capacity building for students and staff. More so, the level of computer skills was a vital determinant of the level of uptake of any technology-based education.

However, when DLP trained teachers and head teachers were separated from DLP untrained teachers and head teachers, the scenario was different. DLP trained teachers registered 3.42 mean score on a five-point likert scale while untrained DLP teachers scored 2.10. The trained DLP head teachers scored 2.73 while their untrained counterparts attained 2.48. When individual sub-counties were compared, Homa Bay (3.69), Mbita (3.62) and Ndhiwa (3.44) were ready for the launch of digital learning. The study noted that the rising levels of computer skills in Homa Bay and Mbita sub-counties could be linked to the higher percentage of teachers who were DLP trained in these sub-counties. A good example is Mbita Sub-County which trained 52.5% of its teachers on DLP. For teachers who were untrained on DLP, no sub-county in Homa Bay managed the required e-learning threshold of 3.41.

Both trained and untrained sample DLP head teachers did not meet the required e-learning readiness level in terms of computer skills. The study connected this to lack of practice using computers specially to head teachers who were DLP trained. Ndhiwa (2.93) which was leading the other sub-counties for head teachers who had attended DLP training but still the score was below the required threshold of 3.41. The study did not give weight to the mean of 3.71 for just a single respondent head teacher in Mbita who was untrained in Mbita Sub-County but looked extraordinarily computer literate and could not accurately represent the views of the untrained head teachers in Mbita Sub-County because even the interviewees were contradicting the questionnaire generated result of 3.71. In this case one respondent said:

> The government rolled out training. The training of teachers and one of my teachers was taken for this. Not fully equipped with the computer knowledge but I am trained. Yaah, to both teachers. Personally in my school

> I know it is a problem. I am in a mentally handicapped school. In my school it will not be very easy (Head teacher, Mbita).

Based on these revelations, the study observed that the 5-day training for DLP improved teachers' computer skills. The study findings were, however, contradicted by a number of studies such as Sharples and Moldéus (2014), Wanzala and Nyamai (2018) and Omanga (2018) that indicated that the 5-day training made very little impact on teachers' computer capacity.

The study observed that the computer skill areas that were tested by this research were necessary for digital content that teachers needed to perform ahead of teaching using laptop computers. In support, Hernandez (2017) added that teachers are faced with the transformative vision of a society that needed them to integrate ICT into the classroom. Successful integration of ICT into education, therefore, depends to a large extent on teacher's computer skills to handle online tools.

Based on the research findings, 54 (74.7%) sample head teachers and 109 (30.9%) teachers were DLP trained. The findings reflected higher percentage of sample head teachers trained compared to sample teachers but the actual level of computer skills showed teachers (2.80) ahead of head teachers (2.61) in computer skills. The study interpreted the research findings to mean that the government offered teachers computer training without prior assessment of the respondents' computer literacy levels and more so, assumed that teachers did not need a lot of time to master the ICT skills. Computer skills entry level was not assessed contrary to effective ICT training requirements as was demonstrated in South Africa (South Africa. DoE, 2003).

However, going by the distribution of teachers based on age, 303 (85.8%) were aged above 31years. The study noted that this category of teachers trained before 2006 when the ICT policy was already put in place in learning institutions in Kenya (Kenya. MoE, 2006). Kenyans, therefore, needed to follow the rest of the world in designing its training programs for ICT integration such that ICT training should be a process (European Commission, 2001). A good example of such a training process was developed in South Africa whereby seven principles for training ICT teachers were executed in phases such as: entry, adoption, adaptation, appropriation and innovation (South Africa. DOE, 2003). In addition, the majority of teachers who were younger than most head teachers were computer literate because of exposure to the use of 2.0 web technologies (Okello-Obura & Ssekitto, 2015).

4.5.15 Teachers' computer capacity in schools with Digital Literacy Programme devices

The study conducted an observation to qualify or disqualify the responses that were given by the respondents in the filled questionnaires on computer capacity/skills. The observation checklists involved practical assessment of some key technical areas that were considered by the study as necessary for teaching and learning using laptop computers. The areas that were observed centered on the respondents' ability to perform the following using laptop computers: rotation of an image, creation of a new document using Microsoft Word, creation of a new document using Microsoft Excel, drawing and labeling diagrams, using power point to present lessons, saving texts in storage device, using browser to access the internet, receiving and sending emails and printing a document.

Table 4.20. Number of schools with computer trained teachers in schools with DLP devices

Trainer	Number of schools	Percent
DLP	37	66.1
Private institutions	7	12.5
Both DLP and private institutions	1	1.8
Non-Response	11	19.6
Total	56	100.0

n=56

The research found that 37 (66.1%) sample teachers out of 56, who were the majority were trained by the government. 6 (12.5%) sample teachers were trained privately.11 (19.6%) respondents did not disclose whether they had been trained or not. The remaining respondent 1 (1.8%) was trained by both the government and privately.

4.5.16 Schools currently teaching and learning with Digital Literacy Programme devices

As shown in Table 4.21, the study generated data using Yes/No to establish the number of schools that were integrating DLP in their schools.

Table 4.21. Schools that were teaching and learning with Digital Literacy Programme devices

Response	Number of schools	Percent
Yes	25	44.6
No	31	55.4
Total	56	100.0

n=56

In line with the research findings, all the 56 sample schools had received DLP devices but, only 25(44.6%) sample schools were using them for teaching and learning. The other 31

(55.4%) sample schools which formed the majority, had received DLP devices in their schools, but they were still kept under lock and key.

4.5.17 Reasons for not teaching and learning using Digital Literacy Programme devices

A total of 31 (55.4%) sample schools received the DLP devices but were not using them. The study generated some of the underlying reasons why the sample schools were not using DLP devices as shown in 4.22.

Table 4.22. Reasons for not teaching using devices in schools with DLP devices

Reason	Frequency	Percent
Lack of power	10	32.4
Insecurity of DLP devices	2	6.5
Inadequate computer training	11	35.5
No designated classrooms	2	6.5
Transfer of DLP teachers	1	3.0
Non-Response	5	16.1
Total	31	100.0

n=31

The sample schools that were not teaching using DLP devices had the following observations made: 10 (32.1%) sample schools lacked of power, 2 (6.5%) attributed failure to insecurity in sample public primary schools, 11 (35.5%) had no properly trained teachers for the DLP project, 2 (6.5%) lacked of designated classrooms for DLP, 1(3.0%) absence of policy on transfer of DLP trained teachers and lastly 5 (16.1%) schools had no clear reasons as to why they had not started teaching and learning using DLP devices in their schools.

4.5.18 Responsibility for repair of Digital Literacy Programme devices

The DLP devices like any other electronic device were bound to breakages. Table 4.23 shows the respondents' views of who was responsible for the breakages and maintenance of DLP devices.

Table 4.23. Responsibility for repair of Digital Literacy Programme devices

Institution	Frequency	Percent
School	4	7.1
ICT Authority	19	33.9
MOEST	11	19.6
Unknown	22	39.3
Total	56	100.0

n=56

After the delivery of DLP devices to schools, some precautions were needed to be taken to ensure DLP devices were maintained in good working condition. The study revealed that 4 (7.1%) sample schools believed that it was the responsibility of each school to repair its own digital devices. 19 (33.9%) sample schools noted that it was the duty of ICT Authority to repair DLP devices in case of damages or malfunctions. The research also found that 11 (19.6%) sample schools were of the opinion that it was the mandate of the Ministry of Education, Science and Technology (MOEST) to take charge of maintenance of DLP devices. 22 (39.3%) respondents had no idea at all as to where and whom to see when breakages or malfunction of the digital devices were realized.

4.5.19 Teachers' computer capacity in schools with Digital Literacy Programme devices

Using a five-point likert scale, the study tested the computer skills levels of teachers who were using DLP devices to teach and recorded the results as shown in table 4.24.

Table 4.24. Teachers' computer capacity in schools with Digital Literacy Programme devices

Code	Operation	Mean
D1	I can rotate an image	3.88
D2	I can create a new document using Microsoft Word	4.12
D3	I can create a new document using Microsoft Excel	4.04
D4	I can draw and label diagrams using computers	2.96
D5	I can use power point to present my lesson	3.80
D6	I can save contents to an external disk	4.00
D7	I can animate using computers	3.16
D8	I can use a browser such as Mozilla or Explorer to navigate World Wide Web	3.60
D9	I know how to send and receive email messages	3.36
D10	I can print a document	3.88
Mean		3.68

n= 25

Average mean scores for computer competency areas from D1 to D10 as displayed in table 4.24 were calculated based on a five-point likert scale where 1 stood for Not at all, 2 for Not so well, 3 for Okay, 4 for Well and 5 for Very well. It is shown that the DLP trained teachers were proficient in rotation of an image ($M_{D1}=3.88>M_{elr}=3.41$), creation of a new document using Microsoft Word ($M_{D2}=4.12>M_{elr}=3.14$), creation of new documents using Microsoft Excel ($M_{D3}=4.04>M_{elr}=3.14$), use of power point to present lessons ($M_{D5}=3.80>M_{elr}=3.41$), saving contents to an external disk (flash disk) ($M_{D6}=4.00>M_{elr}=3.14$), using search engines such as Mozilla or Explorer to navigate the World Wide Web ($M_{D8}=3.60>M_{elr}=3.41$) and finally proficiency in printing documents

(M_{elr}=3.41>M_{D10}=3.88) using laptop computers. It was, however, noted that the DLP trained sample teachers could averagely draw and label diagrams using laptop computers (M_{elr}=3.41>M_{D4}=2.96), animate using laptop computers (M_{elr}=3.41>M_{D7}=3.16), and lastly send and receive email messages (M_{elr}=3.41>M_{D9}=3.36).

4.5.20 Discussion

The research was carried out in 56 sample schools in Homa Bay County to assess the level of computer integration in schools that had received DLP devices. 56 sample teachers who were teaching using laptop computers in these schools were the respondents. The findings showed that 31 (55.4%) schools out of 56 sample schools which were the majority of schools that had received digital devices had not launched the digital learning in their respective schools citing reasons such as inadequate computer skills amongst teachers, 11 (35.5%). To prove this, the findings were in concurrence with other researches which also revealed that even though some schools were in possession of the DLP devices, teachers in such schools were found not to use them for fear of being replaced by technology and that their learners who were proficient in computer use would out smart them in class (Kimuge, 2017; Okello-Obura & Ssekitto, 2015; Sharples & Moldéus 2014, pp.35- 43). In another concurrence, Hernandez (2017) also agreed by saying that integrating ICT into education is grossly dependent on the teacher's computer skills to handle online tools.

The study connected the failure of DLP launch in schools to lack of steady sources of power. The findings showed that 10 (32.4%) sample schools received DLP devices ahead of power connections in their schools which contradicted the government's position that over 19,000 (84.4%) schools had been connected to electricity by 2015 (Republic of Kenya, 2015). In contradiction, ICT Authority in Homa Bay County maintained that the

551 schools that had received DLP devices in Homa Bay County were connected to electricity (Kenya. ICTA, 2016). Even though the study established that 63 (74.8%) schools that were studied either had a functional power source or close-range transformers that the schools could easily tap electricity from, the study noted that a number of schools still had not been connected to any source of power.

The distribution of the digital devices to sub-counties of Homa Bay was also not uniform. According to the statistics of this research under population and sample size estimation, Rachuonyo South was second to Homa Bay in terms of teacher population. But out of the 551 schools that had received DLP devices in Homa Bay County by 2016, Rachuonyo South Sub-County had only 48 (8.7%) of its schools with DLP devices (Kenya. ICTA, 2016). The ICT Authority in Homa Bay County argued in its report that only schools in sub-counties that 'looked' ready for the integration of laptop computers were given first priority in the distribution of digital devices. The study found the argument lacking merit because 10 (32.4%) schools out of the 56 sample schools with DLP devices had no functional power but were in possession of DLP devices. It was, therefore, not very clear to the study the kind of criteria used to distribute digital devices to different sub-counties.

The study established that the respondents had no adequate information on which particular organization(s) were responsible when breakages and malfunctions of the DLP devices took place in a school. This created fear in the use of such devices. To some extent the study linked such failure to launch DLP in these schools to technophobia (Juma, 2001). Some respondents were of the opinion that they could not touch or train using DLP devices because like any other electronic device they were bound to have breakages and repairs. The findings revealed that 22 (39.3%) respondents, who were the majority in schools with

DLP devices, did not know where to repair faulty or broken DLP devices. Although, the ICT Authority in Kenya spelt out that the distribution of the DLP devices was supposed to be done by some other organizations which were either Moi University or Jomo Kenya University of Science and Technology, this communication did not reach schools well and many respondents ended up being confused. It was, therefore, apparent that the respondents were unable to differentiate the roles of the Ministry of Education, ICT Authority and the organizations that were supplying the devices to schools. It seemed that there were no guidelines provided by the government on the administration of DLP in Kenya. In support, Standard Team (2019) observed that a number of primary schools decried disconnect with experts charged with maintenance of the programme. In such schools, teachers' laptops and the tablets were rendered useless after the software ran out of date.

However, the study noted that ICT Authority in Homa Bay County was doing a commendable job by regularly organizing both physical and online training for teachers and head teachers (Kenya. ICT Authority, 2016). In spite of this, implementation of DLP needed a clear policy in procurement, distribution and implementation. In support, e-Learning Foundation (2013) called for the need for an ICT policy document to streamline the implementation process.

When the general performance in all areas of laptop computer expertise were tested, it showed that sampled DLP trained teachers were more ready for the integration of laptop computers in public primary schools in Kenya. This was based on the average mean (3.68) for all areas of computer skills that were observed against the set e-learning readiness scale

of 3.41 (Aydin & Tasci, 2005).The findings proved that although the duration of DLP training was short, it laid the foundation for practice (European Commission, 2011; Tilya, 2007).

And when interviews were conducted with sample teachers and head teachers on their capacity to handle and teach pupils using laptop computers, the findings revealed that 18 (100%) respondents who were both teachers and head teachers contradicted results from questionnaires and observation checklist which found DLP trained teachers and teachers teaching with devices in schools ready for the launch of digital education. Revelation from one respondent who was interviewed noted that:

> …My opinion in introduction of teaching using technology is positive but I feel the government is bringing it in when good readiness is not yet put in place. I feel it was good to introduce it to learners but it is like the government is not having a good plan for its introduction… (Teacher,Rachuonyo South).

Respondents interviewed admitted not being capable of competently teaching using laptop computers citing duration of training as too short, unavailability of laptop computers in their schools for practice, lack of time for private computer training and speedy launch of DLP without proper needs assessment. It was also noted from the interviews that many teachers were left out during DLP training for teachers, but still it was evident that some of these teachers had received ICT training elsewhere. In addition, both male and female teachers were not discriminated in DLP training (Bakr, 2011).

The findings also showed that ICT integration was active in 25 (44.6%) schools out of the 56 sample schools that had received DLP devices. Contrary to the expectations of the government that DLP devices were to be used as tools for teaching and learning, the study

noted that there were no specified times in most school timetables for teaching and learning using DLP devices. In support, Standard Team (2019) also noted that tablets were reduced to toys in schools. The pupils were offered tablets to play with as toys at no specified time **(**Wanzala, & Nyamai, 2018**).** To confirm this one respondent during oral interviews said:

> Not as …It can be brought not as a … the sole mechanism of delivering the content… but can be brought as a way of play things like that; they first of all embrace. Not available but I believe it will be availed. Yes. Personally am…am… content with it… am comfortable with it. So long as we have been trained. You know even the manual one we were trained. So when we are trained on how to handle the digital one then what is the big deal (Head teacher, Mbita).

Real teaching and learning was still being conducted manually by use of textbooks. Examinations for these pupils were still being set and marked manually. There were no close supervision or distinct policies on digital learning in schools. In some schools, teachers utilized laptop computers only to learn how to prepare crucial learning documents such as entry of pupils' marks.

In connection to the phases of ICT training as observed by European Commission (2001), the study observed that sampled teachers were offered several DLP training packages in 5 days. But in reality DLP trained teachers despite their high proficiency levels in computer skills were still struggling with the first phase of computer familiarization. It's like the Kenyan DLP training underrated this computer familiarization phase in its plan for teacher training which may call for further reevaluation on what is good for the training of teachers in Kenya for DLP.

4.6 Teachers' awareness of digital content

Digital content is the soft copy subject matter which has been put into a computer to be taught by the teacher and learnt by pupils. The digital content for DLP was drawn from an approved curriculum for Kenyan schools. The teachers in Kenya were trained around these contents and were expected to organize them into small chunks that could be absorbed by the learners. The approved curriculum contents were organized according to different learning levels and spread throughout the learning period. In Kenya, curriculum contents were developed at the Kenya Institute of Curriculum Development (KICD). For a long time in Kenya, these curriculum contents for primary school education were organized in hard copy textbooks. All subjects taught were designed in hard copy textbooks for different levels of learning. The emergence of the digital learning in Kenya did not change much. Only technology and delivery format changed. The contents remained the same except that they were digitalized. In concurrence, Nyaundi (2018) added that the new technologies adopted in the new curriculum were not only to change how students learn, but also how teachers teach.

Teaching Digital Devices (TDD) and Learners Digital Devices (LDD) were components of DLP devices. The TDD was the laptop computer and LDD were tablets (DLP Secretariat, 2016, p.50). Teachers' awareness of the digital content was considered by this study as an element of readiness for the uptake and integration of laptop computers in public primary schools.

4.6.1 Components of the digital content

Technology was considered by the study as an enabler for teaching and learning. Hard copy contents in the form of books had to be converted into a soft copy format that could be stored and relayed by an appropriate technological device.

4.6.2 Teachers' responses on awareness of the components of digital content

The study listed a number of variables that were considered as components of digital content used for teaching and learning using laptop computers. These included video, audio, images, texts and graphics.

Table 4.25. Teachers' responses on awareness of the components of the digital content

Component(s) of the digital content	Frequency	Average %
Non-response	17	4.8
Video	57	16.1
Audio	10	2.8
Images	46	13.0
Texts	37	10.5
Graphics	30	8.5
All of above (video, audio, images, texts and graphics)	81	22.9
Video and audio	7	2.0
Video, audio, images, and texts	7	2.0
Video and graphics	1	0.3
Images, texts and graphics	7	2.0
Video, images and texts	5	1.4
Video, audio and texts	5	1.4
Audio, images, texts and graphics	7	2.0
Video, images, texts and graphics	2	0.6
Video, audio, images and graphics	5	1.4
Audio and images	3	0.8
Audio and graphics	1	0.3
Video, Audio and Images	8	2.3
Video and images	2	0.6
Video and audio	2	0.6
Audio, images and texts	2	0.6
Images and texts	2	0.6
Images and graphics	1	0.3
Texts and graphics	1	0.3
Video, texts and graphics	4	1.1
Video, audio and graphics	2	0.6
Video, audio, texts and graphics	1	0.3

n=353

The findings from Table 4.25 indicated that the majority, 81 (22.9%), of the respondents chose all the variables that were listed by this research (video, audio, images, texts and graphics) as components of the digital content. 17 (4.8%) respondents did not respond. The research showed that 57(16.1%) respondents regarded video as the only component of the

digital content. Another 10 (2.8%) respondents cited audio as a component of the digital content. Some 46 (13.0%) respondents identified images as the only component of the digital content. Text as a component of the digital content was selected by 37 (10.5%) respondents. 30 (8.5%) respondents mentioned graphics as the sole component of the digital content.

Other combinations of components of digital contents that were identified by the respondents included: 7 (2.0%) respondents were for audio and video; 7 (2.0%) respondents noted video, texts, audio and images ; 1 (0.3%) respondent settled on graphics and videos; 7 (2.0%) respondents viewed images, graphics and texts as components of the digital content; 5 (1.4%) respondents chose video, images and texts ; 5 (1.4%) respondents mentioned video, audio and texts; another 7 (2.0%) respondents identified audio, images, texts and graphics; 2 (0.6%) respondents regarded video, texts, images and graphics as components of the digital content; 5 (1.4%) respondents selected video, audio, images and graphics as components of digital content; 1 (0.3%) respondent was for audio and graphics as the only components of the digital content; 8 (2.3%) respondents selected video, audio and images as components of digital content; 2 (0.6%) respondents selected video and images; another 2 (0.6%) respondents were for video and audio; 2 (0.6%) respondents suggested images and texts; 1 (0.3%) respondent was for images and graphics as components of the digital content; 4 (1.1%) respondents were for video, texts and graphics; 1 (0.3%) respondent chose texts and graphics while 2 (0.6%) respondents settled on video, audio and graphics as digital components. Lastly 1 (0.3%) respondent cited video, audio, texts and graphics as a combination that would be referred to as digital content. 81 (22.9%)

respondents, who were the majority, cited all listed variables by the study such as video, audio, images, texts and graphics as components of digital content.

4.6.3 Head teachers' responses on awareness of components of the digital content

Head teachers like teachers were also considered by this research as actors in primary school education who were directly involved in teaching of pupils using laptop computers and tablets. Their knowledge and use of digital content was necessary given that they were the head of curriculum in schools. The head teachers were asked to choose on the same items that were listed by this study as the components of digital content as shown in Table 4.25**.** These were video, audio, images, texts and graphics. The respondents were allowed to select either one or more options which in their opinions were considered as component(s) of digital content.

Table 4.26. Head teachers' responses on components of digital content

Component(s) of the digital content	Frequency	Average %
Non-response	3	3.8
Video	7	8.9
Audio	1	1.3
Images	8	10.1
Texts	11	13.9
Graphics	6	7.6
Video, audio, images, texts and graphics (All listed)	24	30.4
Video and audio	1	1.3
Video, images, texts and graphics	3	3.8
Images and texts	1	1.3
Video, audio and images	2	2.5
Video, audio, images and texts	2	2.5
Videos, images and texts	2	2.5
Images, texts and graphics	1	1.3
Video, texts and graphics	1	1.3
Video and images	3	3.8
Video and audio	1	1.3
Audio and images	1	1.3
Video, images and graphics	1	1.3

n=79

Based on the findings from Table 4.26, 3 (3.8%) respondents did not have an idea of what constituted digital content. 7 (8.9%) respondents noted video as the only component of the digital content. Audio as a component of the digital content was selected by 1 (1.3%) respondent. Majority of the respondents, 24 (30.4%), recorded video, graphics, texts, audio and images. 8 (10.1%) respondents agreed that digital content were only images. Another 11 (13.9%) respondents indicated that digital content was printed texts. 6 (7.6%) respondents registered graphics. Texts and videos combined were rated by 1(1.3%) respondent as a digital content while 3 (3.8%) respondents settled on graphics, images, texts and graphics to constitute digital content in teaching and learning.

Other combinations of variables that were considered by some respondents as constituting digital content included: 1 (1.3%) images and texts; 2 (2.5%) video, audio and images; 2 (2.5%) video, images, audio and texts as the only digital content found in a digital device; 2 (2.5%) video, images and texts; 1 (1.3%) respondent was for images, texts and graphics only; 1 (1.3%) identified video, texts and graphics; 3 (3.8%) were for videos and images; 1 (1.3%) picked video and audio; 1 (1.3%) selected audio and images; and finally 1 (1.3%) respondent considered video, images and graphics as the digital content useful for teaching and learning. The findings showed that like the teachers, majority of the head teachers identified all the variables listed by the study (graphics, video, images and texts) as digital content.

Findings from the interviews on the availability and awareness of digital content revealed that only 3 (16.7%) respondents out of 18 were aware of the digital content. On the other hand, 15 (83.3%) out of 18 respondents agreed that digital content would make sense when introduced in schools.

4.6.4 Discussion

The research question number four was: 'What awareness do teachers have on the digital content to be delivered to learners by laptop computers?'

It was established that majority of the respondents who were both 81 (22.9%) teachers and 24 (30.4%) head teachers were well informed of the composition of what constitutes digital content as was listed by the study. The respondents' knowledge of video, audio, images, texts and graphics was a good start for DLP both in terms of training and uptake in schools because teachers were considered by the study to have some prior knowledge of

what was expected of them as they migrated to the digital platform. It could also make training start at some point because the respondents were aware of the basics of the training on the digital content. In support, a number of scholars referred to digital content as an educational multimedia that has the capacity to integrate graphics, audio, texts and videos into a single training package in a computer (Suryawanshi & Suryawanshi, 2015; Ciascai & Marchis, 2008).

Ironically, the majority of the respondents who were interviewed were unable to mention the components of the digital content with ease verbally during the interviews as they did on questionnaires. For instance a respondent commented:

> It is not yet available in our local schools. Like currently, even if the laptops were brought we don't have the syllabus with the digital content that shows that we are going to handle. It is not under those people who were trained if at all they were told but currently because nobody has trained. There is no induction. They know computers on their own but not as per the syllabus for the digital content…(Head teacher, Suba).

This indeed called for digital awareness campaign among the teachers so that the theoretical aspect could be linked to the practical aspect of the digital content. However, with the increasing saturation of digital technologies in the world such as mobile phones, teachers interact with digital content on various digital platforms (Nyaundi, 2018). In concurrence with the findings of the study, Reddy and Manjulika (2002) asserted that prior knowledge of the digital content was connected to the explosion of knowledge in the 21st century by use of modern communication technologies.

The requirement of the ICT policy in Kenya that all learning institutions integrate ICT in their teaching and learning could have also contributed to the teachers' knowledge of digital content, especially for the teachers who trained after 2006 when the enactment of

ICT policy in all learning institutions in Kenya was on (Kenya. MoE, 2006). In particular, the study attributed the knowledge of the digital content to the respondents' frequent use of smart phones. In support, Mulwa et al. (2012) added that mobile telephone was among best ICT infrastructures that supported education. The smart phones that were in the market at the time of this study possessed most of the components of the digital content covered in the study.

The Government of Kenya which initiated DLP was also very active in its publicity of the digital content in addition to the 5-day DLP training in Kenya. A good example were the head teachers who according to the Government of Kenya's statement, were all trained on computer competency skills (Republic of Kenya, 2015), but ironically only 24 (30.4%) of 85 sample head teachers admitted to have knowledge of the listed components of the digital content which the study considered to be crucial for teaching and learning using laptop computers and tablets in schools. The meaningfulness of digital content to actors in education was supported by the Commonwealth of Learning (2008) which asserted that information should be chunked and moved sequentially in various formats such as video, audio, images and texts from simple to complex, concrete to abstract, and general to specific. Wanzala (2015) was in agreement by observing that digital content for DLP for lower primary school children should include interactive animations, videos and audio, cartoons, puppets exercises and quizzes that aim at helping pupils learn.

4.6.5 Teachers' ability to manipulate digital content skill(s)

The study listed a number of basic skills that teachers were expected to perform while teaching using laptop computers. These skills were typing, drawing, simulation and doing basic arithmetic using laptop computers. The study considered this component important because digital content was prepared in such formats.

Table 4.27. Teachers' ability to perform digital content skill(s)

Digital component skill(s)	Frequency	Average %
Non-response	24	6.8
Typing	147	41.6
Drawing	24	6.8
Simulation	6	1.7
Basic arithmetic	22	6.2
Typing, drawing, simulation and basic arithmetic (All listed)	42	11.9
Typing and basic arithmetic	17	4.8
Typing, drawing and basic arithmetic	43	12.2
Drawing, simulation and basic arithmetic	7	2.0
Typing and drawing	13	3.7
Typing, simulation and basic arithmetic	2	0.6
Drawing and simulation	2	0.6
Drawing and basic arithmetic	2	0.6
Typing, drawing and simulation	1	0.3
Typing and simulation	1	0.3

n =353

The findings of the study revealed that 147 (41.6%) respondents, who were the majority, were only able to type using computer keyboards. 24 (6.8%) respondents could draw using laptop computers while 22 (6.2%) respondents were able to do basic arithmetic using laptop computers. Simulation was also another digital content skill that 6 (1.7%) respondents noted they could perform. 42 (11.8%) respondents could manipulate all the

listed four listed skill: typing, drawings, simulation and basic arithmetic. 24 (6.8%) respondents did not respond. The following respondents could perform a number of operations: 17 (4.8%) could type and do basic arithmetic; 43 (12.2%) could type, draw and do basic arithmetic; 7 (2.0%) agreed that they could draw, simulate and do basic arithmetic; 13 (3.7%) thought they could type and draw; 2 (0.6%) could type, simulate and do basic arithmetic; 2 (0.6%) could draw and simulate; 2 (0.6%) also admitted they could draw and do basic arithmetic; 1 (0.3%) respondent had the ability to type, draw and simulate; and lastly the remaining respondent (0.3%) could type and simulate. The findings, therefore, showed that majority of the respondents, 147 (41.6%), could only type when provided with laptop computers to teach with.

4.6.6 Discussion

The study was carried out among the 353 teachers to establish their ability to perform particular digital content skills. The digital content skills studied were typing, drawing, simulation and basic arithmetic. The study regarded such skills as basic for teaching and learning using laptop computers, especially in lower classes in primary schools in Kenya and was in line with the five subjects taught in primary schools. The study findings showed that 147 (41.6%) respondents, who were the majority, were only able to type using the keyboard of laptop computers. This actually proved that a majority of the respondents had gadgets such as mobile phones that engaged them in text (typing) such as sending and receiving short message services (SMS), but to some extent typing alone could not improve much the level of digital content readiness in schools since learners for DLP were supposed to be well acquainted with all subjects of the curriculum. In his observation, Wanzala (2015) noted that digital content skills should be centered on the school teaching

subjects in lower primary classes in Kenya such as Mathematics, Science, Social Studies, English and Kiswahili. This argument was premised on the fact that as much as the respondents could type using laptop computers and tablets, it was important for respondents to have knowledge of other digital content skills such as drawing, basic arithmetic and simulation because the DLP was expected to be a full package that required a number of digital skills to operate. The findings were in agreement with Burns (2011) who noted that digital content skills were many and could be applied in text, simulations, animations, presentations, tutorials, collections, resources, subject- and task-specific cognitive tools, references, assessments (quizzes/tests/exams) and readings.

Teachers needed digital content skills to be all round in social life and teaching. They needed to know how to simulate, do basic arithmetic and skills of playing games using laptop computers. Inbuilt computer games were vital for class one level children because they could spend a lot of time playing games since most of these children borrow a lot from their parents' mobile phones. In concurrence, Meirs et al. (2009) observed that facilitators who were teachers in schools should have essential knowledge of laptop computer skills in literacy and numeracy because the entry skill for any ICT driven study was considered important for its success. European Commission (2011) was also in agreement that ICT was generally assumed to have a positive impact on learning with the benefits that were extending beyond the use of computers and the internet alone but spread to the use of other technologies such as digital cameras and mobile phones which can support users' personal development.

Based on the findings of this research, continuous digital device orientation and provision of laptop computers and tablets to schools for on-the-job training could improve the ability and awareness of the teachers on digital content skills. This could trigger the users of laptop computers to learn by making mistakes but continually improving their skills while improving their computer skills. European Commission (2001) in their observation proposed the provision of free computers to schools or individual trainees as a way of boosting teachers' morale and allowing them to practice computer skills anytime anywhere.

4.6.7 Head teachers and teachers' other recommended digital devices for digital content

A part from laptop computers, a number of digital equipment was also proposed by this study to be suitable for teaching and learning digital content. The proposed digital equipment included: radio, desktop computers, television, mobile phones and tablets. The respondents were then asked to select on particular digital equipment which they felt was most appropriate for use by teachers and head teachers to deliver digital content to the learners. The findings were as shown in Table 4.28.

Table 4.28. Head teachers and teachers' awareness of other recommended digital devices for digital content

Digital Equipment	Radio	Desktop Computer	Television	Mobile phones	Tablets	Non-Response
Respondent						
Teachers **(n=353)**	72(20.4%)	111(31.4%)	25(7.1%)	37(10.5%)	106(30.0%)	2 (0.6%)
Head teachers **(n=79)**	13(16.5%)	25(31.6%)	4(5.0%)	10(12.5%)	27(34.2%)	0 (0.0%)

The findings shown in Table 4.28 revealed that 72 (20.4%) sample teachers and 13 (16.5%) head teachers preferred radio as a possible digital device to be used for teaching and learning of the digital content. 111 (31.4%) sample teachers, who were the majority, and 25 (31.6%) sample head teachers were for desktop computers as the other preferred digital device. Television was supported by 25 (7.1%) sample teachers and 4 (5.0%) sample head teachers. The research also showed that 37 (10.5%) sample teachers and 10 (12.5%) sample head teachers chose mobile phones. The findings further noted that 106 (30.0%) sample teachers and 27 (34.2%) sample head teachers selected tablets. From the findings, it was observed that majority of the sample head teachers preferred tablets. On the other hand, majority of the sample teachers selected desktop computers.

4.6.8 Possible barriers to successful delivery of digital content

Successful implementation of laptop computers depended on elimination of possible barriers (Salehi & Salehi, 2012). The study argued that teachers and head teachers needed to be aware of possible limitations that could hinder the smooth delivery of digital content to the learners by DLP devices. The study proposed the following as possible barriers to

delivery of e-content: lack of electricity, high cost of laptop computers, insecurity and resistance from the local teachers as shown in Table 4.29.

4.6.9 Teachers' responses on barriers to the delivery of digital content

As shown in Table 4.29, respondents selected on specific barrier(s) which in their opinion could lower the implementation of DLP in public primary schools in Homa Bay County.

Table 4.29. Teachers' responses on barriers to the delivery of digital content

Possible barriers	Frequency	Average %
Non-response	4	1.1
Lack of electricity	68	19.3
High cost of laptop computers	39	11.0
Insecurity of laptop computers in schools	80	22.7
Resistance from local teachers	18	5.1
Lack of electricity, high cost of laptop computers, insecurity of laptop computers and resistance from local teachers (All of the above)	26	7.4
Lack of electricity and insecurity of laptop computers in schools	37	10.5
Lack of electricity and high cost of laptop computers	8	2.3
High cost of laptop computers and insecurity of laptop computers in schools	18	5.1
Lack of electricity, insecurity of laptop computers and resistance from local teachers	18	5.1
Lack of electricity, high cost of laptop computers and insecurity of laptop computers in school	20	5.7
Insecurity of laptop computers in schools and resistance from local teachers	8	2.3
Lack of electricity and resistance from local teachers	4	1.1
High cost of laptop computers and resistance from local teachers	3	0.8
High cost of laptop computers, insecurity of laptop computers in schools and resistance from local teachers	1	0.3
Lack of electricity, high cost of laptop computers in schools and resistance from local teachers	1	0.3

n =353

The research findings from Table 4.29 shows that 4 (1.1%) respondents did not to respond, 68 (19.3%) respondents cited lack of electricity, 39 (11.0%) respondents noted the high cost of the laptop computers, 80 (22.7%) respondents chose insecurity, and 18 (5.1%) respondents mentioned resistance from local teachers. The number of respondents who selected lack of electricity, high cost of laptop computers, insecurity in schools and resistance from local teachers were 26 (7.4%). Insecurity in schools and lack of electricity were stated by 37 (10.5%) respondents. Some 8 (2.3%) respondents chose high cost of laptop computers and lack of electricity.18 (5.1%) respondents mentioned high cost of laptop computers and insecurity in schools as the major barriers.

Lack of electricity, insecurity in schools and resistance from local teachers were reported by 18 (5.1%) respondents. Some 20 (5.6%) respondents were of the view that barriers to the successful implementation of DLP were lack of electricity, high cost of laptop computers and insecurity in schools. Insecurity of schools and resistance from the local teachers were also chosen by 8 (2.3%) respondents. 4 (1.1%) respondents mentioned lack of electricity and resistance from the local teachers as the main barriers to effective implementation of DLP in schools. 1 (0.3%) respondent cited high cost of laptop computers, insecurity in schools and resistance from the local teachers as the main threat to DLP. High cost of laptop computers and resistance from the local teachers as limiting factors to DLP were identified by 3 (0.8%) respondents.

Lastly, 1 (0.3%) respondent was categorical that lack of electricity, high cost of laptop computers and resistance from the local teachers could block the success of DLP in public schools. It was concluded that majority of the respondents cited lack of security as the main possible barrier of digital content delivery in public primary schools in Kenya.

4.6.10 Head teachers' responses on barriers to the delivery of digital content

The study generated responses from sample head teachers on possible barrier(s) of DLP at school level and presented the results as shown in Table 4.30.

Table 4.30. Head teachers' responses on barriers to the delivery of digital content

Possible barriers	Frequency	Average %
Lack of electricity	13	16.5
High cost of laptop computers	6	7.6
Insecurity of laptop computers in school	19	24.1
Resistance from local teachers	3	3.8
Lack of electricity, high cost of laptop computers, insecurity of laptop computers in school and resistance from local teachers (All of the above)	8	10.1
Lack of electricity, high cost of laptop computers and insecurity of laptop computers in schools	2	2.5
Lack of electricity and insecurity of laptop computers in school	14	17.7
High cost of laptop computers and insecurity of laptop computers in schools	8	10.1
Insecurity of laptop computers in schools and resistance from local teachers	2	2.5
Lack of electricity, high cost of computer and insecurity of laptop computers in school	3	3.8
Lack of electricity, high cost of laptop computers and resistance from local teachers	1	1.3

n=79

The research findings showed that 13 (16.5%) respondents who were the sample head teachers cited lack of electricity as the main threat to the implementation of DLP. 6 (7.6%) respondents stated high cost of laptop computers as a barrier to the success of DLP. Insecurity in schools was recorded by 19 (24.1%) respondents, who were the majority. Some 3 (3.8%) respondents chose resistance from local teachers as a limiting factor to DLP in Kenyan schools. 8 (10.1%) respondents mentioned lack of electricity, high cost of

laptop computers, insecurity of public primary schools and resistance from the local school teachers as the main threat to DLP. Lack of electricity, high cost of laptop computers and insecurity in public primary schools were selected by 5 (6.3%) respondents. 14 (17.7%) respondents were of the opinion that lack of electricity and insecurity in schools were the main challenges of the success of DLP.

Another 8 (10.1%) respondents chose high cost of laptop computers and insecurity of laptop computers in schools as limiting factors to the introduction of DLP in schools. 2 (2.5%) respondents argued that insecurity of laptop computers and resistance from the local teachers combined could contribute to the failure for the uptake and integration of laptop computers in public primary schools in Kenya. 1 (1.3%) respondent was of the opinion that lack of electricity, high cost of laptop computers and resistance from the local teachers could contribute to the failure of the DLP in schools. Based on the research findings, majority of the sample head teachers cited insecurity of laptop computers followed by lack of electricity as the main threats to delivery of digital content in public primary schools in Homa Bay County.

4.6.11 Discussion

A total of 353 sample teachers and 79 sample teachers participated in a study that investigated the other recommended digital equipment that the respondents could use instead of laptop computers and the possible barriers to the delivery of the digital content. It is shown from the research findings that majority of the sample teachers, 111 (31.4%), were comfortable with desktop computers being installed in public primary schools. On the other hand, 27 (34.2%) respondents who were the majority of the sample head teachers recommended tablets. The study based on such findings, therefore, found that the

Government of Kenya's move that resulted in the distribution of tablets to the pupils in Kenya was welcomed by both teachers and head teachers. The study attributed this to sameness in functionality of tablets, laptop computers and desktop computers. Hernandez (2017) acknowledged that these modern technologies as mobile phones, television and others could also be as effective as computers. Njagi (2013) added that the speedy substitution of desktop computers with smart phones in the market and other portable small sized devices could not be ignored. And because desktop computers had been in the market for a long time, most respondents were aware of its history, stability when handling and security. Desktops are not easily stolen like mobile phones and tablets. Tablets looked popular to respondents because of government's publicity and due to the fact that some schools had received them at the time of this research (Kenya. ICTA, 2016; Wanzala, 2017). More so, the Government of Kenya also increased tablets' popularity when it changed its position from laptop computers to tablets because of financial factors (Kenya. ICTA, 2016).

However, smooth implementation of DLP could not take place without challenges. A number of possible barriers that could hamper the smooth delivery of the digital content to schools were also noted by this study. The research findings revealed that the main barrier that was cited by both 80 (22.7%) sample teachers and 19 (24.1%) sample head teachers was insecurity of laptop computers and tablets in schools. The research findings showed that the Government of Kenya invested heavily on DLP, but seriously ignored the fact that most infrastructures in primary schools such as fencing, building of burglar proof rooms and employment of watchmen in these primary schools in Kenya had been left in the hands of poor parents whose efforts to secure the schools were wanting (Kubania, 2014). In

addition, many public primary schools in the rural set ups of Kenya were reported to be dilapidated to the extent that they could not accommodate hard copy textbooks leave a lone tablets and laptop computers (Standard Team, 2019; Kenya. Ministry of Education, 2005; Kubania, 2014; Omanga, 2018). Based on the poor state of classrooms, most laptop computers and tablets in schools that had received them were kept in school offices that looked more secure than DLP classrooms.

In addition, a number of theft cases of DLP devices had been reported in different parts of the Homa Bay County. Notably some of the school offices which were not burglar proof had been broken into at the time of the study (Kenya. ICTA, 2016). The stakeholders in the education sector, therefore, needed to put emphasis on security of the already available or distributed DLP devices. In fact, security of learning institutions should not only be left in the hands of financially unstable public primary schools but should be an issue of national concern taken over seriously by the national government (Muriuki, 2017). Some schools had to take the gadgets to chiefs' camps and police stations for safe keeping (Standard Team, 2019).

Electricity as a barrier for laptop computers' implementation was supported by Eke (2009); Hennessy et al., 2010; Hermandez, 2017; Kubania, 2014 and Mulwa et al, 2012). On the other hand, insecurity and lack of steady power sources were serious implementation challenges that were mentioned by several respondents during the interviews.

In conclusion, DLP faced numerous challenges in delivery of the course syllabus to learners. Wanzala and Nyamai (2018) reiterated that teachers were equally facing challenges of DLP implementation by arguing that use of DLP devices was dragging

behind the syllabus coverage because it could not be wholly relied on due to numerous implementation challenges such as inadequate teacher skills, lack of power, lack of proper infrastructure and the slow pace of implementation. However, there are more merits than demerits of online education in any society in the whole world.

4.7 Teachers attitudes towards uptake and integration of laptop computers

The research question number four which was based on attitude (What are the teachers' attitudes towards laptop computers uptake in public primary schools in Homa Bay County?) was divided into three areas: the first area was directed to 353 sample teachers on ease of use and usefulness of laptop computers. The second area investigated the attitudes of 79 sample head teachers towards ICT policy and lastly the attitudes of the 8 sample CSOs towards ICT integration were established. In this study, an attitude formation was based on the respondents' perception and was treated an indicator of one's feelings to embrace or not to embrace technology for teaching and learning (Ouma, et al., 2013).

The success of any newly launched technology into the market such as the Digital Literacy Programme (DLP) in Kenya, therefore, depended mostly on the perception of the recipients who were teachers especially on the usefulness and ease of use of Teacher Digital Device (TDD) which in this project were laptop computers. According to Raman, Malik, and Sofian (2015), perception leads to formation of attitudes.

4.7.1 Teachers' perception on usefulness of laptop computers

The study used a five-point likert scale to establish teachers' perception on usefulness of laptop computers. Likert scales were necessary because they had been used in marketing

research as either interval or ordinal scales for attitude measurement by researchers to calculate mean scores that can then be compared (Gakuu, 2007).

Table 4.31. Perceived usefulness of laptop computers

Code	Statement	Mean
T6	Laptop computers will not improve delivery of my lesson as a teacher	3.85
T7	Laptop computers will reduce time spent on writing assignment on the chalk wall	4.12
T8	Laptop computers are not useful in addressing lack of teachers in school	2.62
T9	Laptop computers will improve my Information Communication and Technology skills such as typing and drawing	3.85
Overall mean		3.61

n=353

The researcher calculated the means in Table 4.31 based on a five-point ratings of Strongly Disagree (SD)=1, Disagree (D)=2, Undecided (U)=3, Agree (A)=4 and Strongly Agree (SA)=5. The interpretation of the results was then done based on the e-learning scale shown in Table 4.13. It is found that 272 out of 353 respondents disagreed with the statement 'laptop computers will not improve my delivery as a teacher' (M_{T6}=3.85>M_{elr}=3.41). 291 out of 353 respondents agreed that laptop computers could reduce time spent writing assignments on the chalk boards (M_{T7}=4.12>M_{elr}=3.41). 184 out of 353 respondents, who were the majority, agreed with the statement 'laptop computers are not useful in addressing lack of teachers'. The mean of M_{T8}=2.62 which was less than the expected mean for e-learning readiness, (M_{elr}=3.41), was obtained. Finally, when respondents were asked whether laptop computers would improve their Information Communication and Technology skills, 272 out of 353 respondents, who were the overwhelming majority, agreed as was displayed in the average mean of M_{T9}=3.85 which

was greater than the expected e-learning readiness mean 3.41 (Aydin & Tasci, 2005). In general, the findings based on all tested areas of perception on usefulness of laptop computers studied in this research showed that the average mean for the respondents' perception on the usefulness of laptop computers in teaching and learning was 3.61 which was greater than the e-readiness level mean of 3.41 (Aydin & Tasci, 2005). This suggested to the study that the respondents had a positive attitude towards uptake and integration of laptop computers based on their high perception on the usefulness of laptop computers in teaching and learning.

4.7.2 Teachers' perception on ease of use of laptop computers

Ease of use of laptop computers was essential for the application of laptop computers in teaching and learning. When participants feel laptop computers usage requires little effort, obviously they will like and consequently their attitude would be positive. On the other hand, the respondents may experience difficulties when manipulating laptop computers which may result into partial or complete dislike of the device. The average mean schools on perception statements are displayed in Table 4.32.

Table 4.32. Teachers' perception on ease of use of laptop computers

Code	Statement	Mean
T10	Laptop computers does not support users in typing word documents	4.31
T11	I make minimal errors when using laptop computers	3.68
T12	Doing my work using laptop computers is not enjoyable	4.14
T13	I require little mental effort when using laptop computers	3.11
T14	I cannot easily recover from errors encountered while using laptop computer	3.81
Overall Mean		3.81

n=353

To establish teachers' attitude on ease of use of laptop computer, the study calculated the mean scores of statements generated from respondents on a five-point likert ratings of Strongly Disagree (SD)=1, Disagree (D)=2, Undecided (U)=3, Agree (A)=4 and Strongly Agree (SA)=5 as shown in Table 4.32. The interpretation of the results was then done based on the e-learning scale shown in Table 4.13. It was established that 304 out 353 respondents who were the majority (M_{T10}=4.31) disagreed with the statements 'laptop computers does not support users when typing word documents'. The research findings were equally above the expected e-learning readiness level of 3.41(Aydin & Tasci, 2005). On the declarative statement 'I make minimal errors when using laptop computers', 260 out of 353 respondents (M_{T11}=3.68>M_{elr}=3.41) agreed that they could make minimal errors when using laptop computers. Working with laptop computer was perceived to be enjoyable among the 292 out of 353 respondents (M_{T12}=4.14>M_{elr}=3.41) who disagreed with the statement 'Doing my work using laptop computers is not enjoyable'. 220 out of 353 respondents on the other hand disagreed with the fact that use of laptop computers required little mental effort. This was based on an arithmetic mean of M_{T13}=3.11 that was lower than the expected e-learning readiness mean of M_{elr}=3.41. Lastly when respondents were asked to state whether it was not easy to recover from errors encountered when using laptop computers, the arithmetic mean rating was M_{T14}=3.81 >M_{elr}=3.41 which indicated that 269 out of the 353 sample teachers studied disagreed that it was not easy to recover from errors when working with computers. The findings showed that the mean for the respondents' perception on the ease of use of laptop computers, 3.81, was above the e-readiness mean of 3.41 (Aydin & Tasci, 2005). However, the interpretation of this e-readiness means showed that teachers believed it was not easy for them to manipulate

laptop computers especially when the respondents disagreed that computers required little mental effort as in T13 in Table 4.32.

From the interviews conducted with teachers and head teachers, 18 (100%) respondents agreed that computers were both useful and easy to use in teaching and learning. Both teachers and head teachers had positive attitude towards the introduction of DLP in Kenyan schools. The following verbatim quotation represented opinion of the respondents who were interviewed:

> Mmm! Well! My feelings, aaah, it is good the world is moving forward on that direction and so we as a country we should move together with the world. Today, many things are done digitally. We are on the computer platform we stop by digitally. You need to actually everything is now done using computers so it is a good thing that in the past may be the curriculum, the books made the teaching methods were done manually but you see every time and again things are changing and so it is good that today teaching is done digitally and the children are going to learn using computers…(Head teacher, Homa Bay).

4.7.3 Discussion

The findings of the study revealed positive attitude of the respondents on usefulness of laptop computers in teaching and learning but were skeptical on ease of use of laptop computers since the majority of the respondents felt they could use laptop computers comfortably but with a lot of mental effort. In support, several researches were keen to note that among the most relevant barriers to effective diffusion of e-learning concerned the cultural and personal attitudes of teachers towards e-learning (Afshari et al., 2009; Oketch, 2013). The introduction of laptop computer project in primary schools in Kenya needed the attention of the facilitators, who, in a primary school level in Kenya, was the teacher.

Based on the research findings, the government rolled out DLP in public primary schools found teachers receptive but were cautious with some statements such as ‘laptop computers are not useful in addressing lack of teachers’. Such kind of statement created fear of job loss for teachers when DLP was being rolled out in the Kenyan schools. The findings were in concurrence with Kimunge (2017) reports that observed that teachers would be declared redundant by the government when technology was in place. The study noted that to avert fear of job loss among the teachers more teachers ought to be employed and trained to work with technology as a tool of teaching and learning in Kenya. This is because other studies also showed that teachers’ perceptions and attitudes towards technologies can influence greatly the effective use of technologies in teaching and learning (Paraskeva, Bouta, & Papagianna, 2008).

Sharples and Moldéus (2014) were in concurrence with the observations of Paraskeva, Bouta, and Papagianna (2008) and asserted that perceptions of participants on the usefulness and ease of use of laptop computers are regarded as the main factors that influence technology adoption in any educational system and could obviously lead to an attitude formation. They observed that the ease of use and usefulness are the degrees to which an individual’s attitude towards ICT is based. However, this was in sharp contradiction with the findings of Wanzala and Nyamai (2018) who noted that laptop computers were overburdening and a source of confusion as a teaching methodology which of course to some extent explained that laptop computers were not easy to use as was observed by the majority of the respondents.

It was also interesting to note in the study that respondents were of the opinion that working with laptop computer was enjoyable and that laptop computers could successfully be used to improve lesson delivery. But in a sharp contradiction, the same respondents argued that laptop computers required a lot of mental energy to operate. The study observed that, of course, it was true that majority of the teachers could type word documents, make minimal errors and recover from errors when working with laptop computers but these respondents required a lot of mental efforts for the same. This meant to the study that teachers welcomed the use of technology in schools but were missing the practical computer skills of manipulating laptop computers efficiently. Based on the findings, therefore, laptop computers were believed to be useful by the respondents but not very easy to use in the teaching and learning process. This was in line with the findings of Sharples and Moldéus (2014) that 95% of the Kenyan teachers found laptop computers useful but only 8% could use them with ease. Kimuge (2017**)** also observed that teachers were not fully integrating DLP devices in Kenyan schools for fear of incompetence before learners. In considerations of their usefulness, laptop computers were endorsed by the government as the best tool for use in integrating Information Communication and Technology (ICT) in teaching and learning in public primary schools in Kenya (Republic of Kenya, 2015). However, because of cost implications, the government decided to use tablets as a Learner Digital Device (LDD).

In addition, teachers in Kenya were expected to embrace technology learning by playing an active role of facilitating learning by use of appropriate teaching approaches. However, this could only be made possible when full acceptance of technology was realized in the teaching fraternity. The teachers' attitudes towards technology and the digital content to be

taught was found to be great determinants of the outcome of any digital learning (Hennessy et al., 2010). The findings were also in concurrence with Ali Alamin and Elgabar (2014) who noted that learning institutions did not only require a robust technical infrastructure to support the delivery of the courses, but more importantly, the complete acceptance of its major would-be users who in Kenya were the teachers and pupils.

In summary, the aggregate mean scores of all areas of teachers' perception on usefulness of laptop computers overwhelmingly showed that Kenyan teachers were ready and willing to migrate to the digital world but needed confidence building and training to boost their attitude on ease of use of laptop computers. In support, Hennessy, et al. (2010) added that teachers who regard ICT as very useful have always found them easier to use in teaching and learning. In response to the robust nature of technology, teachers are fast joining the rest of the world in embracing technology as an ally and thus increasing the chances of the government wooing teachers and other stakeholders to adopt technology in the process of teaching and learning in the Kenyan schools (Reddy & Manjulika, 2002). Khan et al. (2012) adds that in an environment where less technologically capable teachers possess positive attitudes towards ICT, they may only require less effort to learn the skills necessary for the implementation of ICT in their classrooms.

As an emerging theme, 1 (6%) out the 18 respondents who was interviewed had positive attitude towards technology-based education and viewed technology usage in schools as a way of fulfilling the goals of vision 2030 in various sectors of the Kenyan economy. This is what was said by an interviewee:

> I think it is the right time. If others are using it, why not us? Even in Kenya they had started in other schools. So we also want it! I think it is good

> because…Eeeh! The 2030 vision to be fulfilled, I think it is necessary (Head teacher, Ndhiwa).

The study treated technology as an abler of the vision 2030. Education being at the epicenter of all productive sectors of the economy has no otherwise but to accept and adopt technology in teaching and learning. This was in concurrence with the findings of Teo, Lee, and Chai (2008) who observed that perceptions on usefulness and ease of use of computers were found to be significant contributors of uptake and integration of computers in Singapore.

4.7.4 Head teachers' perception of ICT infrastructure (ICT policy document)

An attitude formation was not only confined to computers in schools, other areas of readiness in a school equally needed to be taken into account by teachers and other stakeholders. The study gave emphasis to head teachers' attitudes towards an ICT policy because the ICT policy document was considered by the study as a vital document for meaningful uptake and integration of laptop computers and, therefore, was necessary for teachers as well. The head teacher being the head of curriculum in the institution was expected to put in place guidelines and procedures that could create order in handling devices and implementing DLP at the school level. The study generated mean scores of head teachers' feelings on the importance attached to policy documents in schools. The responses were spread in a five-point likert scale: Strongly Agree (SA)=1, Agree (A)=2, Undecided (U)=3, Disagree (D)=4 and Strongly Disagree (SD)=5.

Table 4.33. Head teachers' perception on ICT policy (ICT policy document)

Perceived ICT Policy	Mean
There is no government ICT policy on education	3.23
ICT policy guidelines are necessary for the success of laptop computers in my school	4.54
My school has not developed its own ICT policy for pupils and teachers	2.85
ICT policy in my school is operational	2.76
Teachers and pupils of my school have not been sensitized on the existence of ICT policy	3.42
Mean	3.36

n=79

The following declarative statements registered sample head teachers' positive attitude on the necessity of ICT policy in the school: 'ICT policy guidelines are necessary for the success of laptop computers in my school (4.54) and teachers and pupils of my school have not been sensitized on the existence of ICT policy (3.42). On the other hand, declarative statements such as 'there is no government ICT policy on education (3.23), my school has not developed its own ICT policy for pupils and teachers (2.85) and ICT policy in my school is operational (2.76)' reflected sample head teachers' negative attitude towards embracing ICT policy as a necessary ICT infrastructure in the school. In general, sample head teachers' attitude based on their perception of ICT policy stood at 3.36 which was regarded as low compared to the expected e-learning readiness levels of 3.41.

4.7.5 Discussion

Responses from 79 out of 85 sampled public primary school head teachers indicated that sampled head teachers attitude stood at 3.36 which was interpreted by the study to be negative when compared to e-learning readiness level of 3.41 as stipulated in Table

4.13.The research findings were found to be far from the reality because in 2006, Kenya developed and started implementing ICT policy in all learning institutions (Kenya. MoE, 2006). Such lack of awareness among the head teachers was regarded by the study as a mismatch in coordination and communication between the Ministry of Education and educational institutions in Kenya. The ICT policy document was supposed to be a public document which ought to have been received and deposited in all learning institutions in Kenya. The belief that the national ICT policy document was not there did not mean that head teachers underrated the need for a policy document, in fact 53 (67.1%) out the 79 head teachers who were sampled strongly agreed that with ICT policy in place, schools could get clear direction on how best to acquire and make good use of DLP at the school level.

Interestingly, 33 (41.8%) of the respondents, who were the majority, despite being head teachers of schools had no idea of the need to develop their own school's ICT policy to guide the roll out of DLP in their respective schools. The study compared the data in this section of the study (presentation, analysis, discussion and interpretation of research findings) and data generated from observation checklist on ICT infrastructure in schools (see attached Appendix 5) and came to an agreement that 69 (81.2%) of the sample schools had no ICT policy guidelines in their schools. And this actually left no answers to some fundamental questions in a DLP school such as 'How are DLP devices managed before and after use in class?'(McGrath, 2006).

Hennessy, et al. (2010) saw the need for an ICT policy. They observed that at the primary school level, the policy should aim at encouraging schools that had acquired the

technology to use them to support teaching, either by producing teaching materials or by use of the technology with students in the actual dissemination of content in class. Before the distribution of DLP devices to schools in Kenya, ICT policy documents should have been sent to schools to give directions on implementation. This is because at the time of this study 551 out 845 schools in Homa Bay County had already received DLP devices but unfortunately these schools had no proper policies in place to streamline the management of the devices in their schools.

Schools, therefore, needed to be trained and encouraged on how to develop their own ICT policies based on the national ICT framework because policy documents are tailor made depending on the environment where the user is (McGrath, 2006). Keegan (1996) argued that a vibrant and well-coordinated ICT framework in education has a multiplier effect throughout the education system.

4.7.6 Curriculum Support Officers' attitudes on ICT integration

Curriculum Support Officers (CSOs) in connection with ICT Authority in Kenya were directly involved in the training of teachers and head teachers on the delivery of the digital content. They were also expected to support the implementation of curriculum in schools by engaging teachers and head teachers directly on how best the digital content should be delivered to the pupils. This involved, among other things, the assessment of the teachers' capacities to engage learners on the digital platforms and ensure the right methodologies were used to deliver digital content. The CSOs attitude towards digital content was, therefore, a concern for this study. To establish this, the study used declarative statements to measure the perception of the (CSOs) as shown in Table 4.34. A likert scale of 'Strong Disagree (SD) =1', 'Disagree (D) =2', 'Undecided (U) =3', 'Agree (A) =4' and 'Strongly

Agree (SA) =5'were used. The average means of the respondents' responses were recorded in Table 4.34. Higher perceptions on a likert scale were regarded by the study as positive attitude as lower perceptions were linked to negative attitude.

Table 4.34. Curriculum Support Officers' perception on ICT integration

Statement	Mean
All schools were represented for DLP training	3.13
There was a follow up to ensure that DLP trained teachers trained others in their schools	2.75
Teachers received inadequate training on digital content	3.88
KICD content has not been availed to teachers in schools	3.75
The schools have inadequate personnel for digital content delivery	3.38
Mean	3.38

n=8

All the declarative statements used in the study: 'all schools were represented for DLP training (3.13), there was a follow up to ensure that DLP trained teachers trained others in their school (2.75), teachers received inadequate training on digital content (3.88), KICD content has not been availed to teachers in schools (3.75) and the schools have inadequate personnel for digital content delivery (3.38)' indicated negative attitude by the CSOs'. In average, the CSOs perception stood at 3.38 which the study observed did not meet the e-learning readiness point of 3.41 and hence, was inadequate for proper launching of DLP in Kenyan schools.

4.7.7 Discussion

This section of the study was based on the perceptions of 8 Curriculum Support Officers (CSOs) in Homa Bay County on ICT integration by use DLP devices in Kenya. CSOs who were employees of the Teachers Service Commission (TSC) of Kenya were in charge of teachers' professional development at the zonal level. They were supposed to avail and orientate teachers on new curriculum demands and the right teaching approaches on all areas of the curriculum in a primary school. Laptop computer integration was a new approach of teaching and learning that fell directly under their docket. The findings of the study showed that 56 (100.0%) sample schools had already received DLP devices and were expected to start the integration process with the support of CSOs.

In addition to DLP, data obtained from ICT Authority Homa Bay County, indicated that a total of 402 (47.6%) schools had 3 teachers trained for DLP (Kenya. ICTA, 2016). There were also media reports that some 62,500 teachers had been trained at the national level (Republic of Kenya, 2015). CSOs were expected to be in attendance of such trainings. However, going by the CSOs opinions, a number of teachers and schools in their jurisdictions had still not been trained at the time of this study because DLP training was supposed to continue in schools and be facilitated by the teachers who had received DLP training. In line with the findings, CSOs contradicted the findings of this study on teachers' computer capacity by claiming that even the few teachers who were trained for 5 days were not skilled enough to jumpstart DLP in their schools. However, the CSO's findings were in concurrence with the observations of Omanga (2018) that a number of teachers stilled lacked adequate computer skills after DLP training. The study interpreted the perception of the CSOs in this study as low and if not given attention by the government

could slow down the implementation of DLP in public primary schools in Kenya. Afshari et al. (2009) supported by noting that negative attitude was a major barrier to the success of any ICT program.

The fact that CSOs were not given the opportunity to be actors in the design of DLP meant that they were left out at the design stages of DLP and only given passive roles in overseeing the already designed DLP. The management of DLP by three different government agencies in Kenya such as the Ministry of Education, Teachers Service Commission and ICT Authority resulted into conflict of roles. The roles were overlapping because according to CSOs, they were supposed to represent Teachers Service Commission (TSC) of Kenya and particularly train teachers on integration of DLP but such training roles were instead assumed by ICT Authority. CSOs being field officers on the ground with the teachers, their reluctance to supervise DLP meant very little may have been taking place in schools under their jurisdictions in relation to DLP activities. In concurrence, Bertea (2009) asserted that a favorable attitude showed a greater probability of success of a program that learners and teachers would accept the new learning system as negative attitude, on the other hand, is associated with lack of understanding, poor communication and absence of trust or conflicting agendas in appropriate use of technology.

The study also noted that Curriculum Support Officers (CSOs) were of the opinion that each school needed additional personnel to run DLP. Their view was that the schools were understaffed and any additional responsibility needed additional work force. However, such findings were refuted by the report from ICT Authority in Homa Bay County which

maintained that DLP did not require any additional workforce because the program only wanted a few teachers to guide pupils on how to use the digital devices and after which pupils were to operate the devices on their own. But in a sharp disagreement, Hennessy, et al. (2010) insists that the best practice on ICT uptake and more particularly in the developed countries was the availability and adequacy of fully trained personnel.

4.8 Contributions of independent variables to uptake and integration of laptop computer model

Models are evaluation tools which can be used to establish the state of ICT utilization and penetration levels in an organization whose output is expected to be successful adoption and proper utilization of the available digital learning resources (Kungwannarongkun & Chanyagorn, 2011). Models show connections and relationships between the variables in different contexts (Healey, 2002). In support Demir and Yurdugü (2015) added that model variables should not be used directly but should be amended and applied in different contexts.

For this study, uptake and integration of laptop computer model consisted of a number of independent variables: ICT infrastructures, ICT policy, teacher computer capacity, awareness of the digital content and teachers' attitudes. Uptake and integration of laptop computer model was made up of a number of ICT readiness areas that the government funded such as institutional ICT infrastructures, teacher computer capacity and the digital content. Even though teachers' attitude and ICT policy did not form part of the readiness areas to be funded by the government, the study found them necessary because they have been successfully used and found to be significant contributors of ICT readiness in a

number of ICT readiness models: Demir and Yurdugü (2015), Mosa et al. (2016), Technology Acceptance Model (TAM) (Mojtahed et al., 2011) and the Kenyan e-readiness Model (Sharples & Moldéus, 2014).

4.8.1 Multiple regression analysis on readiness for uptake and integration of laptop computer model

To show linear dependence, multiple regression analysis was conducted on ICT infrastructures, teachers' computer capacity, teachers' awareness of the digital content, teachers' attitude and the readiness for the uptake and integration of laptop computers model (dependent variable). ICT policy's contribution and its relationship to uptake and integration of laptop computers model was also tested.

4.8.2 Coefficients of regression analysis

The researcher used multiple regression analysis on the independent variables (Institutional ICT infrastructure, ICT policy, teacher computer capacity, teachers' awareness of the digital content and teachers' attitude) to estimate their loadings to uptake and integration of laptop computers in Homa Bay County as shown in Table 4.35.

Table 4.35. Coefficients of multiple regression model

Model	Beta (b)	Sig.	Comment	Model summary (R Square)	Std. Error of the Estimate	ANOVA Sig.
				.832	.216	.000[b]
(Constant)	1.703	.000	Significant			
Teachers' computer capacity	.057	.194	Not significant			
ICT policy	-.055	.464	Not Significant			
Digital content awareness	-.208	.000	Significant			
Teachers' attitude	.080	.004	Significant			
ICT infrastructure	.066	.393	Not Significant			

*** Significant at 0.05 level.**

Dependent Variable: Uptake and integration of laptop computers

The results showed that alpha value (constant) for the ICT model stood at 1.703. The constant value of 1.703 meant that it was the starting point for the uptake and integration of laptop computer model when all the independent variables' contributions were zero. But any unit increase in teachers' computer capacity resulted into an increase of 0.057 in uptake and integration of laptop computer model, teachers' attitudes unit increase would give a positive increase of 0.08 on uptake and integration of laptop computer model, ICT infrastructures' unit increase would positively contribute 0.066 on uptake and integration of laptop computer model. On the other hand, a unit increase in ICT policy (-0.055) and teachers' awareness of the digital content (-0.208) would contribute negatively to uptake and integration of laptop computers model.

The model summary showed that R square stood at 83.2% while adjusted R square had a value of 81.5%. This meant that the variables under study explained 83.2 % of the variations in uptake and integration of computers in public primary schools in Homa Bay County. The low standard error of estimate (0.216) also showed that the model was predictable. The study, therefore, was strong to connect key independent variables to uptake and integration of laptop computers.

The ANOVA results indicated that F was significant at 0.000 which indicated that the model was statistically significant and suitable for testing the relationship between the dependent and independent variables of the study. All the independent variables under study (ICT infrastructure, teachers' computer capacity, digital content awareness, teachers' attitude and a moderating variable (ICT policy) were linearly dependent to uptake and integration of laptop computers.

Based on the contributions of independent variable to uptake and integration of laptop computers in Homa Bay County, the study showed that all the independent variables tested were either negatively or positively related. That is, teachers' computer capacity, ICT infrastructure and teachers attitude had a positive contribution. On the contrary, digital content awareness and ICT policy (moderating variable) had a negative contribution. However, going by the statistical significance of each independent variable, only teachers' attitude and digital content awareness were statistically significant.

4.8.3 Discussion

As the Government of Kenya struggled to implement ICT pedagogy in schools, teachers needed to gain ICT skills and apply the same in the teaching and learning process. Uptake

and integration of laptop computer model for this study was expected to provide a platform for funders and implementers of DLP to crosscheck the contributions of ICT infrastructures, teacher computer capacity, digital content, teachers' attitudes and ICT policy to uptake and integration of online education in Kenya (Asabere, Togo, Acakpovi, Torgby, & Ampadu, 2017; Wanzala, 2017).

The findings of this study established that teachers' attitudes were significant and positively contributed to uptake and integration of laptop computers in Homa Bay County. The formation of positive attitudes towards adoption of laptop computers, especially ease of use and usefulness of laptop computers to teachers in education sector in Kenya, could mean that teachers accepted DLP with the mentality that the DLP devices would be useful and needed less of their mental efforts as compared to manual learning where teachers use a lot of energy to on the blackboard for learners. In support, Chuttur (2009) asserted that users of technology needed to be convinced to accept that they would save some energy when working with such devices in class.

However, going by the findings of this study under objective number 4 (Establishing the teachers' attitudes towards uptake and integration of laptop computers for teaching and learning), there was a concurrence with the outcome of the uptake and integration model; majority of the sample teachers' attitudes were positive. Majority of the sample teachers still believed that laptop computers were useful but not easy to use because they argued that laptop computers needed a lot of mental energy to operate. They needed further training. To this study, this was interpreted to mean that teachers' attitudes alone, even

though statistically significant to uptake and integration of laptop computer model, were not enough for uptake and integration of laptop computers in Kenya.

It's worth noting in this study that teachers' attitudes towards DLP could be improved by mounting vigorous campaigns especially, by supporting teachers to acquire digital equipment for regular practice and usage at their convenience and not necessarily in schools to improve their computer capacity. Building confidence in technology users before, during and after the launch of DLP could make users develop positive attitudes towards the program because peoples' attitudes have been found to be closely linked to the success or failure of any program (Mojtahed et al., 2011). In support, Rhema and Miliszewska (2010) also added that developing countries that are still lacking sufficient awareness and full acceptance of ICTs are facing numerous implementation challenges.

The study summarized this objective number five of the study by noting that even though ICT policy, ICT infrastructures and teachers' computer capacity were not statistically significant in the formation of uptake and integration of laptop computer model in this study, teachers' attitudes alone was not enough for a viable ICT readiness model. ICT policy, ICT infrastructure, teachers' awareness of the digital content and teachers' computer capacity were observed by the study to be practically significant for any meaningful uptake and integration of ICT in schools. This is because there is no ideal ICT environment that does not require ICT infrastructures, teacher computer capacity and more so ICT policy document to give direction on implementation. In support, Dahiru (2008) observed that test of statistical significance is based on chance and may not work very well

in some social phenomenon that are based on logical reasoning. For instance, an ICT policy framework would guide every aspect of the project:

- ICT infrastructure
- Teacher training
- Digital content

ICT Policy formulation should, therefore, be both at the national and school levels because ICT policy guidelines are expected to raise fundamental questions and give answers to critical issues surrounding the entire DLP model (McGrath, 2006):

- What are the right ICT infrastructure for DLP?
- Who should provide these infrastructure and when?
- Who would be responsible for maintenance of the available ICT infrastructure?
- Who should be trained for DLP?
- Which model of training should be adopted?
- How long should the training be for?
- How often should the training be?
- Who is responsible for content development and its mode of distribution?

The answers to these fundamental questions when properly implemented either by the school, government or stakeholders, the entire DLP implementation would be a success. However, each school needed to develop its own ICT policies because practically there are no two same schools in terms of ICT needs (Coopasami, Knight, & Pete, 2017).

The fact that the study variables could only explain up to 83.2% of e-learning readiness areas, the remaining 16.8% could be explained by other factors that were not studied in this

research such as social factors, finance and environment as demonstrated in other ICT models. E-learning system is, therefore, best implemented through stages of careful planning of the components that are needed to establish and maintain a working system. Ad-hoc implementation of e-learning systems usually does not meet users' needs, and end up making the system unusable or stand-alone (Madar & Willis, 2014). While the existing models, for example, TAM (Technology Acceptance Model), Theory-Based E-learning and Pedagogical Models have been used over time, they were generally found to be inadequate and could not meet the needs of all specific ICT set-ups for a given system like the Kenyan DLP. Each and every model has its own criteria and purpose for specific projects and programs (Madar & Willis, 2014). The design of a viable ICT model is dependent on the composition and expectations of the specific project(s) to be carried out. However, models are constantly being created, modified and used (Eke, 2011). There is no best ICT model for all situations.

4.8.4 Summary of the chapter

The chapter presented the findings, data analysis and discussions of the findings. There were 353 sample teachers, 56 sample teachers in schools with DLP devices, 79 sample head teachers and 8 sample CSOs who responded to the study. Some 12 sample teachers and 6 sample head teachers were also interviewed. In addition, 85 sample schools were also observed. The study established that the ICT infrastructure stood at 29.8 % and that, computer safes (79.9 %), electric power (74.8%) and power sockets (90.0%) were available in the 85 sample schools that were studied. The remaining ICT facilities investigated registered lower percentages in terms of availability.

On DLP training, 109 (30.9%) sample teachers, 59 (74.7%) sample head teachers and 4 (50%) sample CSOs had been trained. Out of the 56 sample schools that had received DLP devices, only 25 (44.6%) sample schools were utilizing them for teaching and learning. The general computer competence was low for both sample teachers (2.80) and sample head teachers (2.61) when measured against a five-point likert scale. However, DLP trained sample teachers and sample teachers who were teaching with DLP devices registered a higher mean of 3.42 and 3.68 respectively.

Both sample teachers (22.95%) and sample head teachers (30.38%) who were the majority were aware of the components of the digital content as video, graphics, texts, audio and images. On the other hand, digital content skills were still wanting. 147 (41.6%) sample teachers who were the majority of the sample teachers could only do typing using computer's keyboards. Desktop computer was chosen by 111 (31.4%) sample teachers who were the majority while 27 (34.2%) sample head teachers stated tablets as possible substitute digital equipment to laptop computers. Insecurity as a major threat to the implementation of DLP was cited 80 (22.7%) sample teachers and 19 (24.1%) sample head teachers who were the majority.

On a five-point likert scale of 1 to 5, the study found a higher mean of sample teachers' attitudes (3.61) on usefulness and 3.81 on ease of use of computers towards the uptake and integration of laptop computers in schools. Lastly, the study used multiple regression analysis of independent variables of the study such as ICT infrastructures, teacher computer capacity, teachers' awareness of the digital content, ICT policy and the teachers' attitudes to analyze their contributions to uptake and integration of laptop computer model.

Teachers' attitudes contributions were found to have positively and significantly contributed to uptake and integration of laptop computer model. The next chapter will comprise of a summary of findings, conclusions and recommendations of the study.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents summary of findings, conclusions, recommendations and suggestions for further research. The presentations were done in line with the stated research objectives.

The specific objectives of this study were to:

1. Investigate the presence of institutional ICT infrastructure in schools for uptake of laptop computers
2. Examine the adequacy of teachers' computer capacity in readiness for uptake and integration of laptop computers
3. Determine teachers' awareness of the digital content to be integrated by laptop computers
4. Establish the attitude of teachers towards uptake and integration of laptop computers for teaching and learning
5. To analyze the contribution of independent variables of the study to uptake and integration of laptop computers for teaching and learning

The following research questions guided the study:

1. Are there appropriate institutional ICT infrastructure for uptake of laptop computers in public schools?

2. What capacity do teachers have for using laptop computer for teaching and learning in relation to their training?

3. What is the teachers' level of awareness of the digital content to be delivered to learners by use of laptop computer?

4. What are the teachers' attitudes towards laptop computer uptake and integration in public primary schools?

5. What is the contribution of independent variables of the study to uptake and integration of laptop computers for teaching and learning?

5.2 Summary of the research findings

The research findings were based on the following areas: Institutional ICT infrastructure, teachers' computer capacity, teachers' awareness of the digital content, teachers' attitude, and contributions of independent variables of the study (Institutional ICT infrastructure, ICT policy, teacher computer capacity, teachers' awareness of the digital content and teachers' attitude) to uptake and integration of laptop computer model.

5.2.1 Institutional Information, Communication and Technology infrastructures

The study explored the availability of a number of items considered by this study as necessary infrastructures for uptake and integration of laptop computers as expressed in objective one of this study were: the availability of computer safes, computer room chairs, carpeted floor, internet, power sockets, laptop computer technical assistants, electric power, power generators, solar power, uninterrupted power supply (UPS), laptop computer attendants and laptop computer room policy document.

The research findings showed that:

i. the general readiness for institutional ICT infrastructures in all sampled schools stood at 29.8%.

ii. On specific institutional ICT infrastructures, the major findings were as follows: 68 (79.9%) sample schools had computer storage facilities, 77 (90.0%) sample schools had power sockets and 63 (74.8%) sample schools had electricity as the main source of power. On the other hand, the following institutional ICT infrastructures were available in a minority of the sample schools: 11 (13.1%) sample schools had computer room chairs and tables, 2 (2.1%) sample schools had carpeted floors, 15 (18.0%) sample schools had access to the internet, 14 (17.6%) sample schools had computer technicians, 5 (5.6%) sample schools were in possession of power generators, 6 (7.2%) sample schools were using solar power, 5(5.7%) sample schools possessed Uninterrupted Power Supply (UPS), 19 (22.0) sample schools had computer room attendants and 19 (22.0%) sample schools were in possession of computer room policy document.

The study findings also showed that the ICT infrastructures that were available in most sample schools such as electric power (74.8%), power sockets (90.0%) and storage facilities (79.9%) for DLP devices) were funded by the Government of Kenya but, were not equally distributed in the sub-counties of Homa Bay. For instance:

i. In terms of electric power penetration, Homa Bay (94.1%) and Rachuonyo North (94.1%) sub-counties had the highest while Suba Sub-County (44.4%) registered the least number of power connections.
ii. Homa Bay Sub-County had the highest number of computer storage facilities (94.1%). On the other hand, Ndhiwa Sub-County (60.0%) had the least.
iii. All sample schools (100.0%) in Rachuonyo North Sub-County had power sockets while Mbita Sub County (81.8%) had the least number of power sockets in sample

schools.

The study, therefore, showed that sample schools in Homa Bay County had no uniform uptake and integration points because a number of ICT infrastructural items for laptop computer uptake and integration were not available and unequally distributed in all sub-counties. However, the efforts of the Government of Kenya was observed in the supply of electric power, installation of power sockets and building of computer safes in most sample schools.

5.2.2 Teachers' computer capacity

The teachers' capacity to use laptop computers effectively for purposes of teaching and learning was a major concern for study. The following were the major findings:

i. The computer capacity for the 353 sample teachers and 79 sample head teachers stood at 2.8 and 2.6 respectively when tested using a five-point likert scale. When compared to the expected level of e-learning readiness level of 3.41 (Aydin & Tasci, 2005), the study found the ratings to be low and needed a lot of improvement.The findings showed that all the computer skill areas tested were inadequate for integration and, therefore, required further computer training and familiarization.

ii. But when sample teachers and sample head teachers were grouped as DLP trained and DLP untrained, the findings showed that the computer capacity of 109 (30.9%) sample teachers and 59 (74.7%) sample head teachers who attended DLP training was 3.42 and 2.73 respectively. This indicated that teachers who were DLP trained were ready for the launch. On the other hand, 216 (61.2%) sample teachers and 20

(25.3%) sample head teachers who had not been trained on DLP registered 2.10 and 2.48 respectively. The study observed that the DLP training made some impact on the computer skills for both sample teachers and head teachers.

iii. The Government of Kenya through its DLP had trained 59 (74.7%) sample head teachers, 4 (50.0%) sample Curriculum Support Officers (CSOs) and 109 (30.9%) sample classroom teachers. Teachers and head teachers were trained for 5 days which this study found meaningful for the integration of DLP in schools.

iv. The study found that 35 (44. %) sampled schools which were the majority had no teacher(s) trained on DLP by their counterparts who had attended DLP training because there were no computers in schools for already DLP trained teachers to use for training their colleagues. In fact, some sampled teachers seemed to have lost their skills for operating the devices at the time of study because of lack of follow ups after the DLP training to oversee the implementation and reinforcement of skills that were gained during DLP training.

v. As an emerging view point from interviews, representation of teachers for DLP training by the government did not take into account the fact that some schools had more than one stream for DLP classes. In many instances, DLP trainings for most sampled schools only considered two teachers per school and yet a number of schools had more than one stream. In addition, equity in DLP training was also not observed. Some sub-counties such as Mbita (52.5%) and Homa Bay (37.8%) had higher percentages of DLP trained teachers than others.

vi. The 25 (44.6%) sample teachers in schools that were teaching with DLP devices registered a higher mean score (3.68) on a five-point likert scale in computer skills

which showed that continuous practice with the devices improved their skills further. The study noted that even though all the 56 sample schools had received DLP devices for teaching and learning, 31 (55.4%) which formed the majority of the sample schools had not started teaching using the devices citing inadequate DLP training. Interestingly, 22 (39.3%) of these sample schools that had received DLP devices did not know who to consult when met with challenges of breakages or malfunctioning devices when teaching and learning.

5.2.3 Teachers' awareness of the digital content

The research findings on the respondents' awareness of the digital content were summarized into the following areas: Teachers' knowledge of components of a digital content, teachers' ability to manipulate specific digital content skills, head teachers and teachers' awareness of other recommended digital devices and possible barriers to successful delivery of digital content

The major findings were as follows:

i. 81 (22.9%) sample teachers and 24 (30.4%) sample head teachers, who were the majority of the respondents, were aware of the composition of the study's listed digital content for laptop computer uptake and integration such as video, audio, images, texts and graphics.
ii. 147 (41.6%) sample teachers who were the majority could only type using laptop computers. The study established that other digital skills such as drawing, simulation and basic arithmetic were wanting.
iii. The research findings showed that while a majority of the sampled teachers, 111 (31.4%), were comfortable with desktop computers. On the other hand, majority of the sample head teachers, 27 (34.2%), preferred tablets. The sample teachers argued that desktop computers

had a history in computing and posed lesser risk of breakages because of their fixed positions. Sample head teachers on the other hand preferred tablets because of their portability and convenience.

iv. On possible barriers to the delivery of digital content in public primary schools, the study findings revealed that the main barrier to the majority of sample teachers, 80 (22.7%), and sample head teachers, 19 (24.1%), was lack of proper security for DLP devices. The study noted from the interview ssession with sample teachers and sample head teachers that a number of schools had either been broken into or attempted to be broken into by thieves with the main aim of stealing DLP devices.

5.2.4 Teachers' attitudes

The summary of the outcome for the research objective number four was as follows:

i. The findings showed that the attitude of 353 (100.0%) sample teachers on usefulness of laptop computers stood at a mean score of 3.61 on a five-point likert scale which was interpreted to mean that sample teachers believed that laptop computers were useful tools for teaching and learning. Even though the average rating for ease of use for laptop computers to the teachers projected a mean score of 3.81 on a five-point likert scale, sample teachers specifically pointed out that use of laptop computers in teaching and learning needed a lot of brain power to use when compared to the traditional ways of teaching and learning using hard copy textbooks and blackboards. The mean rating for the declarative statement, 'I require little mental effort when using laptop computers' was 3.11. The respondents' views were compared to the required e-learning readiness level of 3.41 (Aydin & Tasci, 2005) and found to be low for ease of use of laptop computers.

ii. The outcome of this research also established that Curriculum Support Officers' (CSOs) attitude was rated at 2.73 on a five-point likert scale and hence found not positive. The study based its argument on the CSOs failure to make follow ups in schools to ensure that teaching and learning were going on using DLP devices and that teachers who were trained on DLP trained other teachers in their respective schools. The study noted that the pace of distribution of digital devices to schools were low and this left CSOs casting doubts on the seriousness of DLP. This is because the study revealed that a number of schools had not received these devices at the time of this study.

5.2.5 Contributions of independent variables of the study to uptake and integration of laptop computer

A summary of the review of several ICT readiness models under the literature review section showed that key areas of e-readiness such as availability of necessary institutional ICT infrastructures, teachers' computer capacity, teachers' awareness of the digital content, ICT policy and teachers' attitudes were necessary for uptake and integration of laptop computers. The findings of the study noted that institutional ICT infrastructures (0.066), teachers' computer capacity (0.057) and teachers' attitude (0.080) made positive contributions to uptake and integration of laptop computers. On the other side, ICT policy (-0.055) and teachers' awareness of the digital content (-0.208) projected negative contributions on uptake and integration of laptop computers in Homa Bay County. The study emphasized that even though some of the independent variables of the study contributed negatively to the uptake and integration of laptop computer model, they were found to be practically important because no uptake and integration of laptop computers

can work on a single independent variable. However, the study found teachers' attitudes as the most significant contributor to uptake and integration of laptop computer model. The study observed that no appropriate scientific modeling has been done that captured the key variables.

5.3 Conclusions of the study

i. The study concluded that the general ICT infrastructures for DLP in sampled public primary schools in Homa Bay County were not fully developed. The efforts of the Government of Kenya in providing some institutional infrastructures for ICT rollout such as electricity, power points and laptop computer safes was witnessed in most sampled schools but still a lot needed to be done in public primary schools to normalize DLP. The study also concluded that ICT infrastructures that were funded by the government needed to be equitably distributed in different sub-counties of Homa Bay.

ii. Teachers'computer skills were found to be far below the e-learning readiness level required for DLP integration for teachers and head teachers who did not attend the five-day training but was adequate for teachers who were trained on DLP and teachers who were teaching using DLP devices. The study observed that teacher computer capacity needed to be improved. The government could either organize periodic ICT training or avail digital devices for teachers for use at their convenience. The five-day DLP training, though, was successful for the introduction of DLP in Kenya, needed to be reorganized to offer meaningful training to starters in ICT education by breaking training periods into phases to cater for needs of different teachers. This is because many sampled schools that had already received DLP devices did not start digital learning on grounds that they were lacking properly trained DLP teachers. Equity in

DLP training was also not observed. Some sub-counties had higher percentage of DLP trained teachers than others.

iii. It was also concluded that digital content was not new to the sample teachers and sample head teachers who were the respondents. The study observed that the respondents' knowledge of digital content was a good starting point for DLP and the government could utilize this by strengthening teachers' abilities especially, on the usage of the digital content by engaging them more on the digital platform. This is because the study findings established that the majority of the respondents were aware of the different components of digital content mentioned in the study such as video, audio, graphics, texts and images.

iv. The study also concluded that the government was successful in popularizing tablets because majority of the respondents were aware and comfortable with its usage in schools. However, security for the digital devices in schools was found by the majority of the respondents to be a major threat for uptake and integration of laptop computers in public primary schools.

v. Teachers' attitudes were found to be positive especially on the usefulness of laptop computers. However, majority of the teachers were still not convinced that laptop computers were easy to use. The study concluded that there was of lack of practice and exposure for teachers on digital equipment. On contrary, CSOs who were supposed to take center stage in DLP training and helping teachers to integrate DLP devices in their schools showed negative attitude on the implementation of DLP in schools by failing to visit schools in their jurisdictions to supervise the integration process.

vi. The study concluded that the independent variables of the study such as institutional

ICT infrastructures, ICT policy, teachers computer capacity, teachers' awareness of the digital content, ICT policy and teachers' attitudes formed a dependable uptake and integration of laptop computer model that explained 83.2% of the factors that contribute to uptake and integration of laptop computers in Homa Bay County. Even though some of these variables of study such as institutional ICT infrastructures, teachers' computer capacity and ICT policy were not statistically significant, they were considered by the study to be practically significant because no appropriate ICT model can function well alone without the input of other ICT components. The study concluded that as in many other studies, ICT models are varied but no one best ICT model can fit all digital environments. Models are designed, revised and modified to suit a particular digital platform.

5.4 Recommendations

The researcher made the following recommendations:

i. The government should ensure that teacher training for ICT integration is anchored in ICT policy framework and extended to all levels of education in Kenya in line with the changing needs and demands of the curriculum. The ICT policy framework should properly define proper guidelines for ICT training. Length and frequency of such trainings should also be specified in a policy guideline. The study recommends that such training should be mandatory to all practicing teachers irrespective of their level of engagement.

ii. The ICT integration in learning institutions should be anchored in a country's ICT policy framework. Technocrats in ICT, education, finance, security and other relevant bodies should work together with other stakeholders in education and come out with clear and comprehensive policies that give direction(s) on the possibilities of launching and

sustaining DLP in schools for teaching and learning.

iii. The Ministry of Education and ICT should take charge of all schools by ensuring that frequent follow ups are made in all areas of preparedness for DLP so as to ensure failures and successes of the program are noted for improvement in time. The current position where schools are coordinated by head teachers who are from Ministry of Education, Science and Technology and DLP devices managed by ICT Authority provides many gaps that could lead to failure. The research recommends that the Ministry of Education, Science and Technology should create a Digital Literacy programme (DLP) department, train teachers in ICT and use teachers who are knowledgeable in both education and ICT to run DLP in Kenya.

iv. There is no one best model for ICT but the study recommends that the government should come up with a tailored ICT model for its specific programs in learning institutions. However, particular ICT models may be amended to suit the demands of other similar projects. In the light of uptake and integration of laptop computers model, the study recommends the formulation of an ICT models with various components that are well researched and can contribute to uptake and integration of technology in an institution.

v. This research recommends that project implementers such as the Ministry of Education officials and school managers to benchmark with other countries with best practice in ICT integration in Africa such as Rwanda and in the rest of the world such as United Kingdom and United States of America with a view to replicating the same in Kenya, especially in areas of ICT capacity building for teachers, setting up of necessary infrastructures, ICT policies, funding, staffing and sustainability of ICT projects.

vi. To improve the penetration of ICT in the country, the government should reduce taxes on

digital equipment so that the majority of the citizens can afford them.

5.5 Recommendations for further research

The researcher suggests the following areas for further research:

i. A cost- benefits study on the current DLP in Kenya.

ii. A comparative study between two or more counties to establish differences or similarities in levels of ICT readiness in different regions of Kenya.

iii. A study should be carried out between private and public schools in Kenya to establish ICT readiness levels.

iv. A comparative study on the usefulness of hard copy contents and soft copy contents in schools.

v. A study on possible barriers to effective implementation of DLP in Kenyan schools.

vi. A study on the suitability of different digital devices for ICT integration in Kenyan schools.

vii. A study on ICT policy in Kenya and its influence on teaching and learning in schools.

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APPENDICES

APPENDIX 1: LETTER ACCOMPANYING THE QUESTIONNAIRE

Dear Respondent,

I am a PhD student at Rongo University. The study is aiming at collecting data for research on the ‘‘Readiness for the uptake of laptop computers in selected public primary schools in Homa Bay County’’. The study is based on the need to integrate ICT in education in Kenya as stipulated in the National ICT Policy document of 2006. A success in this study will ensure that teachers and pupils of the Republic of Kenya embrace the use of laptop computers for teaching and learning purposes.

I invite you to fill this questionnaire, which will take you less than ten minutes. Any information given in this questionnaire will be confidential and intended not to be used for any other purpose than for this study. The data collected from you will be treated anonymously and your privacy is guaranteed.

Please return the filled questionnaire to Ouma Omito (0722106659) within two days if possible.

I thank you for sparing time to fill the questionnaire.

Yours Sincerely,

OUMA OMITO

APPENDIX 2: QUESTIONNAIRES TO TEACHERS

This section of the questionnaire aims at generating demographic information of the respondents. Do not write your name anywhere in this paper. Please respond by indicating(**x**) against the correct option. Kindly respond.

SECTION A: DEMOGRAPHIC INFORMATION

1. Indicate your sex

(a) Male [] (b) Female []

2. Indicate your age in the most appropriate box

18-25 [] 26-30 [] 31-35 [] 36-40 []

41-45 [] 46-50 [] 51-55 [] 55+ []

3. Indicate the name of your school _____

4. Indicate your sub county

Homa Bay [ ] Mbita [ ] Rachuonyo North [] Rachuonyo South [] Suba [] Ndhiwa []

5. What is your level of education?

P1 [] Diploma [] Degree [] Master []

Any other, please specify_____

6. How many years have you served as a primary school teacher?

0-5 [] 6-10 [] 10-15 [] 16-20 [] 20-25 [] 26-30 [] 31-35 [] 36-40 []

SECTION B: ATTITUDE OF THE TEACHING STAFF TOWARDS THE UPTAKE OF LAPTOP COMPUTERS

a) Teachers perception on usefulness of laptop computers

Please respond by indicating (**x**) against the correct option based on the following key:

SA = Strongly Agree (5), A =Agree (4) , U =Undecided(3), D= Disagree(2) , SD =Strongly Disagree(1)

Perceived Usefulness of laptop computers	**SA 5**	**A 4**	**U 3**	**D 2**	**SD 1**
7. Laptop computers will not improve my delivery of lessons as a teacher					
8. Laptop computers will reduce time spent for writing assignment on the chalk wall					
9. Laptop computers are not useful in addressing lack of teachers in schools					
10. Use of laptop computers will improve my information technology skills such as typing and drawing					

b) Teacher's Perception on Ease of Use of laptop computers. Please respond by indicating (**x**) against the correct option based on the following key: **SA = Strongly Agree (5), A =Agree(4) , U =Undecided(3), D= Disagree(2) , SD =Strongly Disagree(1)**

Perceived Ease of Use of laptop computers	**SA 5**	**A 4**	**U 3**	**D 2**	**SD 1**
11. Laptop computers does not support users in typing word documents					
12. I make minimal errors when using laptop computers					

13. Doing my work using laptop computers is not enjoyable.					
14. I require little mental effort when using laptop computers					
15. I cannot easily recover from errors encountered while using laptop computers					

SECTION C: TEACHERS' COMPUTER CAPACITY IN READINESS FOR UPTAKE OF LAPTOP COMPUTERS

16. Have you ever been trained on computer use?

Yes [ ] No [ ]

If your answer to number 16 is Yes,

a) When were you trained? _____

b) How long was the training period? 5 days [ ] 1 week [ ] 2 weeks [ ] 3 weeks [ ] One month [ ] More than one month [ ]

17. Have you ever been trained on laptop computers integration and adoption in primary schools in Kenya?

Yes [ ] No [ ]

Kindly put **(x)** where appropriate. **Not at all = 1, Not so well =2, Okay =3, well=4, Very well=5**

Operation	**Very well 5**	**Well 4**	**Okay 3**	**Not so well 2**	**Not at all 1**
. I can rotate an image using laptop computer					

. I can create a newdocument using Microsoft Word in a laptop computer					
. I can create a newdocument using Microsoft Excel in a laptop computer					
. I can draw and label diagrams using a laptop computer					
. I can use power point to present my lesson using laptop computer					
. I can save textcontents to an external disk (flash disk) using laptop computer					
. I can animate using laptop computer					
. I can use a browsersuch as Mozilla or Explorer to navigate the World Wide Web using laptop computer					
. I know how to send and receive e-mail messages using laptop computer					
. I can print adocument using laptop computer					

SECTION D: TEACHERS' AWARENESS OF DIGITAL CONTENT

28. What do you consider as the component(s) of the digital content? Please (**x**) as appropriate.

    Video [ ]

    Audio [ ]

    Images [ ]

    Texts [ ]

    Graphics [ ]

29. Indicate by putting (**x**) the component(s) of the digital contents are you able to perform using laptop computers?

    Typing [ ]

    Drawing [ ]

Simulation [ ]

Basic arithmetic [ ]

30. In your view what would likely be the barrier(s) to the delivery of digital contents in public primary schools in Kenya? Please (**x**) as appropriate.

    Lack of electricity [ ]

    High cost of laptop computers [ ]

    Insecurity of laptop computers in schools [ ]

    Resistance from local teachers [ ]

31. Apart from laptop computers which other digital equipment would you recommend for the delivery of digital content

    Radio [ ] Desktop computers [ ] Television [ ] Mobile phone [ ] Tablets [ ]

    Please give your reason for number 31_____

32. Do you think your school is ready for the uptake of laptop computers? Not ready at all [] Fairly ready [] Not sure [] Ready [] Very ready []

APPENDIX 3: QUESTIONNAIRES TO HEAD TEACHERS

This section of the questionnaire aims at generating demographic information of the respondents. Do not write your name anywhere in this paper. Please respond by indicating(**x**) against the correct option. Kindly respond.

SECTION A: DEMOGRAPHIC INFORMATION

1. Indicate your sex

(a) Male [] (b) Female []

2. Indicate your age in the most appropriate box

18-25 [] 26-30 [] 31-35 [] 36-40 []

41-45 [] 46-50 [] 51-55 [] 55+ []

3. Indicate the name of your school_____

4. Indicate your sub county

Homa Bay [] Mbita [] Rachuonyo North [] Rachuonyo South [] Suba [] Ndhiwa []

5. What is your level of education?

P1 [ ] Diploma [ ] Degree [ ] Master [ ]

Any other, please specify_____

6. How many years have you served as a primary school head teacher?

0-5 [] 6-10 [] 11-15 [] 16-20 [] 21-25 [] 26-30 [] 31-35 [] 36-40 []

SECTION B: ATTITUDE OF HEADTEACHERS' TOWARDS THE UPTAKE OF LAPTOP COMPUTERS

Please indicate **(x)** in the appropriate box.

SA = Strongly Agree (5), A =Agree (4) , U =Undecided(3), D= Disagree(2) , SD =Strongly Disagree(1)

Perceived ICT Policy	SA 5	A 4	U 3	D 2	SD 1
There is no government ICT policy document for education					
ICT Policy guidelines is necessary for the success of laptop computers program in my school					
My school has not developed its own ICT policy for pupils and teachers					
). ICT policy in my school is operational					
1. Teachers and pupils of my school have not been sensitized on the existence of ICT policy					

SECTION C: HEADTEACHERS' COMPUTER CAPACITY IN READINESS FOR UPTAKE OF LAPTOP COMPUTERS

12. Have you ever been trained on laptop computers integration and adoption in primary schools in Kenya?

Yes [ ] No [ ]

13. Did the teachers who were trained on laptop computers integration train other teachers in your school train others? Yes [ ] No [ ]

14. If your answer to number 13 is Yes, how many teachers were trained from your school? _____

Please put(**x**) in the appropriate box.

Not at all = 1, Not so well =2, Okay =3, well=4, Very well =5

Operation	**Very well 5**	**Well 4**	**Okay 3**	**Not so well 2**	**Not at all 1**
15. I can rotate an image using laptop computer					
16. I can create a new document using Microsoft Word a laptop computer.					
17. I can create a new document using Microsoft Excel in a laptop computer.					
18. I can draw and label diagrams using a laptop computer.					
19. I can use power point to present my lesson using laptop computer.					
20. I can save text contents to an external disk (flash disk) using laptop computer.					
21. I can animate using laptop computer					
22. I can use a browser such as Mozilla or Explorer to navigate the World Wide using laptop computer					
23. I know how to send and receive e-mails messages using laptop computer.					
24. I can print a document using laptop computer.					

SECTION D: HEAD TEACHERS' AWARENESS OF DIGITAL CONTENT

25. What do you consider as the component(s) of the digital content? Please put (**x)** as appropriate

Video []

Audio []

Images []

Texts []

Graphics []

26. In your view what would likely be the barrier(s) to the delivery of digital contents in public primary schools in Kenya? Please (**x**) as appropriate.

Lack of electricity [ ]

High cost of laptop computers [ ]

Insecurity of laptop computers in schools [ ]

Resistance from local teachers [ ]

27. Apart from laptop computers, which other digital equipment would you recommend for the delivery of digital content? Please (**x**) as appropriate.

Radio [ ] Desktop computers [ ] Television [ ] Mobile phone [ ] Tablets [ ]

Please give your reason for number 27_____

28. Do you think your school is ready for the uptake of laptop computers?

Not ready at all [ ] Fairly ready [ ] Not sure [ ] Ready [ ] Very ready [ ]

APPENDIX 4: QUESTIONNAIRES TO CURRICULUM SUPPORT OFFICERS

This section of the questionnaire aims at generating demographic information of the respondents. Do not write your name anywhere in this paper. Please respond by indicating(**x**) against the correct option. Kindly respond.

SECTION A: DEMOGRAPHIC INFORMATION

1. Indicate your sex

(a) Male [] (b) Female []

2. Indicate your age in the most appropriate box

18-25 [] 26-30 [] 31-35 [] 36-40 [] 41-45 [] 46-50 [] 51-55 [] 55+ []

3. Indicate your sub county

Homa Bay [] Mbita [] Rachuonyo North [] Rachuonyo South [] Suba [] Ndhiwa []

4. What is your level of education?

P1 [] Diploma [] Degree [] Master []

Any other, please specify_____

5. How many years have you served as a curriculum support officer?

0-5 [ ] 6-10 [] 10-15 [] 16-20 [] 20-25 [] 26-30 [] 31-35 [] 36-40 []

6. Have you ever been trained to train teachers on laptop computer integration and adoption in primary schools in Kenya?

Yes [ ] No [ ]

SECTION B: CURRICULUM SUPPORT OFFICERS' ATTITUDE ON DIGITAL CONTENT

Please indicate **(x)** in the appropriate box.

SA = Strongly Agree (5), A =Agree (4), U =Undecided (3), D= Disagree (2) , SD =Strongly Disagree(1)

Perceived digital content	**SA 5**	**A 4**	**U 3**	**D 2**	**SD 1**
7. All schools were represented for training on digital content using laptop computers					
8. There was a follow up to ensure the trained teachers on digital content using laptop computers trained others in their schools					
9. Teachers received inadequate training on digital content					
10. KICD digital content has not been availed to teachers in schools					
11. The schools have inadequate personnel for digital content delivery					

12. Do you think your schools are ready for the uptake of laptop computers? Not ready at all [ ] Fairly ready [ ] Not sure [ ] Ready [ ] Very ready [ ]

APPENDIX 5: DIRECT OBSERVATION CHECKLIST ON INSTITUTIONAL INFRASTRUCTURE FOR LAPTOP COMPUTERS UPTAKE IN PRIMARY SCHOOLS

Indicate the sub county

Homa Bay [ ] Mbita [ ] Rachuonyo North [] Rachuonyo South [] Suba [] Ndhiwa []

Indicate the name of the school_____

ICT Readiness facilities	**Available**	**Not Available**
Laptop computers store/safe		
Computer room chairs		
Carpeted floor		
Internet		
Power Sockets		
Laptop computer technical assistant		
Electric power		
Power generator		
Solar power		
Uninterrupted Power Supply(UPS)		
Laptop computer classroom attendant		
Laptop computer room policy document		

APPENDIX 6: DIRECT OBSERVATION SCHEDULE ON TEACHERS' TECHNICAL COMPETENCE ON USE AND INTEGRATION OF LAPTOP COMPUTERS

SECTION A: PRELIMINARY INFORMATION BEFORE DIRECT OBSERVATION

Indicate the sub county

Homa Bay [ ]Mbita [ ] Rachuonyo North [] Rachuonyo South [ ] Suba [ ] Ndhiwa [ ]

Indicate the name of the school_____

1. Has your school received laptop computers and tablets? Yes [ ] No [ ]
2. If your answer to number 1 is Yes, when did you receive the laptop computers and tablets
   1 to 2months ago [ ] 3 to 6 months ago [ ] 6 months to 1 year ago [ ]
   more than 1 year ago [ ]
3. Are you trained to teach using laptop computers? Yes [ ] No [ ]
4. If your answer to number 3 is yes, where were you trained? Digital literacy program by the Government of Kenya [ ] Privately [ ]
5. Are you currently teaching pupils using laptop computers and tablets? Yes [ ] No [ ]
   If your answer to number 5 is No, what is the main reason? Lack of power [ ] Lack of security for laptops [ ] Inadequate training for teachers [ ] No designed classroom for laptop computers [ ] Teachers who were trained on use and integration of laptop computers were transferred by TSC [ ] Any other reason(s)
   _____
6. If your answer to number 5 is Yes, kindly allow me observe you perform the following operations using laptop computers
7. Who should repair damaged laptop computers/tablets in your school?
   The school [ ] ICT Authority [ ] Ministry of Education, Science and Technology [ ] I don't know [ ]

SECTION B: DIRECT OBSERVATION SCHEDULE

Kindly, put (**x)** where appropriate. **Not at all = 1, Not so well =2, Okay =3, well=4, Very well=5**

Operation	**Very well 5**	**Well 4**	**Okay 3**	**Not so well 2**	**Not at all 1**
Rotation of an image using laptop computer					
Creation of a newdocument using Microsoft Excel in a laptop computer					
Creation of a new document using Microsoft Word in a laptop computer					
Drawing and labeling of diagrams using a laptop computer					
Use of power point to present lesson using a laptop computer					
Saving text contents to an external disk (flash disk) using a laptop computer					
Animation using a laptop computer					
Use of browsersuch as Mozilla or Explorer to navigate the World Wide Web using laptop computer.					
Sending and receiving e-mail messages using a laptop computer					
Printing adocument using a laptop computer					

APPENDIX 7: INTERVIEW SCHEDULE

1. Do you think your school has enough facilities for laptop computers uptake?

2. What are your feelings about the introduction of technology (laptop computers) in teaching and learning?

3. Are school teachers adequately trained for the uptake of laptop computers uptake?

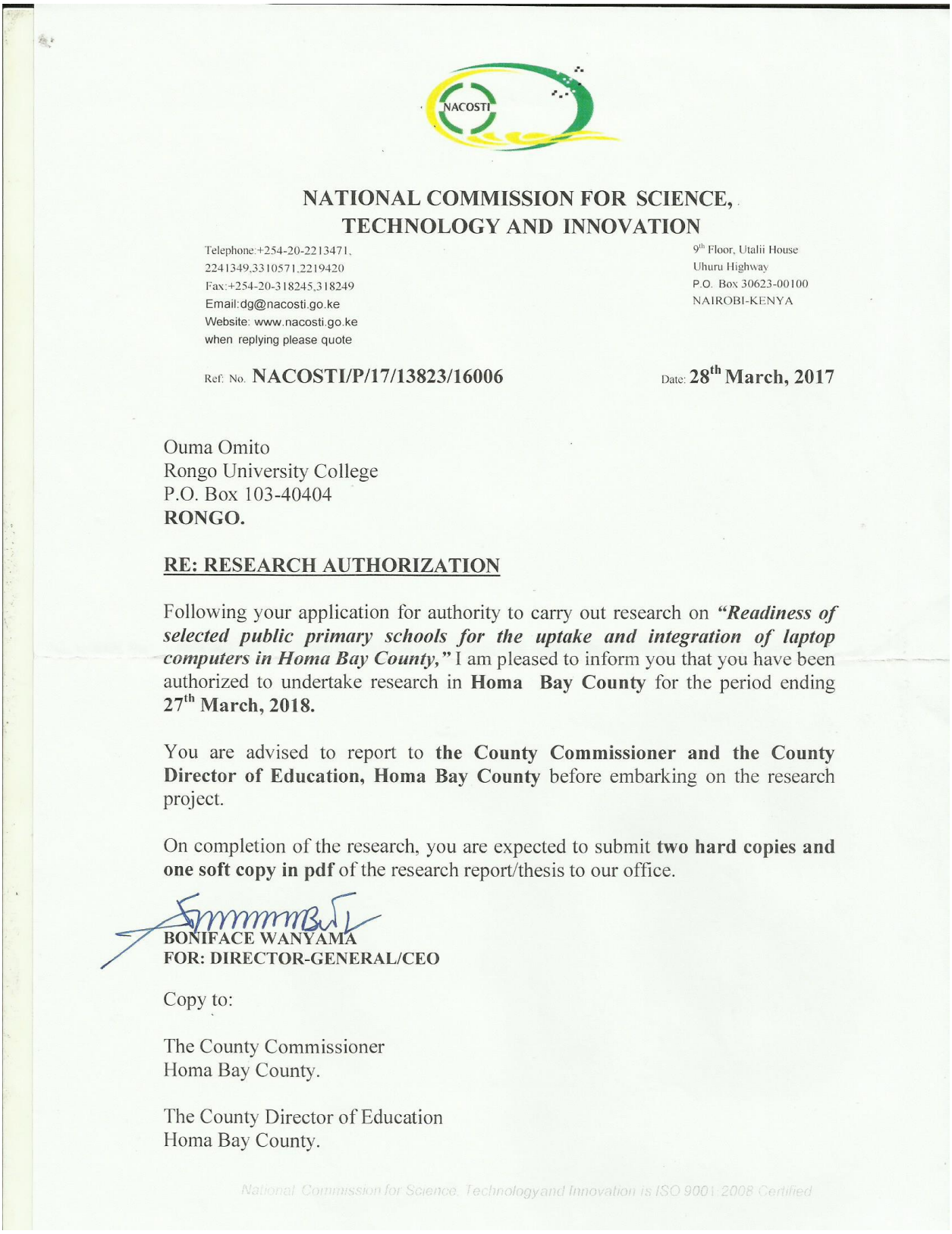
4. What are your comments on availability of the digital contents intended to be used in public primary schools in Kenya?

5. Do you think the digital content intended to be used in public primary schools in Kenya will make sense to pupils and teachers?

6. In your view, what measures should the government put in place to overcome challenges that may face the integration of laptop computers in primary schools?

7. Do you think that this is the right time to introduce laptop computers in your school? Do you have any other comments?

APPENDIX 8: RESEARCH AUTHORIZATION



NACOSTI

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471, 2241349,3310571,2219420
Fax:+254-20-318245,318249
Email:dg@nacosti.go.ke
Website: www.nacosti.go.ke
when replying please quote

9th Floor, Utalii House
Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/17/13823/16006**

Date: **28th March, 2017**

Ouma Omito
Rongo University College
P.O. Box 103-40404
RONGO.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Readiness of selected public primary schools for the uptake and integration of laptop computers in Homa Bay County,"*** I am pleased to inform you that you have been authorized to undertake research in **Homa Bay County** for the period ending **27th March, 2018.**

You are advised to report to **the County Commissioner and the County Director of Education, Homa Bay 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.

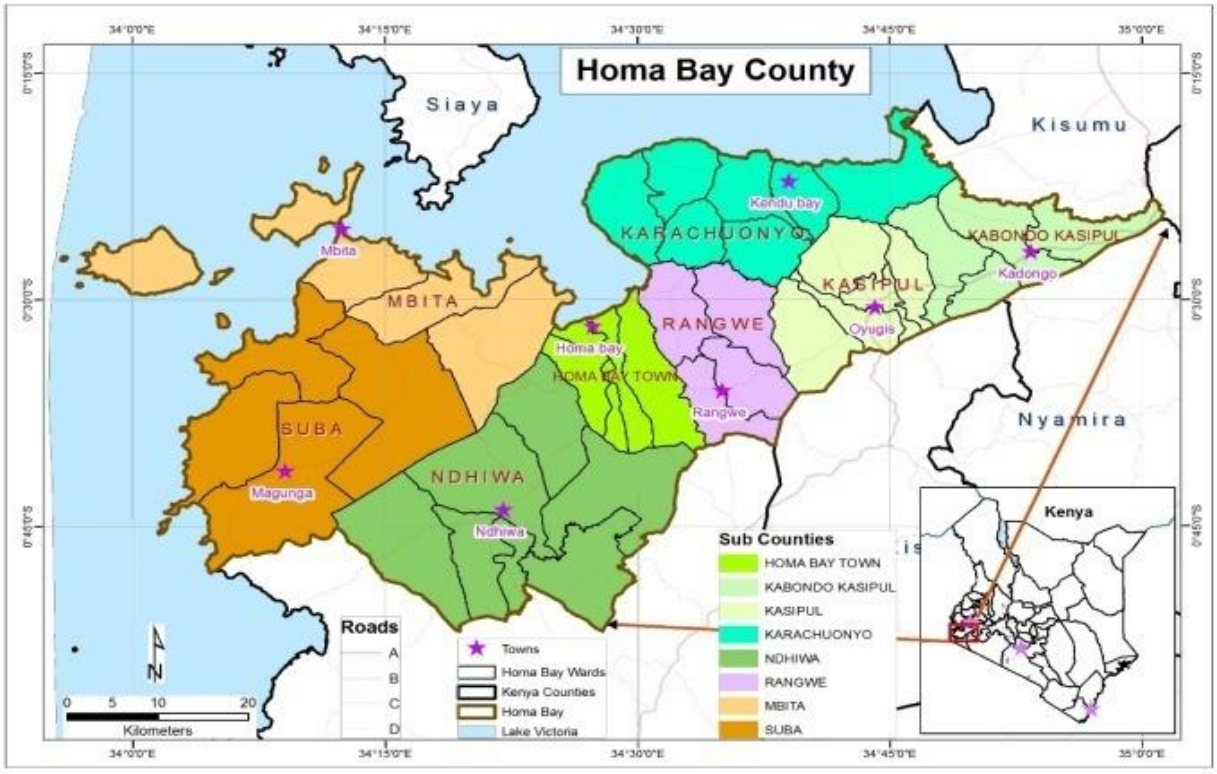
BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Homa Bay County.

The County Director of Education
Homa Bay County.

APPENDIX 9: A MAP OF HOMA BAY COUNTY



Source: Government of Kenya (2013)