EFFECT OF INTEGRATION OF ICT INFRASTRUCTURE ON EFFECTIVE TEACHING AND LEARNING IN PUBLIC PRIMARY SCHOOLS IN TRANS NZOIA COUNTY, KENYA

[1]Tabitha, Nasimiyu, Nyongesa, [2]Dr.Calvin, Otieno.

[1]Jomo Kenyatta University of Agriculture& Technology (Msc .ICT Management)

[2]Jomo Kenyatta University of Agriculture & Technology (Lecturer, PhD).

Abstract: This study was set out to determine the effect of the integration of Information and Communication Technology (ICT) infrastructure on effective teaching and learning in public primary schools in Trans-Nzoia County, Kenya. The sample for the study was drawn strategically from public primary schools in Trans-Nzoia West Sub-County, Trans-Nzoia County. Many public primary schools in Kenya have not yet embraced ICT in teaching and learning despite the fact that the Kenyan government insisted on making a great change to the academic sector so that it becomes digitized. In this study, the objectives were; to examine the level of availability of ICT infrastructure in effective teaching and learning process, to determine the level of ICT teacher competency in using ICT infrastructure in effective teaching and learning process and to determine the technical support on ICT infrastructure in effective teaching and learning process. The study under picture used a descriptive survey design. There was great interest in the several interpretations of usage of ICT infrastructure for effective teaching and learning in a number of public primary schools and different procedures which were taken up to accomplish this study. The target population included head teachers and teachers in the selected primary schools in Trans-Nzoia West Sub-County, Trans-Nzoia County. The sample size for the population was 185 teachers in 37 schools out of the possible 124 public primary schools. In data collection the research instrument used was the questionnaires. The purposive sampling was used in this study. The prediction of the dependent variable was accomplished through the F distribution test (F =17.370),at a 5% significance level that indicated a statistically significant overall model.Availability of ICT Infrastructure r=0.781, ICT Competence r=0.632 and ICT Technical Support r=0.692.The study expects the results to contribute to the management of the ICT Infrastructure in Public Primary Schools in Trans Nzoia County and beyond as well as contributing towards the existing body of knowledge in Public Primary School management as well as forming a basis for scholars who may want to study similar issues. The study findings found a generally positive relationship between the predictor variables (ICT Infrastructure, ICT Competence and ICT Technical Support) and the predicted variable (Effective Teaching and Learning in Public Primary Schools in Trans Nzoia County), although it seemed not to be fully strong due to the prevailing circumstances within the schools targeted in the study. However, the following recommendations were made from the results: That as regards the first variable, Availability of ICT Infrastructure, the public primary schools in Trans Nzoia County, the government, through the ministry of education, should ensure that the public primary schools have suitable and up to date hardware available for use in order to enable them be at par with their peers who have their ICT infrastructure well updated and maintained e.g provision of Laptops or desktops fully fitted with relevant and updated software including the antivirus software for data safety and fast and reliable internet/Wi-Fi connections for teacher self upgrades among others benefits. The standby power supply and/or UPS will also be another important milestone in making the graduates at each level of education in the Kenyan education system a world market admired product.

Keywords: Availability of ICT infrastructure, ICT teacher competence, ICT technical support and teaching and learning.

I. INTRODUCTION

Background of the study

Information and Communications Technology (ICT) has gone through innovations and transformed our society that has totally changed the way people think, work and live (Grabe, 2015). As part of this, schools and other educational institutions which are supposed to prepare students to live in "a knowledge society" need to consider ICT integration in their curriculum (Ghavifekr, Afshari and AmlaSalleh, 2012). In conjunction with preparing students for the current digital era, teachers are seen as the key players in using ICT in their daily classrooms. This is due to the capability of having ICT infrastructure in providing dynamic and proactive teaching-learning environment (Arnseth and Hatlevik, 2012). The introduction of ICT and especially ICT infrastructure into the educational institutions has brought about great changes. Many years ago, technology had not been embraced as much as it has been embraced in the recent past. However, learning institutions are under increasing pressure to embrace ICT infrastructure to teach students on the knowledge and skills that are essential in the 21st century (Wan, 2011).

Global Perspective

Computer hardware, software and mobile phones would play a key role in achieving it. Information Communication and Technology (ICT) integration in teaching is therefore inevitable. Understandably, this is the ability to use technology as a tool to research, organize, evaluate and communicate information (Kenney, 2016). Furthermore, Amara (2006) postulates integration of computers as an extent to which teachers utilize ICT for teaching and includes multimedia projectors, overhead projectors (OHP) and mobile phones. In line with this, Pernia (2012) perceives ICT to entail actual application of computers and internet technology to enhance effective teaching and learning. Apparently, ICT consists of hardware, software, networks and media.

In the United Kingdom, according to Estyn, (2013) the office of Her Majesty's Inspectorate for Education and Training in Wales, the weak areas within ICT as a subject are quite weak in the usage of the acquired ICT skills in other subjects. More than half of the learning institutions have not embraced the integration of ICT infrastructure fully enough to help the talented and well enabled pupils. A large number of public primary schools in the United Kingdom have integrated ICT infrastructure to give support on intervention of numeracy and can show the connection between usage of ICT infrastructure and standards improvement. In almost all the primary schools, integration of ICT infrastructure has a positive influence on teaching and learning, this is majorly by engaging the pupils and motivating them (Estyn, 2013).

Regional Perspective

The Education Ministries of Africa have risen up and decided to be extra active in leading and coordinating the improvement and enhancement of ICT infrastructure in institutions of learning. Moreover, their implementation and ICT policies have kicked off. However, the civil society specifically the Non-Governmental Organizations that work along with agencies of donors take up a major task principally NGOs working with donor agencies continues to play a major role in providing computers to schools and lobbying government to take a leading role.That said, their efforts have been frustrated by the lack of connectivity, inconsistent electrical supply, and lack of technical support services—particularly in rural areas (Farrell, Glen and Shafika Isaacs, 2010). The ICT policies place a great deal of emphasis on providing ICT infrastructure to secondary schools and, eventually, to primary schools as well. But implementing these policies and plans will require time and major infusions of resources. A number of countries in southern Africa have established an open schools' consortium that involves a range of institutions providing secondary education through distance learning. Their focus is on preparing learners to secure sustainable livelihoods by improving their academic qualifications and providing training to create and maintain income-generating opportunities. These institutions will be sharing their resources and experience in developing academic and vocational education programmes and materials. (Farrell, Glen and Shafika Isaacs, 2010)

Selwyn, (2007) points out that, despite the budgetary provisions, educational institutions may not achieve the intended goals. This study investigated the factors that may hinder the achievement of the goals in spite of measures taken by both the government and other stakeholders in encouraging the integration of ICTs in teaching and learning processes. Today, there is a growing awareness among global policy makers and educators that the education system needs to be reformed if

it is to effectively equip students with the knowledge, attitudes and skills that they will need to succeed and thrive in the knowledge society. Nowadays a shift towards integrated ICTs pedagogy which for the purpose of this study means the use of computers and computer-related technologies for educational purposes is being witnessed.

Local perspective

Kenya has not been left behind and towards this end it has developed an ICT policy that advocates for accessibility, equity and infrastructure development, with the aim of reducing the digital divide among the citizens (Ministry of Education, Science and Technology report, 2016).In an effort to keep up with these new developments, the Kenyan Government, through its key ministries of Education, Science and Technology and Information and Communication Technology, has developed several policy and strategy documents to guide the integration of ICT in education (National ICT Policy, 2006; Sessional Paper No. 1 of 2005 and Kenya Education Sector Support Programme, 2005-2010).The challenge confronting our educational institutions is how to transform the curriculum and teaching-learning process to provide students with the skills to function effectively in this dynamic, information-rich, and continuously changing environment. To meet these challenges, learning institutions must embrace the new technologies and appropriate ICT tools for learning. They must also move towards the goal of transforming the traditional paradigm of teaching (Marshall, Kinuthiaand Taylor, 2009).As early as 1990s, primary schools in Kenya increasingly acquired computers. Initially this was driven by pressure from education stakeholders such as parents, communities as well as politicians. Most of these computers came in form of donations and were basically used for administrative duties such as typing and printing of examinations, maintaining students' and fees records.

Lately, the Kenyan government has made remarkable progress putting in place an ICT policy framework and implementation strategy complete with measurable outcomes and time frames. In 2006, National ICT policy was launched with the main objective of making Kenya an ICT hub and a premier location for Business Process Outsourcing (BPO) in Africa. This is a key step towards vision 2030 and attainment of Millennium Development Goals (MDGs). The process has had the benefit of sound advice from officials and stakeholders and, perhaps more importantly, strong leadership from the then Ministry of Information and Communication (National ICT policy, 2006).

However, universal implementation is challenging given the lack of resources, national ICT infrastructure, and even electricity supply – particularly in the rural areas.

The private sector has not been left behind in encouraging schools to integrate ICT in the effective teaching and learning process. One such non-governmental organization is Computer for Schools – Kenya (CFSK) whose mission is to provide Kenya's youth with access to modern technology through donation of computers to Kenyan public schools (Reddick, 2010). Up to 2013 CFSK had sourced for 50,000 computers which were then distributed to about 3000 learning institutions. During the same period, Kenya School-net initiated a Trainer of Trainers training program with the aim of equipping personnel with skills and knowledge to facilitate learning of computers in Kenya.In addition to the factors that affect individual teachers there are those that are out of their control. According to the ICT Ministerial strategic plan 2013-2017, the Kenyan Government working hand in hand with the private sector has developed programs that equip teachers with the necessary knowledge and skills to enable them use ICTs in their teaching practice. Technology lessons require time to assemble the content as well as visit several internet sites to consolidate information this makes the teachers to shy away from using ICTs in the teaching practice.

According to ICT Authority Kenya (2018), at least 351 primary schools out of 377 have been connected to digital literacy devices in Trans Nzoia County. In 2015 there were around 202,000 pupils in Trans Nzoia in public primary schools. However, the enrollment rose to 237,000 in 2018. (Education Directorate, Trans-Nzoia County, 2018).According to the Directorate of Education, Trans-Nzoia County (2018), it is pointed out that there existed a challenge which was retirement of the already trained teachers under the program and phobia of some of the old teachers to embrace use of the devices. But even so, the directorate attributed the success of the program in the area to teamwork from various stakeholders, including the Kenya power company. (ICT Authority Kenya, 2018).

Statement of the Problem

Most schools in Kenya have not embraced usage of ICT infrastructure. Most teachers focus on the black board and use of hardcopy books which has been since time immemorial. According to Singh (2007), the knowledge society reflects a shift from the learner as a passive consumer of educational offerings to an active knowledge gathering and productive participant in educational. In the primary school setup, there is need for the teachers and the top management of the administration to focus on bringing in the ICT Infrastructure. In line with Daily Nation 1st December, 2015 the Kenyan government had already implemented the Digital Learning Program (DLP). In the program, it had made focus on the learners students in all public primary schools. Moreover, it is intended to integrate the usage of digital technology which has been on the rise. The focus of the teachers in the primary schools has been on the imparting of knowledge in to the students. Basically, that has been the main focus. In order to see the ability of using the ICT infrastructure in the public primary schools, there is need for a study to be done in order to establish availability and possibility of these materials being used.

Using ICT infrastructure for practice of basic skills qualifies to be of great effectiveness according to a vast data body and infinite usage history (Kulk, 1994). In accordance to Kulk (1994), learners learn so much, and they do learn faster, in programs that utilize computers assisted instruction (CAI). ICT infrastructure gives a chance to learners to have control over learning, to think intensively and with more critic, and collaboratively work. As an outcome, lack of ICT infrastructure teaching and learning, is not effective; the teachers are not able to access ICT infrastructure to enhance their duties in the teaching process (Kosakowski, 1998).

Research Objectives

General Objective

The aim of this research is to determine the effect of integration of ICT infrastructure in teaching and learning in the public primary schools in Trans-Nzoia West Sub-County, Kenya.

Specific Objectives

This study aims at achieving these objectives: -

I.   To examine the effect of Availability of ICT Infrastructure on Effective Teaching and Learning in Public Primary Schools in Trans Nzoia West County, Kenya.

II. To determine the effect of ICT Technical Support on Effective Teaching and Learning in Public Primary Schools in Trans Nzoia West County, Kenya.

III. To determine the effect of ICT Teacher Competence on Effective Teaching and Learning in Public Primary Schools in Trans Nzoia West County, Kenya.

Research Questions

The study will attempt to answer the following questions:

I.   How does the availability of ICT Infrastructure have an effect on Effective teaching and learning in Public Primary Schools in Trans Nzoia West County?

II. How does ICT Technical Support have an effect on Effective teaching and learning in Public Primary Schoolsin Trans Nzoia West County?

III. What is the effect of ICT Teacher Competence on Effective teaching and learning in Public Primary Schoolsin Trans Nzoia West County?

Justification of the Study

The study will major the knowledge on the factors that influence the integration of ICTs in effective teaching and learning processes in primary schools in Trans-Nzoia West Sub-County, Trans-Nzoia County. The gathered information will be used in integration of ICT infrastructure in effective teaching and learning process in primary schools in Trans-Nzoia

West Sub-County, Trans-Nzoia County. The beneficiaries of this study will be the teachers in primary school and the overall education sector of Trans-Nzoia County in Kenya. Other beneficiaries will include the suppliers of the infrastructure since they will get tenders on supplying the materials. The administration of the schools will also benefit from the study since they will have efficient running of their programs and services in the school. There are also expected better instructions from the teachers to the students by use of ICT infrastructure.

Scope of the Study

The study will be conducted among teachers at selected public primary schools in Trans-Nzoia West County, Kenya. The study will be focused on how integration of ICT infrastructure has influenced the teaching and learning process in the selected public primary schools in the sub-county. Apart from the teachers the scope will include the technical support and the administration of the different schools that the study will cover.

2. LITERATURE REVIEW

Introduction:

This section brings out the theoretical review, conceptual framework, and critique of the existing literature relevant to the study, summary and research gaps.

Theoretical Framework

Many studies have been done to research on the various educational theories concerning ICT infrastructure integration. These theories are: Behaviourism theory, Constructivism theory and Diffusion of Innovation theory (DOI).

The Behaviourism Theory

This theory was developed over the years by several psychologists including Ivan Pavlov, Edward Thorndike and B F Skinner among others. These researchers used an animal to describe and experiment that is parallel to human learning. Behaviorists believe that new knowledge can be acquired by operant conditioning where responses were learned from repeated stimuli and reinforced by rewards (Skinner, 1953). The learning process could be conceptualized as a series of small progressive steps leading up to a defined final performance. Bloom applied this theory to propose the Bloom's taxonomy that is used in testing learned behavior to date (Eisner 2000). The idea of learning following a linear order was challenged by Buxkemper and Hartfiel (2003) they pointed out that learning is a complex process which does not follow a linear structure. Dewey's classic works suggest a student centered learning which led to the cognitive theory of learning. Despite the criticism leveled against this theory, it is imperative to note that it can be applied in ICTs adoption in teaching and learning process. Through this theory the teachers and can progressively learn the use of ICTs in the teaching and learning process. Each new learnt concept will form a basis and motivation for learning the next concept. Teachers will gain competence as they use ICTs in lesson delivery and students will look forward to the next lesson with anticipation to learn a new concept. Cumulatively both teacher and student will start to appreciate the benefits of ICTs in the teaching and learning process. This will lead to adoption of ICTs by both teachers and learners.

The Constructivism Theory

Constructivism is a learning theory of educational philosophy that many educators began to consider in the 1990s. One of the primary tenets of this philosophy is that teachers construct their own meaning from new information, as they interact with reality or others with different perspectives.Constructivist learning environments require learners to use their prior knowledge and experiences to formulate new, related, and/or adaptive concepts in learning. Under this framework the role of the teacher becomes that of a facilitator, providing guidance so that learners can construct their own knowledge. Constructivist educators must make sure that the prior learning experiences are appropriate and related to the concepts being taught. Jonassen (1997) suggests "well-structured" learning environments are useful for novice learners and that "ill-structured" environments are only useful for more advanced learners. Educators utilizing technology when teaching with a constructivist perspective should choose technologies that reinforce prior learning perhaps in a problem-solving environment.

This study is based on the constructivist theory which will emphasize on cooperative and collaborative learning.In cooperative learning teachers work together to accomplish a learning task. This is achieved through division of labor among the participating students. It is a learner oriented approach to learning with the teacher giving general guidance (Baker, Blaye and O'Malley, 1996). ICT will give teachers a lee way to externalize their thinking, and allow them to put ideas into a more concrete form because of the available feedback. On the other hand collaborative learning is a coordinated, synchronous activity that is the result of continued attempt to construct and maintain a shared conception of a problem (Rochelle and Teasley, 1995). The adoption of ICTs in the effective teaching and learning process makes it possible for students to learn "on their own", the teacher gives general guidance on a concept and then supervises the students as they work together to build on prior knowledge to solve a problem. Learning becomes student centered giving them a lee way to explore different ways to solve a particular problem. Once the student learns how to work together, teaching and learning becomes enjoyable both to the teacher and student. This encourages more teachers to adopt technology in order to enjoy these benefits.

Diffusion of Innovation theory (DOI)

DOI is a theory of how, why and at what rate new ideas and technology spread through cultures, operating at the individual or firm level.The theory indicates that innovations are communicated through certain channels overtime and within a particular social system (Rogers, 1995). According to this theory individual adopt innovations with varying degrees of willingness. Thus the theory classifies individuals into five segments of innovativeness namely innovators, early adopters, early majority, late majority and laggards (Rogers, 1995). DOI supposes that, innovativeness is related to such variables as individual characteristics, internal organizational structural characteristics and external characteristics of an organization. Individual characteristics describe the leader attitude towards change on the other hand internal characteristics of organization structure includes; centralization, complexity, formalization, interconnectedness, organization slack and size. External characteristics refer to the system openness (Rogers, 1995).

This model emphasizes on individual characteristics that can be mapped on the independent variable of teacher competency in the study as well as the moderating variables of age and gender. The characteristics of the organization are mapped onto the DOI has been slowly guiding the adoption of ICTs in primary schools have aggressively integrated ICTs in effective teaching and learning processes. This has made other schools to emulate the same causing ICTs to diffuse into the education system. Most schools are working on the individual characteristics of teachers in order to make this diffusion a reality. The Kenyan government has also stepped in to assist schools in the adoption of ICTs by formulating policies aimed and reducing the digital divide among the schools. Head teachers have been sensitized on the need to spearhead this change by creating conducive environment for ICT adoption. The government through the Kenya Institute of Curriculum Development has developed e-content for use in schools. These initiatives have made it possible for technology to diffuse through schools with aim of creating a knowledge society.

The Theory of Planned Behavior (TPB)

This theory deals with the intention for use of a new technology. It assumes that for an individual to adopt an innovation he must display the willingness to use the said innovation. The theory identifies three independent variables that would affect the adoption of an innovation. The first variable is attitude towards the behavior which refers to the extent to which an individual is for or against the behavior in question (Ajzen, 1976). The second variable is subjective norm which refers to the perceived social pressure to perform or not perform behavior. This is indicative of the influence the environment has on the subject towards acting in a certain manner. Lastly, the model considers perceived behavior control as the third variable. This refers to the perceived ease or difficulty of performing behavior. Perceived behavior control is assumed to reflect past experiences as well as anticipated impediments and obstacles (Ajzen, 1976). The model's independent variables closely maps into the independent variables in this study namely; teacher competency, availability of facilities and technical support. Teacher competency determines whether a teacher is willing to use ICTs in teaching and learning process or not. When the school's administration or other stakeholders provide resources they expect the teachers to use the resources in effective teaching and learning process. This puts some pressure on the teachers to perform the intended behavior. Technical support makes teachers to gain confidence in the use of ICTs and hence maps into the third independent variable of perceived behavior control.

Initially teachers could be apprehensive about adopting ICTs in their day to day teaching due to fears and may actually be against the idea as demonstrated by their opposition to the introduction of laptops for primary school pupils in Kenya. However, once they learn its usefulness such as effectiveness in lesson preparation and delivery as well as storage of notes (with little editing), adoption becomes the norm rather than the exception. In addition increased teacher competency and changing lesson delivery methods will cause teachers to embrace technology and make it part of their teaching and learning process.This model could be used by teachers who have embraced use of technology in their day to day undertaking. The willingness to use technology coupled with the current trend of using ICTs among peers for teaching and learning process could make teachers start using technology. The continuous reduction in complexity on the use of ICTs has led to a growing number of users including teachers. The theory of planned behavior therefore informs the use of ICTs in teaching and learning process among teachers.

Technology Acceptance Model (TAM)

TAM states that user acceptance of new technology is affected by perceived usefulness and perceived ease of use (Davis, 1989). Perceived usefulness is defined as the degree to which a user believes that using a particular technology would improve his job performance. On the other hand, perceived ease of use is defined as the degree to which a person believes using a particular technology will be free of effort (Davis, 1989).The model suggests that when an individual is presented with new technology, a number of factors come into play. Among the factors, perceived usefulness and perceived ease of use will determine how and when the individual will use the technology. TAM does not consider factors such as economic, suppliers, customers as well as competitors.

This study's independent variables of teacher competency, availability of facilities as well as technical support can be modeled on TAM's variables of perceived usefulness and perceived ease of use. Teacher competency and technical support leads to ease of use while the availability of facilities informs the teacher on the usefulness of ICTs in effective teaching and learning process. The model indicates that for a person to adopt an innovation, one should be convinced that it will improve performance as well as be easy to use. It presumes that the individual know the benefits of the technology and has basic skills on its use. The increasing number of schools adopting the use of ICTs in effective teaching and learning process is creating awareness on the advantages that could accrue from the behavior. This awareness coupled with increasing levels of teacher competence has made it easy for teachers to use ICTs and be part of the revolution. Many teachers, who know the benefits of ICTs in the teaching practice, have enrolled themselves in colleges to acquire the competency to use ICTs. This has generally increased the number of teachers integrating ICTs in the teaching and learning processes.

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

UTAUT identifies four independent variables that affect the adoption of new technology namely; performance expectancy, effort expectancy, social influence and facilitation conditions (Vankatesh*et al.,* 2003). Performance expectancy is "the degree to which an individual believes that using a system will help him or her to attain gains in job performance". Effort expectancy is the amount of effort required to use the said innovation. Social influence is the degree to which an individual perceives that other important people believe he or she should use the new system. Lastly facilitating conditions are defined as "the degree to which an individual believes that an organization and technical infrastructure exists to support use of the system. This study is intended to investigate the influence of teacher competency, availability of resources and technical support on the use of ICTs in effective teaching and learning process as moderated by age and gender. In the UTAUT model, performance expectancy and effort expectancy can be mapped onto teacher competency while social influence and facilitating conditions can be mapped on the availability of facilities and technical support.

This theory advocates for job effectiveness, ease of use, social influence and existing infrastructure. Lately teachers have learnt the efficiency ICTs can bring into the teaching practice and have continuously acquired the necessary skills to improve on their competency level. In addition education stakeholders have been encouraging teachers to change from the age old "chalk and talk" method of teaching and embrace teaching methods that promote innovativeness. These factors coupled with the government policy of providing ICTs to schools have made it easy for teachers to adopt technology in their teaching in order to tap on the array of benefits that ICTs can offer both the teacher as well as the learners.

Conceptual Framework

This section mainly deals with the independent variables, dependent variable and intervening variable.
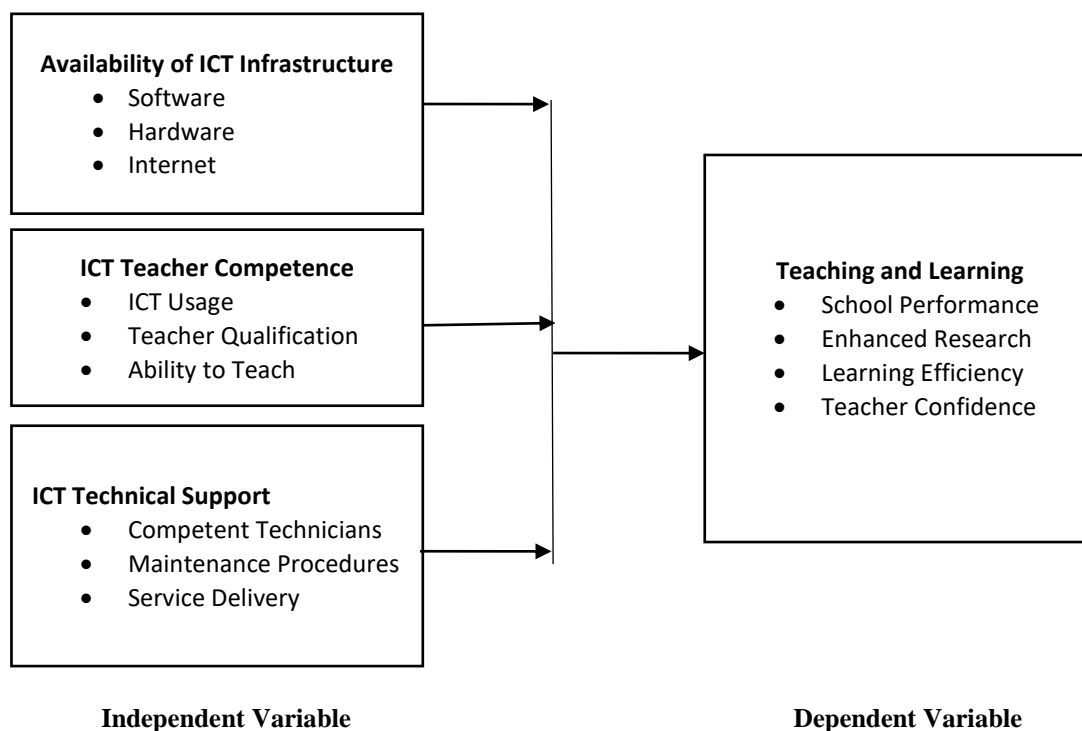

Independent Variable   Dependent Variable

Figure 2.1: Conceptual Framework

Review of Variables

Availability of ICT Infrastructure

According to Vanderlinde and van Braak (2010), ICT infrastructure measures the perceived availability and suitability of the ICT tools such as hardware, software and peripheral equipment provided in the school. In Pelgrum's (2016) study, ICT infrastructure refers to the availability of equipment, software, Internet access and other similar resources in the school. Additionally, recourses and facilities in schools are designed and enabled in the direction of supporting continuous transformation and development of various learning approaches (Anderson and van Weert, 2002). In the year 1998, Krysa conducted a research to determine and examine regularly occurring factors that affect the implementation of the technology among the school teachers. A qualitative study among four school teachers was carried out to identify the factors. Based on the findings, it was reported by one of the teachers that the outmoded hardware limits the use of computers in instruction (Krysa, 1998). The teacher was not able to integrate technology into instruction due to the old and outdated hardware. Conversely, one of the informants stated that limited software act as one of the antecedents that prevents the use of computers as an instructional tool (Krysa, 1998).

According to Shiue (2017), teachers will perceive greater control to employ technology into instructional use when they have the necessary hardware and software resources. Cowie and Jones (2015) reported with the ICT infrastructure provided, the teachers were able to access school network, the Internet and laptop accessories (printer, digital camera, data projector, large TV screen, scanner and video camera). Hence, the educators have more prospects to utilize instructional technology when the ICT infrastructures are provided in a well manner. Past research studies have shown clearly that ICT infrastructure can be one of the factors that influence the technology use among the teachers (Cowie and Jones, 2015; Krysa, 1998; Shiue, 2017).

Teacher Competence

Puckett, and Cabuk (2004) argued that teachers' acquaintance, confidence, and competency in using ICT in teaching was largely dependent on their training. Mingaine (2013) maintains that teacher professional development is key to successful implementation of ICT in the teaching – learning process. Furthermore, Arntzen and Krug (2010) argued that the

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pedagogical challenge of using ICT in teaching does not only call for acquisition of basic ICT skills but also most importantly the methods of teaching using ICT to enhance learning. This study sought to investigate the kind of ICT knowledge and skills required for effective integration of ICT into the effective teaching and learning. Inan and Lowther (2010) in their study in USA examined the effects of teachers' characteristics and factors that influence their use of ICT in the classroom instruction. The study found that teachers' computer proficiency had a significant influence on their beliefs about use of ICT in classroom practice. Kagocha (2013) conducted a study in Nyeri County, Kenya focusing on teachers' ICT competencies, access to ICTs and their actual use in their teaching. The findings of this study revealed that most teachers only possessed basic computer literacy skills mainly acquired through personal initiatives. Majority of the teachers did not possess knowledge and skills required to effectively integrate ICT in their pedagogical practices. Pelgrum (2016) argues that the success of any educational program depends largely on knowledge and skills that the teachers who are program implementers possess.

Liew (2007) found that most teachers may not be in favor of the ICT program because they lack competency in dealing with ICT. Is this the main cause of low level of ICT usage among teachers? According to Hamsha (2011), adopting ICT competency standards and adequate training will help teachers to incorporate ICT effectively in education. Besides, it is also commonly acknowledged that ICT is expanding rapidly; if teachers are not ready with adequate and latest knowledge and skills, they would be unable to keep pace with the ever-changing technology and inevitably will be left behind and hampered from mastering new ICT competencies (Mas Nida, Wong, andAyub, 2011). Hence, a paradigm shift needed to maximize the potential of ICT and its application is very much expected in the minds of the teachers and the concerned authority that is in charge of preparing the teachers to keep abreast of rapid ICT development (Sathiamoorthy*et al.*, 2011). So, in order to prepare teachers to use technology effectively, we need to identify the current level of teacher ICT competency; in other words, how teachers perceived their own ICT competency. Hogenbirk (2006) points out that the ICT competences of teachers should support the following educational goals: making teaching flexible, creating individual learning paths, enhancing the possibilities of part time education, creating rich learning environments, trying out new teaching concepts, intensifying interaction teacher – students, supporting collaborative learning, motivating students, preparing students for lifelong learning, enhancing the effectiveness of teaching, costs reduction, enhancing the attractiveness of the profession of teachers.

Technical Support

Resta (2012) defines technical support as specialized skill personnel who are able to support and assist the educators in implementing technology into instruction. Meanwhile, Dexter, Anderson, and Ronnkvist (2002) have characterized the technical support as the access, operation and troubleshooting of hardware, software and network resources. According to Frost and Sullivan (2006), technical support includes ICT facilities vendor and internal helpdesks provided within the education ministry. Technology support has an encouraging impact on educators' own uses of ICT (Moses et al., 2008), and their integration of ICT infrastructure into the teaching-learning practices as well (Dexter, Seashore, and Anderson, 2013). For this reason, it is essential to provide guidance, support and services as parts of the technology applications (Haslaman, Mumcu, andUsluel, 2016). In the integration of the ICT infrastructure, technical support is needed for technology use throughout the curriculum because the lack of it may create difficulties and result in diminished support for the curriculum (Resta, 2002). At the same time, Resta (2002) also suggested giving more technical support to overcome the identified barriers. It is evident that technical support is important to teachers. Research studies have shown that technical support has an impact in enhancing the use of computers among teachers (Dexter et al., 2003; Resta, 2002). Therefore, technical support is required in schools to facilitate the educators to use the laptop effectively in their teaching practices.

Effective Teaching and learning

As ICT infrastructure is being increasingly used in education, indicators to monitor their impact and demonstrate accountability to funding sources and the public are ever more needed. Indicators are required to show the relationships between technology use and educational performance. There is also a need to show that education should be seen as using technology not only as an end in itself, but as a means to promote research, creativity, empowerment and equality and produce efficient learners and problem solvers. Many academic researchers have tried to answer this question at theoretical and empirical levels. They have faced two main difficulties. On one hand, student performance is hard to observe and there is still confusion about its definition. On the other, ICT entails evolving technologies and their effects

are difficult to isolate from their environment. Consequently, the relationship between the use of ICT and educational performance is unclear, and contradictory results are presented in the literature (Youssef and Dahmani, 2008).

Currently, there is a significant number of initiatives to assess and monitor the efficiency of ICT use and its impact on education. SITES (the second information technology in educational study), sponsored by the International Association for the Evaluation of Educational Achievement (IEA), is an exemplary study which identifies and describes the educational use of ICT across 26 countries in the world. The study explores the use of computers in teaching through sampling teachers, principals and ICT responsibility in schools. While it does not look into student achievement, it does look at the perceived impact of ICT on students from the teacher's perspective (Pelgrum and Anderson, 1999; Kozma, 2003). Moreover, Balanskat et al. (2006) reviewed several studies on the impact of ICT on schools in Europe. They conclude that the evidence is scarce and comparability is limited. Each study employs a different methodology and approach, and comparisons between countries must be made cautiously. In addition, in several other studies (see Yusuf, andAfolabi, 2010; Shaikh, 2009; Jayson, 2008; Shaheeda et al., 2007) it is argued that ICT helps to improve the quality of learning and educational outcomes. Some other surveys (e.g., Iqbal, and Ahmed, 2010; Hameed, 2006) argue that, in order to be successful, a country should improve its education system by implementing effective and robust ICT policies.

Critique of the existing literature relevant to the study.

Becta (2013) classifies the barriers as either teacher level or school level barriers. Teacher level barriers include lack of time, lack of confidence and resistance to change while school level barriers consist of lack of effective training in solving technical problems and lack of access to resources. Balanskat et al. (2006) divided the barriers into micro level barriers, including those related to teachers' attitudes and approach to ICT, meso level barriers, including those related to the institutional context. He also identified macro level barriers (system level barriers), including those related to the wider educational framework.These studies classify the barriers at teacher, institution or system level. However, this study aims at determining the effect of integration of ICT infrastructure in effective teaching and learning process in primary schools in Trans-Nzoia West Sub-County, Trans-Nzoia County. It therefore focuses on the factors relating to the teacher and the selected schools.Studies have shown that teachers' competence is a factor that influences ICTs use in effective teaching and learning. This refers to the knowledge and skills required to effectively use ICTs. Becta (2013) argued that teacher competence hinders the adoption of ICTs into pedagogical practice. If a teacher has the necessary skills, he/she will find it easy and enjoyable to employ technology in his/her teaching practice. However if one lacks these skills he will not be willing to embrace the use of technology in the teaching practice. It is important to note that this factor varies from one country to another and even regions (Pelgrum 2016, Al-Oteawi 2002).

Closely related to teachers' competence is teacher confidence; ability to use ICTs without fear of failure). Dawes (2001) sees this as a contextual factor which can act as a barrier. According to Becta (2012), the issue of teacher confidence was the area that attracted most responses from participants in a survey on ICT practitioners.Studies have shown that teachers who have limited ICT knowledge feel anxious about using ICT in classrooms (Balanskat et al, 2006, Becta, 2012, Cox, 1999). Such teachers will not use ICTs in their teaching since they fear making mistakes in front of their students who probably know more than they do. These studies concluded that lack of ICT confidence affects teachers' decision on whether or not to use ICTs in the effective teaching and learning processes Cox, Preston and Cox (1999) reported that teachers who are confident in the use of ICTs know their usefulness and immerse potential. Such teachers have no problem with adopting ICTs in their teaching/learning process. From the foregoing arguments it can be concluded that teachers' confidence in the use of ICTs influences their decision on whether or not to adopt ICTs.

Besides ICT skill and knowledge, the teachers' attitudes are also another key factor that plays a role in ICT integration in education. Many studies have found that the teachers' attitude toward ICT will affect ICT integration for effective teaching and learning purposes (Hatlevik&Arnseth, 2012).In addition to the factors that affect individual teachers there are those that are out of their control. The Kenya Government working hand in hand with the private sector has developed programs that equip teachers with the necessary knowledge and skills to enable them use ICTs in their teaching practice. Surprisingly not many of the teachers have adopted ICTs in their teaching practice. Similarly, Peeraer and Van Petegem (2012) claim that to ensure successful ICT integration in primary schools, scholars have to emphasize that it is about how teachers integrate ICT into the teaching and learning process as the implementation process to foster students' thinking skills and lastly promote better learning outcomes. Therefore, teachers of today should always be ready and well equipped with ICT competencies and positive attitude to provide ICT-based learning opportunities for students to improve their

learning quality (Hamidi et al., 2011).Apart from on the job training teachers go through as they prepare to use ICTs in the teaching practice, there are few if any training opportunities for teachers, (Pelgrum, 2016). The training opportunities available are for computer literacy and no meaningful training in ICTs use is available. This scenario makes it difficult for teachers to adopt ICTs in their teaching practice (Beggs, 2000). According to Becta (2012), the issue of training is complex because it brings together several aspects such as time for training, pedagogical training, skill training and ICT use in the initial teacher training. It is paramount to note that the initial teacher training should incorporate aspects of ICT pedagogical training so as to equip teachers with the necessary skills to enable them use ICTs in their teaching practice.Inadequate resources in schools affect the adoption of ICTs in the teaching and learning process. Teachers complained about the frustrations they undergo when they tried to access computer facilities in their schools (Sicilia, 2005). The lack of access could be due to inadequate facilities or in some instances poor planning, making it difficult for both teachers and students to access the facilities (Becta, 2012). Resources such as internet connectivity and relevant educational software were not available in some cases; this made it difficult for teachers to effectively prepare for their lessons (Korte and Husing, 2007). However according to Balanskat et al, (2006) accessibility to ICT resources is not a guarantee that they will be successfully adopted in the effective teaching and learning process.

Research Gap

There are a few gaps that exist in literature reviewed. First, the commitment of the management of the school in the ICT infrastructure quality management is unknown. Additionally, the engagement of the teachers in the usage of ICT infrastructure in the public primary schools which consequently showed the outcome of the performance is briefly known and the extent of the practice of continuous improvement in ICT system usage is not known in most of the schools in practice.

Summary

The study will be carried out in Trans-Nzoia West Sub-county. The study employed the behaviorism theory, constructivism theory and diffusion of innovation theory. The constructivist theory emphasizes on cooperative and collaborative learning. Concurrently, the behaviorism theory displays the fact that new knowledge can be acquired by operant conditioning where responses were learned from repeated stimuli and reinforced by rewards. This will help in accomplishing the enhanced performance in schools by repetitive usage of the ICT infrastructure. For the teachers as well, they will be able to master their ICT skills by using the infrastructure over and over. The diffusion of innovation theory is significant in those individual characteristics that can be mapped on the independent variable of teacher competency in the study as well as the moderating variables of infrastructure availability and technical support. The theoretical and empirical review together with the formulation of the conceptual framework guides the research study.

3. RESEARCH METHODOLOGY

Introduction

This chapter presents the research design, study area, population, sampling frame, sample and sampling technique, instruments, data collection procedure, pilot-test, data processing and analysis. It also highlights reliability and validity of the instruments.

Research Design

Orodho (2013) defines a research design as the arrangement of conditions for collection and analysis of data in a manner that aims to combine significance to the research purpose with economy in the procedure. The study will use the descriptive survey research design. For the triangulation, the researcher shall see need to gather quantitative data by administering questionnaires to the teachers. There will be administration of questionnaires to the people who will be given the chance to give information about the integration of ICT infrastructure in effective teaching and learning in the different schools.

Target Population

This study will be conducted in Trans-Nzoia West Sub-County Public Primary Schools. Trans-Nzoia West Sub-County was selected on purpose by the researcher since the rapport created between the researcher and the respondents who are the teachers, students and administration is good. This will help in ensuring that the researcher has an easy time in the

handling of the respondents. The sub county has a total of 124 public primary schools (Schools Statistics Return, D.E.O's office, Trans-Nzoia County, 2017). The target population will include head teachers and four other teachers namely; HODs for Mathematics, Languages, Sciences and the Senior Masters. This makes to five teachers per school. The head teachers are essential in this study because they are in authority of the expenses and are responsible for the very tough amendments concerning ICT infrastructure in their given schools. The heads of departments put down the rules and policies of the curriculum of the school and consequently play a huge role in the teaching and learning process.

Sample Size and Sampling Technique

According to Nkpa (1997), sampling refers to picking a given number of subjects from a well-defined populace, as a representation of the populace. Mugenda and Mugenda (2013) stated that 30% of the target population is sufficient to be used as a sample for the research. Of the total 124 schools in Trans Nzoia West Sub-County, 30% yielded 37 schools which are the sample size of the research. This sample totals to 185 respondents (Five per school).

This study adopted the purposive sampling method for the 37 schools targeted for data collection. The purposive sampling method was instrumental since the schools were selected on purpose of those which have the ICT infrastructure hence leading to the study findings being representative enough of the study population.

Data Collection Instruments and Procedure

In this study the research instrument that was used is the questionnaires.

Questionnaires

Questionnaires will be used to achieve the objectives of the study. The researcher employed the Likert questionnaires. One advantage that comes along with the questionnaire is that it is simple to understand. Davis' (1989) original measurement scales for perceived usefulness and perceived ease of use included seven levels. The researcher adopted a 5 - point likert type questions. Likert type questions are used to assess perceptions and they have the advantage of yielding continuous data that lends itself to many statistical analyses. An advantage that stands out in the usage of questionnaires is that it is impossible to be biased on neither the respondent nor the researcher.

Pilot Test

According to Kothari (2014), a pilot test is quite necessary for purposes of checking both the reliability and validity of the data collection instruments. According to Connelly (2008), a pilot study sample should be 10% of the sample size. Out of the 37 schools targeted, 10% yields 3.7. This pilot study was carried out in three (3) (MoiMarura Primary School, University of Eldoret Primary School and Kimumu Primary School) schools in Eldoret town, UasinGishu County. A total of 15 respondents participated in the study. The pre-testing results enabled the researcher to make questionnaire adjustments in preparation for capturing all the required and necessary data from the respondents during the actual data collection for the research.

Validity of Research instruments

Validity is concerned with whether the findings are really about what they appear to be about (Saunders *et al*., 2013). Validity is defined as the extent to which the data collection method or methods accurately measures what they were intended to measure (Saunders et al, 2013). Cooper and Schindler (2016) believed that validity refers to theextent to which a test measures what is actually wished to measured. Mugenda and Mugenda (2013) posited that there are two forms of validity i.e. external and internal validity where external validity of research findings refers to the data's ability to be generalized across persons, settings, and times while internal validity is the ability of a research instrument to measure what it purposed to measure. According to Orodho and Kombo (2015), the validity of a study is the extent to which an instrument measures what is intended to be measured by it. The researcher will aim at how much valid the content is; this deals with the accuracy with which a given instrument measures the given variable that is being studied. The validity of the content will be measured by checking through the research questions and also the questionnaires. There is expected to be a validity of content improvement by the help of the university supervisors, experts and my fellow colleagues in the field of research.

Reliability of Research instruments

The reliability of an instrument refers to its ability to produce consistent and stable measurements (Kothari, 2014). The Cronbach alpha coefficient is used in this study to estimate internal coherence of all items on a test of data (Kothari, 2014). Cronbach (1951) stated that the reliability is expressed as a coefficient between 0 and 1 where acceptable strength should be 0.7 and above. The higher the coefficient, the more reliable is the test.

The findings of the study were: Availability of ICT Infrastructure had a coefficient of 0.739; Respondents' ICT Competence, a coefficient of 0.803, ICT Technical Supportat 0.721 and Effect on Effective Teaching and Learningat a coefficient of 0.719. In all the variables, the values of the Cronbach Alpha coefficients were above the acceptable value of 0.7 which enabled the researcher to consider them reliable (Cronbach, 1951; Mugenda and Mugenda, 2013). These results were captured in the tables below.

Table 3.1: Reliability Analysis

Variables	Number of items	Cronbach alpha	Comment
Availability of ICT Infrastructure	4	0.739	Acceptable
Respondents' ICT Competence	4	0.803	Acceptable
ICT Technical Support	4	0.721	Acceptable
Effective Teaching and Learning	4	0.719	Acceptable

From the table above, the overall reliability statistics table was as shown below;

Table 3.2: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.746	.751	4

Data collection procedure

The researcher will get an introduction letter from The Jomo Kenyatta University of Agriculture and Technology (JKUAT), which shall aid in getting the research permit from the National Commission for Science Technology and Innovation (NACOSTI). After acquiring the letter, the researcher will have to keenly select the respondents and let them know the purpose of the study that is yet to be carried out. The questionnaires shall be delivered to the schools that will have been selected and allow them to have an ample time to fill in the given questionnaires. The respondents should be given good time to respond to avoid the rush in answering. The questionnaires will then be collected at a time agreed later. Every matter that dealt with the responsibilities and rights of the subjects of the research will be addressed and ensure that all the data that will be collected will be confidential. The researcher needs to give enough instructions to the selected respondents that will then fill the questionnaires.

Data Processing and Analysis

The data collected will be coded and checked for completeness. Frequency tables, percentages and graphs will be used to present the research findings. The frequency tables will show the number of respondents in each of the required categories. The percentage of the respondents who choose a particular component will be computed and comparison made among the categories.Statistical measures such as the mean, mode and standard deviation are also to be computed for comparison purposes. Finally, the computed frequency, percentages and statistical measures are supposed to be represented on tables and graphs for ease of interpretation. After all data has been collected, the researcher will conduct data cleaning, which will involve identification of incomplete or inaccurate responses and correct to improve the quality of the   raw data (Kombo and Tromp, 2006). The collected data will also be analyzed and presented using Statistical

Package for Social Sciences (SPSS) version 23. Inferential statistics methods that will be used include ;Multiple regression analysis, Analysis of Variances (ANOVA) and correlation analysis to determine the relationship between the variables.

4. RESEARCH FINDINGS AND DISCUSSIONS

Introduction

Chapter four of this study discussed the research findings, and their presentation based on the study objectives. Both descriptive and inferential statistics were used in the data analysis. The response rate, reliability analysis, regression and correlation analyses results were presented in this chapter.

Background Information

Response Rate

One hundred and eighty five (185) questionnaires were distributed to respondents in the selected schools for the collection of research data where each of the 37 public primary schools had four (4) teachers targeted and one (1) head teacher. The teachers were the HODs in Mathematics, Languages, Sciences and the schools senior teachers respectively. All the 185 questionnaires were fully filled and returned representing a response rate of 100%.

Respondents' Gender

Data was collected as regards the gender of the respondents, analyzed and presented as shown in table 4.1 below;

Table 4.1: Respondents' Gender

Gender	Frequency	Percent
Female	65	35
Male	120	65
Trans Gender	0	0
Total	**185**	**100**

The analyzed data, as presented in table 4.1 above ,from the collected data on the gender of the respondents, 35% of the respondents were female teachers (including 5 head teachers) while 65% were male teachers (including 32 head teachers).

Respondents' Age

The findings of the respondents' age were as presented in table 4.2 as shown below.

Table 4.2: Respondents Age

Age bracket (Years)	Frequency	Percent
20-30	20	11
31-40	92	50
41-50	47	25
Above 50	26	14
TOTAL	**185**	**100**

The study found that majority (50%) of the respondents were aged between 31 and 40 years ,followed by 25%who were aged between 41 and 50 years, where 41-50 years included 16 head teachers. The next category of respondents constituted 14% who were aged above 50 years (majority of whom were head teachers-21) while the minority group was 11% made up of those aged between 20 and 30 years old, this group had no head teacher.

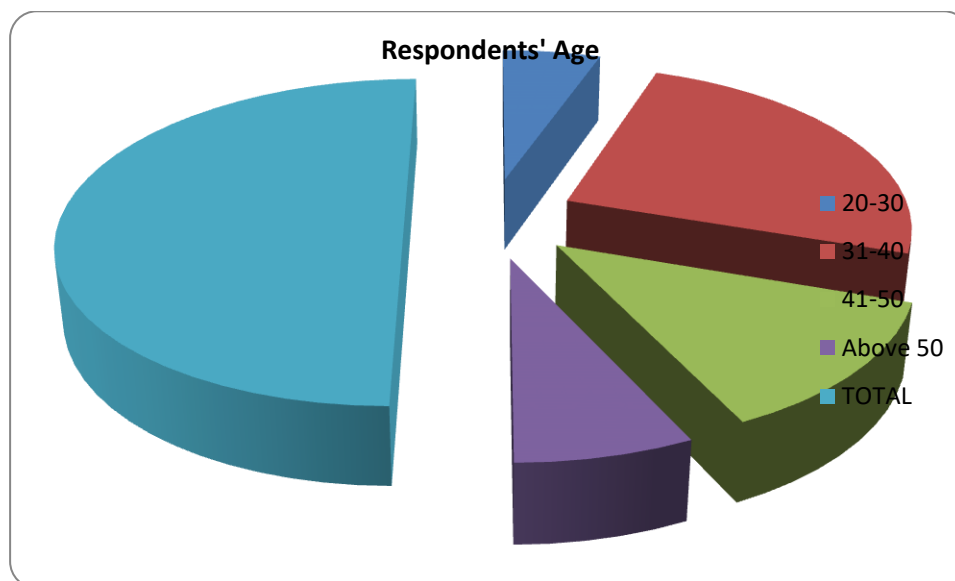**Figure 4.1 below represented this data on age of respondents:**

Figure 4.1: Respondents' Age

Respondents' Period of Service

The findings of the respondents' experience in teaching and management were as presented in table 4.3 as shown below:

Table 4.3: Respondents' Experience in Teaching and Management

Period in Years	Frequency	Percent
0 -5	33	18
6 - 10	20	11
11 -20	101	55
Above 20	31	16
TOTAL	**185**	**100**

Table 4.3 above showed the period of years the respondents had been in service in their respective departments. This information was important because it had a direct effect on the degree of reliability on data collected from the respondent for purposes of forming firm conclusions after the analysis of the same collected data. Majority of the respondents had been in service between 11 and 20 years at 55% (11 head teachers), followed by those between 0 and 5 years at 18% (10 head teachers), then those above 20 years at 16% (12 head teachers) and the minority group represented those between 6 and 10 years of experience at 11% (4 head teachers).

Respondents' ICT Qualification level

Data on ICT qualifications for both teachers and head teachers was collected and tabulated as shown in table 4.4 below:

Table 4.4 showing the Respondents ICT Qualification Level

Category	Frequency	Percent
Certificate	68	37
Diploma	27	14
Undergraduate	9	5
Post Graduate	0	0
Others	81	44
TOTAL	**185**	**100**

The researcher purposed to collect data on the ICT qualifications of the respondents given that it was the main target of the study. From the collected and tabulated data as shown in Table 4.4 above, the respondents who were teachers in the respective schools had ICT qualifications.37% of the respondents had certificate qualifications (the figure including 21 head teachers ostensibly from the qualification obtained from the government training exercise carried out for purposes of rolling out the laptop program in the country's lower primary pupils in 2013), 14% of the respondents had diploma qualifications (including 7 head teachers), 5% of the respondents were degree holders in ICT (2 head teachers), none of the respondents had post graduate qualifications while another 44% had qualifications that could not fall under the provided categories, which was understood to be self-trainings in ICT while the head teachers (7) in this category happened to be ICT illiterate apparently aged above 50 years. These results indicated that majority of the respondents could at least understand and operate with ICT knowledge.

Analysis of the Effect of ICT in Effective Teaching and Learning

Data collected on the dependent variable, Effect of ICT in Effective Teaching and Learning, was presented in table 4.6 as shown below;

Table 4.5: Effect of ICT in Teaching and Learning

Item	SD %	D %	N %	A %	SA %
The school performance has improved immensely due to the integration of ICT infrastructure in teaching and learning	0	0	11	84	5
The school has experienced enhanced research and knowledge acquisition through the teachers using ICT infrastructure	0	5	14	73	8
There is great learning efficiency in the school since there is no time wastage and work is done mainly by machines	0	19	54	16	11
The administration supports the use of ICT infrastructure in the teaching and learning environment	0	0	8	86	5

Table 4.5 above, on the effect of the independent variables on the dependent variable, Effective Teaching and Learning in Public Primary schools, none of the respondents either strongly disagreed or disagreed when asked whether the school performance had improved immensely due to the integration of ICT infrastructure in effective teaching and learning,11% remained neutral, 84% agreed to this statement while 5% of the respondents strongly agreed that indeed the schools' performance had improved immensely due to the integration of ICT infrastructure in effective teaching and learning. On whether the school had experienced enhanced research and knowledge acquisition through the teachers using ICT infrastructure, 8% of the respondents strongly agreed, 73% agreed, 14% remained neutral,5% remained neutral while none either strongly disagreed to this statement. The respondents were also asked whether there is great learning efficiency in the school, due to minimal time wastage and work being done mainly by machines, 0% strongly disagreed, 19% disagreed, 54% of the respondents were non-committal, 16% agreed while only 11% strongly agreed to this statement. In relation to whether the administration supports the use of ICT infrastructure in the effective teaching and learning environment, 8% of the respondents remained neutral, 86% of the respondents agreed while 5% of those respondents strongly agreed that indeed the administration supports the use of ICT infrastructure in the teaching and learning environment.

Analysis of Specific Objectives

Availability of ICT Infrastructure on Effective Teaching and Learning

The findings on the effect of Availability of ICT Infrastructure on Effective Teaching and Learning in Public Primary Schools were presented in Table 4.6 as shown below;

Table 4.6: Effect of Availability of ICT Infrastructure on Teaching and Learning

Item	SD	D	N	A	SA
	%	%	%	%	%
The school has suitable hardware available for use e.g Laptops, desktops etc	0	6	20	15	59
The school has relevant updated software for use for instance, computers have valid installed antivirus for data safety	11	47	17	24	0
The school has a fast and reliable internet connection	49	21	7	19	3
The school has standby power supply and/or UPS to avoid data loss during power outage	56	19	7	18	0

Table 4.6 above presented the respondents' feedback on the first independent variable, availability of ICT Infrastructure. When asked whether the school has suitable hardware available for use e.g Laptops, desktops etc, none of the respondents strongly disagreed, 6% of the respondents disagreed,20% seemed not ready to take sides as they remained neutral, 15% agreed while 59% of the respondents strongly agreed to this statement. The school has relevant updated software for use for instance, computers have valid installed antivirus for data safety, was the second question posed to the respondents,11% of the respondents strongly disagreed,47% disagreed, 17% were neutral while 24% of the respondents agreed while none strongly agreed that the schools had relevant updated software for use for instance, computers have valid installed antivirus for data safety.

On whether the schools have fast and reliable internet connection, 49% of the respondents strongly disagreed, 21% disagreed, 7% of the respondents remained neutral, and 19% of them agreed that truly the schools have fast and reliable internet connection with only 3% strongly agreeing that indeed the statement was true. Whether the schools had standby power supply and/or UPS to avoid data loss during power outage,56% strongly disagreed, another 19% disagreed to the statement, 7% remained neutral with 18 of the respondents agreeing and none strongly agreeing that the schools have standby power supply and/or UPS to avoid data loss during power outage.

Relationship Between Variables

Regression Results on Effective Teaching and Learning

The study used predictor variables for purposes of exploring the indicators of the predicted variable (Effective Teaching and Learning). The co-efficient of determination (R-Squared) was the tool used in identifying the extent to which the independent variables measured the variations in the dependent variable. A sufficiently large value R^2, the better and reliable the model can be. The model was as presented below;

Table 4.7: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.575[a]	.519	.522	.004

a. Predictors: (Constant), ICT Infrastructure, ICT Competence and ICT Technical Support

The independent variables (ICT Infrastructure, ICT Competence and ICT Technical Support)accounted for 57.5% (R^2 = 0.575) of the variations in the dependent variable (EffectiveTeaching and Learning) as shown in the table above, indicating that 47.7% of the variations in the dependent variable was due to the variables not within the scope of this study.

Relationship between variables

The study used the regression equation in measuring and presenting the nature of the relationship between the independent variables and the dependent variable. The ANOVA table was used in the depiction of the predictions from the collected data as shown in table 4.8 below;

Table 4.8: ANOVA

ANOVAª

Model	Sum of Squares	df	Mean Square	f	Sig.
Regression	96.612	1	96.612	17.370	.0000ᵇ
1 Residual	1023.457	184	5.562		
Total	1120.069	185			

a. Dependent Variable: Effective Teaching and Learning in Public Primary Schools

b. Predictors: (Constant), Availability of ICT Infrastructure, ICT Technical Support and ICT Competence

The F-test from the analysis was provided by the ANOVA table above for the measurement of the relationship between the variables. Table 4.8 represents the relationship between Effective Teaching and Learning in Public Primary Schools as the dependent variable and the specific variables (Availability of ICT Infrastructure, ICT Technical Support and ICT Competence).The table indicated that at the F-ratio=17.370, $p<0.000$, being above the significance level of 5%, the independent variables were capable of measuring the dependent variable.

5. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

This chapter presented the summary of the research findings, Conclusions and recommendations from the analysis of the research data. The researcher also made suggestions on areas for further study.

Summary

From the analyzed data, the independent variables (Availability of ICT Infrastructure, ICT Technical Support and ICT Competence), had mixed influence on the dependent variable (Teaching & Learning in Public Primary Schools). Some variables positively and significantly affected the dependent variable while others had mild or weak influence on the dependent variable.In some questionnaire statements/questions, respondents felt that ICT has not been fully implemented in primary schools as expected or popularized to be installed and operational. Generally, therefore, the independent variables (Availability of ICT Infrastructure, ICT Technical Support and ICT Competence) predicted 57.5% (R square = 0.575) of the dependent variable (Teaching & Learning in Public Primary Schools). The predictor variables positively influenced dependent variable to 57.5% while the unexplained variation of 42.5% was understood to be due to other factors of predictors not covered in this study.

Availability of ICT Infrastructure on Effective Teaching and Learning

The respondents' feedback on the first specific objective of the study, Availability of ICT Infrastructure on Effective Teaching and Learning, reflected the strongest influence on the teaching & learning in public primary schools in Trans Nzoia County than the other predictor variables. The respondents strongly agreed that the public primary schools in Trans Nzoia County had suitable hardware available for use e.g Laptops, desktops etc. Majority of the respondents were of the opinion that the schools didn't have relevant and updated software for use, for instance, computers had no valid installed antivirus for data safety. This was evident from the over three-quarters of the respondents who returned unfavourable feedback on this question. The public primary schools in Trans Nzoia County didn't also have fast and reliable internet connection since only slightly more than a quarter of the respondents thought otherwise. The respondents also responded that the schools didn't also have standby power supply and/or UPS to avoid data loss during power outage. This was evidenced by over 80% of the respondents who thought the statement was not true.

Conclusion

From the research analysis results, the following were the conclusions made in relation to the variables involved in the study;

Availability of ICT Infrastructure

Availability of ICT Infrastructure on Effective Teaching and Learning in public primary schools in Trans Nzoia County had the strongest effect on the teaching & learning, (at r=0.781) than the other predictor variables. The public primary schools in Trans Nzoia County had suitable hardware available for use e.g Laptops, desktops etc. However, the public primary schools in the county didn't have relevant and updated software for use; for instance, those schools with computers did not valid installed antivirus software for data safety. The ICT sector is so dynamic that updating the software should be taken care of frequently, especially in a learning institution.

From the different respondents, the public primary schools in Trans Nzoia County didn't also have fast and reliable internet connection. These schools also risked losing the little infrastructural equipment since it was evident that they didn't have standby power supply and/or UPS to avoid data loss or severe damage during power outage.

ICT Competence on Effective Teaching and Learning

While examining the effect ICT Competence had on Effective Teaching and Learning in public primary schools in Trans Nzoia County, it was evident that, from majority of the respondents, the teachers in the public primary schools in Trans Nzoia County are capable of using the ICT infrastructure confidently with no fear. This conclusion was arrived at after analyzing closely the feeling of the teachers who were themselves users of the ICT infrastructure in those schools. Students are not being well taught on how to use the computers accordingly in the Trans Nzoia County primary schools, this was concluded so due to the unavailability of sufficient or enough ICT infrastructure in the public primary schools in Trans Nzoia County. The public primary school teachers in the county used computers to access educational resources for their respective schools. Since the general feeling was that these schools had no enough or sufficient ICT infrastructure, it was evident that the schools are struggling to access such resources. And finally, a few schools with computers used them for keeping student records and student performance. But with deficiencies in the ICT infrastructure requirements, this can only be said to be risky since the computers were said not to be having antivirus software or proper hardware/software maintenance schedules or even manuals.

Recommendations

The study findings found a generally positive relationship between the predictor variables (ICT Infrastructure, ICT Competence and ICT Technical Support) and the predicted variable (Effective Teaching and Learning in Public Primary Schools in Trans Nzoia County), although it seemed not to be fully strong due to the prevailing circumstances within the schools targeted in the study. However, the following recommendations were made from the results: That as regards the first variable, Availability of ICT Infrastructure, the public primary schools in Trans Nzoia County, the government, through the ministry of education, should ensure that the public primary schools have suitable and up to date hardware available for use in order to enable them be at par with their peers who have their ICT infrastructure well updated and maintained e.g provision of Laptops or desktops fully fitted with relevant and updated software including the antivirus software for data safety and fast and reliable internet/Wi-Fi connections for teacher self upgrades among others benefits. The standby power supply and/or UPS will also be another important milestone in making the graduates at each level of education in the Kenyan education system a world market admired product. On ICT Competence, sufficient and efficient ICT infrastructure in schools will ensure, given that teacher competence is free from problems as evidenced by this study, students are handled/taught on how to use the computers accordingly in the Trans Nzoia County primary schools. Availability of ICT infrastructure will enable the schools to be computerized for better service delivery especially for keeping student records among them student performance records

Areas for further Research

Because this study only focused on a single county, it may not fully bring out a common scenario that can be replicated all over the country, it was therefore recommended that more research, probably using the same variables, and comparisons made to fully understand the challenges in the country. There is need for future scholars to put more emphasis in the education sector to ensure that the many challenges in the education sector are sufficiently researched and suggestions made for the improvement or reduction of the challenges in the sector. This should be done in other different counties and probably using different variables to broaden the scope. Many issues came up during research work which was way outside the scope of the study. In this regard, the researcher suggested to future scholars to carry out studies on other variables affecting the education sector either in Trans Nzoia County or anywhere within the country. Some of the issues included the disparities in public schools in urban areas and pure rural areas.

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