A FRAMEWORK FOR ONLINE RESOURCES AND E-LEARNING IMPLEMENTATION (OREI) IN TANZANIA SECONDARY SCHOOLS

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ABSTRACT

The generic model of an education system is formed by pedagogy, social interaction, and technological components. Current generation is born into a digital world, distinguished from other generations by the presence of sophisticated media, World Wide Web, mobile devices, and the multitasking computer systems that enhance learning beyond the classroom walls. In recent years, the shortcomings on the traditional learning approaches have forced an increased demand for the use of digital educational resources that enhance effectiveness to the pre-existed approaches. However, deployment of Information and Communication Technologies (ICTs) in schools face internal and external challenges that are either related to lack of funding, lack of ICT implementation strategic plan, lack of experts' involvement, lack of users competencies and or relevant infrastructures and technologies to be used. As a gap to this study, most of previous studies focused on the design of elearning tools (software, mobile apps, and interactive systems). However, the lack of a framework that integrates efforts of all key players for the planning of ICT use in secondary education exists. In addition, ICT tools are dumped in schools where users have no skills and their readiness is not well determined. A solid approach for technology and infrastructure deployment in the education system is essential. This study introduced an integrated online resources and e-learning implementation (OREI) framework.

In Tanzania, applying pedagogical ICT tools in secondary education is highly considered as a necessity. The need therefore for teachers' professional development should be aligned to the overall education objectives and the opportunities of the pedagogical use of ICTs. In this study, a mixed research design used qualitative and quantitative approaches to collect data using questionnaires, interviews and document reviews from the MoEVT head office, Tanzania institute of education (TIE), Schools' inspection eastern zone office, Morogoro Teachers Training College, Mzumbe University, four public Secondary Schools (Kilakala, Kipera, Mongola and Lupanga) both from Morogoro region.

This study found that, teachers are passionate to know and use ICTs but failed due to existing external limitations (e.g. accessibility to hardware and software) and internal limitations-(e.g. personal attitudes, skills and perceptions about a technology). Teachers' education level could not determine their ICT use competency levels. Majorities are poorly prepared in ICT use and

could fail to mix digital and non-digital technologies in classrooms when enabled. The challenges secondary schools face in relation to ICT use are complex and should not be resolved from single direction. The uses of ICTs have mostly focused on infrastructures and less on ICT associated learning opportunities. Among the worst practices have been dumping hardware in schools without relevant e-contents, adopting ICT-related models and practices of the developed nations hoping for them to work, lack of clearly defined ICT in education implementation plan and framework. Emerging from the reviewed literature and the empirical data, we introduced an innovative framework to support the process of planning, deployment, and monitoring and evaluation of the ICTs in education in Tanzania, which is a study case. The study identified seven components of the OREI framework namely: (1) government support, (2) ICT infrastructures, (3) technology deployment, (4) policies and guidelines, (5) training and recruitment, (6) stake holders involvement and (7) the monitoring and evaluation; followed by the design based approach which led to the initial framework design.

ELearning application in developing countries could only be realized when the ICT in education policies, the education vision strategic plan and the implementation framework are well coordinated. This study presents key recommendations. The government should clearly define the model of technology use in secondary education. The strategic plan should state measurable achievements to avoid entering the worst ICT investment practices. There is a need for authoritative approach to the study of the degree of ICT in education integration that makes use of such indicators within developmental models of integration of ICT in education with considerations of local circumstances. Tanzania as a nation should define levels of ICT integration and break them into goal oriented phases. For the government to know whether one model of instructional materials is a better choice than another, it must know which students are being exposed to which instructional materials. In the perspective of ICT in education planning, designing and deployment it is necessary to bring ICT into a familiar educational framework as a tool equally to textbooks and in time allow and pro-actively encourage the government to intentionally budget for them equally. It is clear that a balance is required between providing offline digital content resources, online content and online content creation tools that allow teachers and students to create and share their own teaching and learning contents.

DECLARATION

I, **Patrick D.Kihoza** do hereby declare to the Senate of Nelson Mandela African Institution of Science and Technology that this dissertation is my own original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

Patrick D.Kihoza **4Th April 2016**

Name and signature of candidate **Date**

The above declaration is confirmed

Name and Signature of Principal Supervisor **Date**

Dr. Joseph K.Bada **5th April 2016**

Name and Signature of Co-Supervisor **Date**

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CERTIFICATION

The undersigned certify that they have read and found the dissertation titled **"A Framework for Online Resources and E-learning Implementation (OREI) in Tanzanian Secondary Schools"** qualify for acceptance by the Nelson Mandela African Institution of Science and Technology (NM-AIST) in Arusha, in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Information and Communication Science and Engineering of NM-AIST.

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My deep sense of gratitude should go the Ministry of Education and Vocational Training for allowing me to carry out this study within the secondary education domain. The schools and teacher training colleges I visited real deserve this acknowledgement for their humble cooperation.

Once again, I thank you all.

DEDICATION

To the most high God and Jesus Christ whose precious love, atonement, care and grace have transformed me, let His love lead. I will never doubt His desire and ability to uplift me.

To my lovely family and those with whom we suffered together from childhood to adulthood, we are one another's strengths. I lay this great work over you, hoping that my future is holding the pearl of great price.

It was neither my power nor my work but my faith in His finished work.

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LIST OF ABBREVIATIONS AND SYMBOLS

ADDIE	Analyse, Design, Develop, Implement, and Evaluate
BEST	Basic Education Statistics in Tanzania
CMS	Content Management Systems
JISC	Joint Information Systems Committee
LMS	Learning Management systems
LCMS	Learning Content Management Systems
MOOCs	Massive Open Online Courses
MEB	Malaysia Education Blueprint
NECTA	National Examination Council of Tanzania
OECD	Organization for Economic Co-Operation and Development
OREI	Online Resources and E-learning Implementation
PBL	Project /Problem- Based Leaning
URT	United Republic of Tanzania
UNESCO	United Nations Educational, Scientific, and Cultural Organization

CHAPTER ONE

Contextual Background

Summary

This dissertation aimed at designing a framework for online educational resources and e-learning implementation in Tanzanian secondary education. This chapter introduces the dissertation contextual background by discussing the Tanzania secondary education and the state of classroom ICT use. The chapter presents the discussion of the importance of web based e-resources, the digital educational resources, supportive infrastructures, the importance of ICT policies, and the implementation strategic plans, the state of ICT use in Tanzania and the pedagogical implications in secondary education. The chapter presents the objective of the study that includes the problem definition, main and research objectives, research questions, study significance, problem statement, research design and the methodology.

1.1 Introduction

Computer-assisted learning in its numerous generations has acted to open up the world of information to everyone and its most influential alternative, online e-Learning, has become a compound that has permitted massive changes in what is learned and who is able to learn it. Current generation , termed as generation Z is born into a digital world, distinguished from other generations by the invention of electronic devices, world wide web, cloud computing and multitasking systems with sophisticated media and computer environment (Daanen & Facer, 2007a; Renfro, 2012a; Rideout, Foehr, & Roberts, 2010; Waldron, 2012). Many devices have become widespread across generations, leading to newer generations increased mobility as they prefer laptops over desktops and mobile devices for a variety of purposes, including internet, email, music, games, and video. The Internet permits communication and collaboration regardless of physical location that delimit todays' learning (Blair, 2012; Renfro, 2012b; Waldron, 2012). The presence of ubiquitous digital technologies in education provides new ways of thinking, collaboration and communication (Olsen, 2012; Sbihi & Kadiri, 2010; Tripathi, 2002; Wastiau et al., 2013). The elearning Africa report 2013, states six dominant and interrelated themes subject to the use of technology in education as: (1) increased access to resources, information and knowledge (2) the emergence of new methods of learning and teaching (3) increased effectiveness in the education system and infrastructure (4) increased

student motivation (5) improvement in teacher training and teaching itself and (6) improved understanding of how to make effective use of technology (Isaacs, 2013: p. 6). The increased access and use of information and communication technology (ICT) among secondary school students should be coordinated to enhance searching for specific information on a website that frees visiting more task irrelevant pages to the task-relevant web pages (OECD, 2015). Information and Communications Technology (ICT) refers to technology that store, retrieve, manipulate, transmit or receive information electronically or in a digital form (Owston, 1997; Plowman & Stephen, 2003). The term ICT includes hardware, communications devices or applications, ranging from computer hardware, software, network infrastructure, video conferencing, telephone and mobile devices (Herselman & Britton, 2006; Large & Beheshti, 2000; Mooij & Smeets, 2001).

The uses of ICTs stand as the major e-learning facilitator. An important influence on the use made of ICT in subjects and classes is the amount and range of ICT resources available to teachers and learners. Examples of the specific uses of ICT most frequently reported in the literature according to Cox et al.(2003: p.34) include simulations and modelling in science and other subjects, modelling environments and other software in mathematics, Word-processing for language and literacy and the internet to extend students subject knowledge. Other uses entail Presentation software to develop students' presentation and literacy skills and the interactive whiteboards to promote class discussions and students' explanations and presentation skills. Three major components make up e-learning; digital pedagogy, digital content (including e-curriculum) and e-learning spaces (Henrick, 2011; Henry, 2001; Queensland Smart Classrooms initiative, 2008). However, teachers' perceptions of pedagogy relating to ICT are often confined to classroom practice. The pedagogical practices of teachers using ICT can range from basic enhancements of practices using what are essentially traditional methods, to more fundamental changes in their approach to teaching using ICTs (Cox et al., 2003). However, full e-learning might be the best option in many developing countries; it is difficult to implement due to the prevailing challenges. In the world, full of multiple sources of information, education systems should benefit from both traditional and technology enabled teaching and learning. Blended learning approach is positioned at the forefront of transforming classroom practices and student learning opportunities. The blended e-learning approach comprise of three interrelated and co-dependent components of digital pedagogy approaches, digital content creation, use and sharing

(including eCurriculum) and the e-learning spaces as a technology for enhancing publishing, downloading and accessing of digital contents (Zhang & Nunamaker, 2003). According to Littlejohn & Pegler (2007: p. 28), blended e-learning could mean (1) access to a wide range of global sources of information, (2) using podcasts and e-books shared via wireless connections and (3) seamless integration of physical and virtual learning spaces that integrate and accommodate technology, but focus on student learning. The use of blended learning in classroom cannot be realized without the blend of space, time and media to offer new possibilities as to the sorts of activities students carry out and the ways they can collaborate using available electronic tools (Littlejohn & Pegler, 2007: p. 21).

According to the Australian Curriculum , Assessment and Reporting Authority (ACARA, 2013), any positive education reform should focus on knowledge developing technologies, collaborative learning environments that allow creativity and innovative engagement with technologies. The use of ICT in education has been regarded as the most important classroom tool of the 21st century (Malaysian Government, 2012b, p. 6; McKinsely and Company, 2009; Singapore Ministry of Education, 2010). The use of ICT pedagogical tools improves teaching and learning, empowers students interactions with the curriculum in classrooms and outside the classrooms (Fang et al., 2011; Fernandez, 2011; Wong, 2012, 2013). As the pedagogy, shifts from being teacher-centered to student-centered, students become engaged in exploration and simulation instead of being passive recipients of information (Karwoski, 2013; UNESCO, 2004; Wehling, 2007). In most of developing countries, online educational resources and web-based activities unfortunately more or less have been considered as parts of the curriculum planning and many struggled to succeed with traditional educational systems (Georgsen & Zander, 2013; Gulati, 2008; Kessy, Kaemba, & Gachoka, 2006; Pade-Khene, 2015). There have been extensive disappointments on how ICT in education are planned, used and able to transform secondary education (Trucano et al., 2011). The use of ICTs have focused much on infrastructures and less on enhancing learning opportunities through direct integration of relevant pedagogical resources in curriculums (Dumont & Istance, 2010; Farrell, Isaacs, & Trucano, 2007; Trucano, 2012; Trucano et al., 2011).

In Tanzania, for example, there are limited e-learning infrastructural support for relevant teaching and learning like multimedia classrooms and internet connection for direct delivery of

web 2.0 services (Andersson, Nfuka, Sumra, Uimonen, & Pain, 2014; Farrell et al., 2007; United Republic of Tanzania, 2007). However, there are few ICT infrastructures provided in some schools, the use of pedagogical ICT for teaching and learning is still poorly (Andersson et al., 2014: p. 9). The real potentials of ICTs in secondary education have largely being untapped. Teacher trainees who are anticipated to influence adoption of ICTs in education do not practice ICT uses like any other medium for teaching (Tondeur et al., 2012). There is a need to align pedagogical ICT design with the curriculum, locally developed e-contents, teachers' knowledge, skills, and accessibility of the technology that focus on providing opportunities to access, sharing, creating and using of curriculum relevant ICT tools. Planning for eLearning implementation in education is the most important aspect. The worst experience teachers and students face in e-learning environment is finding traditional teaching and learning materials simply moved to the computer screen. The e-learning strategy takes a view of worthwhile education system development, quality learning processes and pedagogical innovation. Ideally, planning and implementation of e-learning should broadly be integrated with many factors ranging from institutional, pedagogical, infrastructural to the choice of technology and the related polices and guidelines. Such a broad strategy needs to be defined at the national education sector level to reflect the ICT use in education strategic plan.

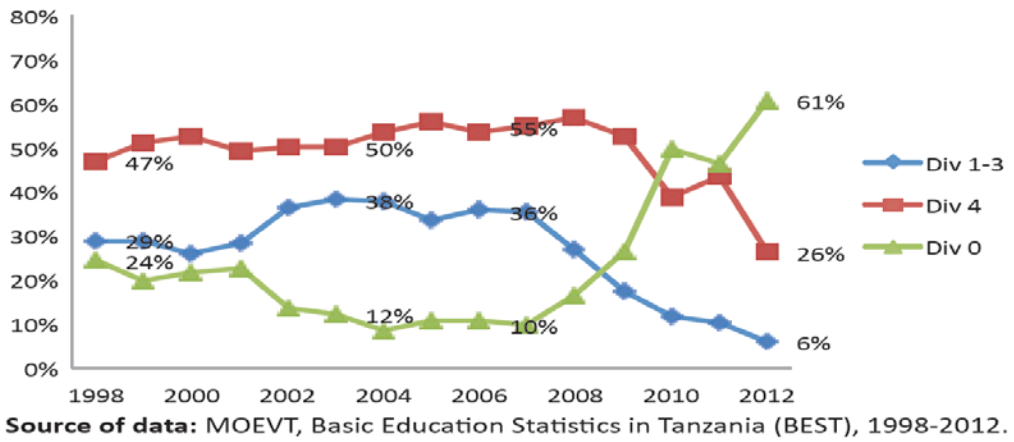
1.2 Current Status of ICT use in Tanzania secondary Education

In Tanzania, the use of ICTs in most of government secondary schools is still very low. There is limited teaching of basic ICT skills and no integration into the classroom teaching and learning process (Andersson et al., 2014: p. 47; Barakabitze, Kitindi, Sanga, Kibirige, & Makwinya, 2015; GESCI, 2011b; Hooker, Mwiyeria, & Verma, 2011: p. 16). Most of the government secondary schools in Tanzania have poor information and communication Technologies infrastructure. However, the Ministry of Education and Vocational Training (MoEVT) priorities on ICT use in education has been Teachers' Colleges followed by secondary schools (United Republic of Tanzania, 2010d: p. 38). It is unknown how student teachers leaving colleges are using their ICT knowledge and skills when they enter the job market as professional teachers and technology use ambassadors (Andersson et al., 2014: p. 49). In most African countries, top constraints to the use of ICT for teaching and learning are lack of financial resources, lack of appropriate hardware and software and the internet bandwidth constraints (Isaacs, 2013: p. 20).

There are many other factors hindering the ICT use in secondary education. These include technology affordability and accessibility, lack of Government ICT4E policy awareness, lack of public community ICT facilities, teachers' attitudes, pedagogy, skills, knowledge and beliefs about ICT, and students' ICT literacy. Other hindrances also include political, corruption and economic factors, lack of effective leadership, work ethic and human capacity. (Barakabitze, 2014; Kessy et al., 2006; Swarts & Wachira, 2010). Moreover, lack of access to multimedia classrooms and internet connections that could deliver online educational resources to learners constitute other constraints (Barakabitze et al., 2015; Farrell et al., 2007; Ndibalema, 2014). Furthermore, there are shortage of ICT based competent teachers and eBooks (Andreas, 2012; Froelich, Bourdon, & Michaelowa, 2007; Kangai & Bukaliya, 2011). Currently, no framework that has been developed to create a road map that responds to the ICT policy for basic education on the use of pedagogical ICT tools in secondary education (Swarts & Wachira, 2010; United Republic of Tanzania, 2003b, 2013b). As opposed to traditional teaching and learning currently being used in Tanzania, online educational resources, digital contents and technologies are not sufficiently exploited (United Republic of Tanzania, 2007, 2008b).

1.3 The need for ICT use in Tanzania Secondary Education

In Tanzania, application of pedagogical ICT tools in secondary education is considered as a necessity (Barakabitze et al., 2015; United Republic of Tanzania, 2007, 2010b). According to the basic education statistics report (United Republic of Tanzania, 2013b) Tanzania has experienced an increased number of secondary schools (19.2 %) and students enrolment (54.8 %). In contrast, the teacher-student ratio in mathematics and Science subject also continued to increase yearly. The most reported critical challenges facing the education sector in Tanzania are shortages of text books and teachers in science subjects. These are viewed to have contributed to the poor performance in the form four (IV) final examinations, mainly Basic Mathematics and Science subjects (United Republic of Tanzania, 2013b).



Source of data: MOEVT, Basic Education Statistics in Tanzania (BEST), 1998-2012.

Figure 1.1: Form Four student's Performance Trends

Such alarming challenges can be minimized with exposure to the relevant information technologies that augment competence based learning skills (Ardaiz-Villanueva et al., 2011). However, technology changes teachers' roles from a centralized position to that of a decentralized position, but can never replace teachers (Chin & Hortin, 1993). The ubiquity of digital technologies provides new ways of thinking, collaborating and communicating for people of all ages and abilities (Aceto, Borotis, Devine, & Fischer, 2013; Andrade, 2010). Potential pedagogical ICT users in schools, should stop seeing ICT as subsidiary classroom tools that teachers need to add-on, adjunct rather than as a part and parcel of the learning process (Inan & Lowther, 2009; Kessy et al., 2006; UNESCO, 2005). The integration of ICT into teaching and learning always has placed pedagogy over technology (Means, Olson, & Singh, 1995; Okojie, Olinzock, & Okojie-Boulder, 2006; Scott et al., 2002; Venezky, 2004). The notion of skills for mastering hardware and software is not enough; potential users should have the ability to organize the classroom tasks so that ICT resources become automatic and natural response to the requirements for learning environments in the same way teachers use markers and whiteboards in the classroom (UNESCO, 2005).

1.4 Transformative Influence of ICTs in Education

Effective classroom technology integration requires not just content, technology and pedagogical knowledge, but also their relationship. The level and impact of ICT in education and the possible benefits to learning are very dependent upon the availability of ICT resources in schools (Chukwunonso, Ibrahim, Selamat, Idama, & Gadzama, 2013; Condie & Munro, 2007; Cox, 2013; Inan & Lowther, 2010; Kozma & Vota, 2014; Nagel, 2013; Punie, Zinnbauer, & Cabrera,

2006). Teachers who favour ICT are likely to have well developed ICT skills and to see ICT as an important tool for learning and instruction. The growth of ICT and its abilities to enhance diversities of knowledge and information transfer allows teachers and students to have access to a rich nature of the worldwide web educational resources beyond the classroom (Kozma, 2005; Lim, 2006; McKenna & Williams, 2015; Trucano, 2012; UNESCO, 2012b). As a result of the rapid changing in the uptake of digital educational resources, research into ICT in education should focus on continuous innovation, where pedagogy can be transformed using new digital contents and online educational resources (McDougall, Murnane, Jones, & Reynolds, 2010: p. 154). Fully utilisation of ICT in education can connect learning beyond the school walls, support efficient communication and collaboration with the wider school community, and connect students and staff to external knowledge and learning networks (OECD, 2009). The term ICTs have been described as the tools and the processes to access, retrieve, store, organise, manipulate, produce, present and exchange information by electronic and other automated means (UNESCO IITE, 2004, 2012) . According to Shulman as reported by Cox et al. (2003), teachers' knowledge bases include the following categories of knowledge: content knowledge, general pedagogical knowledge, curriculum knowledge, pedagogical content knowledge, knowledge of learners and their characteristics, knowledge of educational contexts (e.g groups, classes) and the knowledge of educational ends, purpose and values and their philosophical and historical grounds.

The best aspects to describe the environment in which teachers practice technology are knowledge of the curriculum, pedagogical competence, attitude towards technology, content knowledge and the cognitive skills for effective use of educational technology. In addition teachers should have knowledge of infrastructure (hardware and software), perception of school as a learning organization where both teachers and students remain learners at some point and the understanding of the learners and their social backgrounds. In education, ICT tools can simulate ideas, organise and present resources of libraries and laboratories (Daanen & Facer, 2007b). It has the power and potential to transform traditional teaching and the process of the learning environment and envision a new learning culture showered by interactivity, flexibility and convenience (Backhouse, 2003; Hofer, Grandgenett, Harris, & Swan, 2011; Keeler, 2008; Lawrence, 2012; Tondeur, Van Braak, & Valcke, 2007). Examples of the ICT potentials are, firstly, it helps to access, explore and represent information dynamically and in multi-modal

forms (Majumdar, 2009; Miao, 2009). Secondly, ICT serves for flexibility of spatial and temporal dimensions changes the way the teacher teaches and the learners learn. Thirdly, it has the potential to open up immense opportunities for the learners to access, extend, transform and share information and ideas at their own pace and time (UNESCO, 2005). The real power of ICT could be revealed when used as a tool to prompt and inspire critical thinking and creativity, it is meant for not just memorizing or engaging with technology for the sake of activity, but for enhancing meaningful learning that promotes learner centred principles (Fryer, 2005; Hew & Brush, 2006; Mwiyeria & Zelezny-Green, 2014; UNESCO, 2005). When ICT is integrated in the curriculum, learners are given more responsibilities for their own learning (Hicks, 2011; Livingstone, 2012; McFarlane & Sakellariou, 2002; Trucano, 2009; J. Voogt, Knezek, Cox, Knezek, & ten Brummelhuis, 2013). ICT enhances deeper understanding of learning and provides tools for collaborative learning environment, where learners are encouraged to construct, evaluate, manipulate and present their ideas and knowledge that inspires creativity, stimulates curiosity and develops skills of innovation (UNESCO, 2005). Integrating technology with classroom practices enhance students engagement by linking them to a global audience, becoming creators of digital media, and practice collaboration skills that prepare them for the future (Warter-Perez & Dong, 2012).

1.5 Research Problem

There are several worst practices in information and communications technology (ICT) use in education that have restricted most developing countries from succeeding in technology use. These include dumping hardware in schools without relevant pedagogical educational contents, adopting ICT-related models and practices of the developed nations hoping for them to work and lack of clearly defined ICT in education implementation plan and frameworks (Trucano, 2010). Teaching and learning are both changing. A fundamental force in bringing about this change is the use of ICT, which delivers richer, more immediate, access to relevant open educational resources and opportunities. When used well, ICT augments learning and improves teaching. It invigorates classroom activities and is a powerful motivational tool that encourages teachers and learners to progress in more personalized and self-directed ways.

In Tanzania, the Government's efforts to deploy pedagogical ICT contents in secondary schools have focused much on infrastructure and technology rich educational contents that could enhance teaching and learning opportunities (Andersson et al., 2014). The challenge lies in shifting from

teaching and learning about ICT to teaching and learning with and through ICT. This means when teacher trainees are taught to use technology to do old things in new ways, they miss doing new things in new ways that could enable and transform teaching, learning and the curriculum. Learners need opportunities to reflect on the new material, discuss their tentative understandings with others, actively search for more information to throw light on areas of interests or difficulties and build conceptual connections to their own existing knowledge base. With the current advancement of shared global educational resources, knowledge and collaborations there are new learning opportunities beyond the traditional-book-teacher model. In order to transform today's secondary education into suitable 21st century education settings, schools' demand for rich digital contents that goes far beyond digitized print textbooks.

Engaging learning with mixed media can support the kind of learning that stimulates cognitive processes and encourages students to achieve more than teachers expect. Mobile devices, tablets, e-readers, laptops and computers enable students to access digital contents anywhere, anytime. Digital learning objects, lecture capture, education applications, content repositories, online videos, and social media provide students with an interactive, engaging learning experience. Projectors, interactive whiteboards, content filtering, and content management systems support digital curriculum. The internet has opened wide opportunities for technology-supported learning re-setting the boundaries of educational possibilities through blended learning implementation. Currently, in Tanzania there is lack of technical documentation on how these tools could be enhanced in Tanzania secondary schools.

Effective use of online educational resources and e-learning in developing countries could only be realized when the ICT use in education and related policies, the policy vision strategic implementation plan and frameworks are harmonised (Manji, Jal, Badisang, & Opoku-Mensah, 2015: p. 9). The concept of online resources and e-learning implementation in the education system should begin with the teacher and the ways in which teachers teach. In Tanzania, the penetration of ICT has significantly increased; however, its integration as classroom tools has been very slow. The inhibiting obstacles to the ICT penetration in education initiatives are mostly related to: (1) policy, (2) economical, (3) social change and belief, (4) knowledge and skills, and (6) technology-infrastructures availability. Recently, the UNESCO Institute for Statistics (UIS) reported Tanzania as among twenty one countries in sub-Saharan Africa without

ICT policy implementation strategic plan (UNESCO, 2015: p. 9). Across the country, there is teaching and learning about ICT but less of classrooms ICT pedagogical applications. However, few secondary schools have hardware and e-contents adopted from elsewhere; traditional teaching and learning approaches that do not borrow use of modern technologies still prevailed. Past studies focused much attention on fiscal resources, learning content, user attitudes, and financial sustainability; however, the biggest challenge to effective online education resources and e-learning implementation is poor practices and lack of good understanding of the overall end-to-end chain of e-learning projects. In many cases, there has been lack of proper and clear systems for harmonizing the projected education objectives and the ICT use strategic plan. Decision makers think that availing ICT hardware in schools solves everything, off-the-shelf practices can always work, e-content can be planned for later and get imported. A harmonized framework which sets priority to the availability of ICT in education implementation strategic planning is a must. In this study, we proposed a roadmap that should harmonise key requirements and avoid wasting resources, time, and efforts of various ICT use players and decision makers.

1.6 Objective

1.6.1 General Objective

To explore accessibility of online educational resources and e-learning enhancement requirements in order to design a framework that could work as a roadmap for ICT in education implementation. The name of the framework presented is “Online Resources and E-learning Implementation (OREI)” framework in Tanzanian secondary schools.

1.6.2 Specific Objectives

The following specific objectives were of primary focus for this study:

i. To critically examine issues associated with teachers readiness to use online educational resources and support eLearning implementation in Tanzanian secondary education

ii. To assess ICTs Opportunities and Re-use complexities of online resources and elearning in Tanzanian Secondary education

iii. To explore online resources and eLearning enhancement requirements, and design a framework that could work as a roadmap for ICT in education implementation

iv. To evaluate the framework based on SWOT (Strength, Weakness, Opportunities, and Threats) analysis of the ICT use in Tanzanian secondary education.

1.7 Research Questions

We used the following research questions to realize the above specific objectives:

i. How supportive are the secondary school resources (human and ICT infrastructure) for online digital educational resources sharing and blended learning implementation?

ii. What are the opportunities and challenges facing ICT integration in the secondary schools' teaching and learning process?

iii. What are the critical requirements that could support online educational resources and the e-Learning models implementation in Tanzania secondary schools?

iv. What are the Strengths, Weaknesses, Opportunities, and Challenges which the online resources and eLearning implementation framework needs to consider?

1.8 Significance of the Study

Students mainly learn through interactions with people (teachers and peers) and instructional materials (textbooks, workbooks, instructional software, web-based content, homework, projects and quizzes) (Chingos & Whitehurst, 2012). The frameworks and domains within which these interactions occur are surely important. To promote and incorporate e-learning in secondary education, the Tanzania Secondary Education Development Plan (SEDP II 2010-2015) (United Republic of Tanzania, 2010c) emphasises on increased access and use of ICT in secondary schools and teacher training colleges by the year 2015. Most of ICT in education projects have been implemented without strategic plan and framework to guide the online resources and the e-learning implementation as primary goals (United Republic of Tanzania, 2011).

The World Wide Web is now a primary information repository for the education industry; a vast digital library of documents, multimedia elements such as still images and graphics, video, virtual reality, animations, simulations, audio, music, interactive, and gaming elements, covering a multitude of subjects, levels of study and application areas (OECD, 2007). Despite the current advancement in the web services, the Tanzania secondary education communities lack access to relevant educational web resources and technological infrastructures. The current digital technologies have revolutionized the way people communicate and learn, causing many

education experts to re-examine the role of print content in the classroom (Intel Corporation, 2010). Rich digital educational contents are powerful way of providing students with high quality, relevant and up to-date educational materials. The use of Web 2.0 content and social media tools have continued to increase and extended learning beyond physical learning spaces (Skaug, 2012). Ways to ensure that teachers and learners can reliably determine, collect, share, download, and fully explore online educational resources must be found. The Vision, competency, and technology designed with usability in mind are necessary in order to make permanent changes in the process of teaching and learning (Fetaji & Fetaji, 2007; Skaug, 2012; Tondeur, van Keer, van Braak, & Valcke, 2008). As the pressure heightens for teachers to better understand new ways to integrate technology into their existing teaching practices, billions of Tanzanian shillings and numerous resources are often put into hardware, software and professional development and training-often without consequential results (Andersson et al., 2014; MoEVT, 2011; United Republic of Tanzania, 2011). Despite these investments, in many classrooms and contexts across the country where the ICT projects have been carried out, technology integration remains in basic levels of use.

The practice of blending different learning approaches, strategies, and opportunities with modern technologies is not new. Many Governments are having frameworks to lead and guide the use of pedagogical ICTs and blended learning from early years of studies to the advanced levels (ACARA, 2013; Farrell & Isaacs, 2007; Mägi, 2009; Malaysian Government, 2012a; UNESCO, 2012b). The most effective teaching and learning have always involved the use of different methods, approaches, and strategies to maximize knowledge acquisition and skills development (Allen et al., 2007; Armstrong, 2012; Wood et al., 2003). Effective teachers will always use more than one method or approach in their teaching, and good learners will always combine different strategies in learning (Ahrens & Zaščerinska, 2014; Alesandrini & Larson, 2002; Andreas, 2012). Good programs of study combine lectures, seminars, group projects, placements, and so on to offer students a variety of different learning opportunities. “Traditional” distance learning courses have long provided blended learning through a combination of self-access content (print/video/TV/radio and face-to-face / telephone support) (Skaug, 2012).

Today’s students are part of a digital generation. The use of pedagogical ICTs in secondary education can reduce teachers’ isolation, widening opportunities to access teaching and learning

resources, and improve teachers' competences (United Republic of Tanzania, 2011). The first official secondary school computer studies syllabus for forms I-IV was developed in 1996 and issued in 1997 (United Republic of Tanzania, 2003b: p. 9). Despite of existing challenges, there are various government's efforts to promote pedagogical ICT tools applications in educations. The lack of supportive infrastructure, resources and programmes for training teachers on relevant pedagogical ICTs and other multi-media utilization were identified as major reasons for slow take up of ICTs in secondary schools (Andersson et al., 2014). Currently, there is no official ICT integrated curriculum for secondary schools; teaching with pedagogical ICT tools depends very much on the competencies of the teacher. Like in other developing countries, in Tanzania, hardware have been dumped in schools without relevant pedagogical ICT tools that teachers and students can use in the process of teaching and learning (Trucano, 2010, 2012).

One of the common predicaments for the Tanzanian secondary education ICT initiatives is how to identify best approach leading to the use of relevant e-contents. Tanzania as a nation lacks a framework that could work as a roadmap for all the ICT in education initiatives. The framework should guide the planning, development/ adoption and deployment of relevant e-contents and assume the level of technology for supporting a continued access to the most relevant pedagogical ICT resources. In order to transform today's classrooms into appropriate 21st-century learning environments, students should be exposed to the rich e-contents that goes far beyond digitized print textbooks. Rich e-contents can take many forms, such as packages that are built upon textbooks, with teacher's guides, assessments and multimedia e-contents all included and aligned to the teaching and learning standards. They can be created in open source format, by a variety of experts, or can be drawn from multiple sources- subscriptions, free online resources and other digitized material-customized locally to meet the needs of a particular classroom or level of study. The most effective e-contents learning environments bring together the three C's of consumption, collaboration and creation that Bitner & Bitner (2002) reported that they could support:

- Empowering teachers to become creators of digital learning resources and not only consumers;
- Allowing access to online and offline digital educational resources that are flexible and adaptable, allowing students to learn at their own pace, and in their own style;
- Offering opportunities for users to select and modify e-contents as desired;

- Offering opportunities for students to share ideas and collaborate with one another through such tools as wikis or social/academic networks;
- Challenging and motivating students to create their own meaning in the form of blogs, multimedia presentations, or other relevant content that builds on what they have learned.

The use of ICTs in education is now a world agenda where many countries are revising their curriculum at all levels to accommodate the use of e-contents. The use of ICT has changed the ways that people share, use, develop and process information.

The above mentioned reasons have prompted this study to visualise the demand for strategy design that could support online educational resources sharing and eLearning implementation. This study presented a framework that could work as a road map for planning and deployment of hardware, software and relevant technology in schools that are aligned to the relevant classrooms pedagogical ICT practices. The government can then align the educational vision and the ICT strategy that focus on designing learning activities. The designed framework business model will guide the government steps by step that leads to the availability of useful hardware and software and gradually enhance the use of online educational resources and best e-learning model in teaching and learning processes. Apart from materials availability, teachers will be motivated to use best practices from the availability of numerous blending options that cover simulations, animations, lecture videos, tutorials; project based learning activities, audios, offline and online instructional materials.

Since the use of online educational resources and e-learning in developing countries can best be suited to blended models of learning, availability of the blended curriculum is potential. The output for this study will be used as a reference for benchmarking and formulation of other digital contents application frameworks and policies that emphasize on the use of online education resources and e-learning models. The digital educational resources, referred in this study inspires the availability of the digital curriculum that has the power to promote student centered learning and empower students with the highly demanded competence based learning skills that could be enhanced through the proper use of online resources and e-learning models.

1.9 Delimitations

The scope of this study was limited to the Ministry of Educational and Vocational Training. People involved in the data collection were secondary school teachers and students, teachers' training college tutors and teacher trainees, MoEVT head office officers (teacher training unit and secondary education unit), Tanzania institute of education officers, and the schools' inspection officers. Teachers' readiness, attitudes, knowledge, skills, competences, and abilities to use pedagogical ICTs and influence the use of online educational resources and e-learning models in the classroom practices were of primary focus. Similarly, the study assessed the opportunities and re-use complexities of online resources and elearning secondary education. In addition, the study explored the requirements for the design of an online resources and e-learning framework that could work as a roadmap for ICT in education implementation. The framework evaluation was made based on SWOT (Strength, Weakness, Opportunities, and Threats) analysis of the ICT use in Tanzania secondary education system. The study involved teachers and students from the ordinary level secondary schools. The study focused on the practices for the systematic implementation of the ICT in education projects.

The optimum objective for the study was to design an integrated framework for online resources and e-learning implementation (OREI) for Tanzanian secondary education. However, the findings that resulted into the framework and its business model we designed may not be generalizable to the education systems in other developing countries. The empirical data for this research were collected from Morogoro region because it was easy to access the teacher training college that specialized in the science subjects, two schools that have previously participated in two different ICT projects, day, and boarding schools both with characteristics that could be generalized to other parts of the country.

1.10 Dissertation Summary

Chapter one is a general introduction to the whole study, which introduces the dissertation contextual background by discussing the importance of digital contents and blended learning implementation in secondary education. The chapter described the goal of the study that includes the problem definition, research objectives, research questions, study significance, problem statement, research design, and the methodology. Then we finally present brief description of the key theoretical terms, the research contributions, and the dissertation outline. **Chapter two**

presents literature on key concepts that covers theories and terminologies related to digital educational resources, blended learning in a more extended details. Some of the concepts defined in this chapter are the concepts of blended learning curriculum, flipped classroom, instructional designer, educational technology, and the systems approach to instructional design. In addition, pedagogical skills for the 21st century, inquiry based approaches, web-based educational resources, cloud computing and educational benefits, web 2.0 tools and education and the linkage between learning theories and pedagogical approaches are explained. **Chapter three** examines teachers' readiness to accept the use of digital educational resources and blended learning implementation as the main objective. We first assessed teachers' readiness to accept blended curriculum contents and, second, examined external and internal challenges that hinder classroom digital educational resources application. Parameters this chapter assessed were (1) teachers' ICT knowledge level and how it contributed to the blended learning implementation, (2) teachers digital educational resources actual classroom use geared by ICT knowledge level (3) teachers' digital educational resources adoption preparedness and the actual classroom practices, and (4) the challenges for implementing blended curriculum contents in schools. **Chapter four** presents results for the assessment of the classroom ICTs integration opportunities and the challenges in relation to the Technological Pedagogical and Content Knowledge (TPACK) and SAMR (Substitute, Augmentation, Modification, and Redefinition) models. The case study involved tutors and teacher trainees from teacher training colleges. **Chapter five** presents key factors that enhance sustainable eLearning initiatives planning and implementation. The seven OREI framework design requirements were identified as government support, infrastructures, the technology, policies and guidelines, training and recruitment, stakeholder's involvements, and the monitoring and evaluation. In **Chapter Six,**following the theoretical background, the chapter discusses the proposed framework and a set of steps to guide the implementation. The study formulated the framework practices and the levels of implementation precedencies using Matlab tools, and used Unified Modeling Language (UML) artifacts to present a business model for planning, implementation, and evaluation for the framework. The description of the framework dimensions, measures, and interrelationships was made using UML Use case and Activity diagrams. **Chapter Seven presents the** evaluation of the OREI framework using SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis. The framework was assessed using data collected from policy makers, teachers, tutors, teacher trainees and school students, and the findings reported. Finally, implications for research and

framework practice were presented. **Chapter eight** summarises the discussions of major findings in response to the research questions and the contributions to the field of e-learning, reflects the study objectives in relationship to existing education system and concludes the research. Future research directions and prospective improvements are presented in the concluding section.

CHAPTER TWO

Description and Definition of Theoretical Terms

Summary

This chapter presents descriptions and definitions of the theoretical terms that cover several concepts used in this study. The chapter describes key concepts that cover the domain for this dissertation. Some of the concepts defined in this chapter are the concepts of e-learning models, instructional designer, educational technology, and the systems approach to instructional design. In addition, this study explained the web-based educational resources, cloud computing, web 2.0 and their linkages to the learning theories and pedagogical applications.

2.1 Educational Resources Metadata

One of the design and users requirements of today's World Wide Web is to provide mechanisms that store, manage and discover resources in an efficient way. Metadata is data about data, or a piece of information that describes another piece of information and provides key information about resources to support their recovery and management (Duval, Hodgins, Sutton, & Weibel, 2002; Robertson, 2011; Wantz & Miller, 1998). Educational metadata is a specific type of metadata for describing the educational use of a resource (Robertson, 2011). This is also essential for all kinds of digital contents and resources available on the web that are increasing at an extremely rapid rate (Duval et al., 2002; Koutsomitropoulos, Solomou, Papatheodorou, & Alexopoulos, 2010). In the educational sector, metadata are used in a wide range of content and tools, including library catalogues, digital libraries, virtual learning environments (VLEs), and content management systems (Robertson, 2011). The traditional search and navigation techniques of the Web are wholly user-directed which lead to the burden of pruning the search space (Wantz & Miller, 1998).

2.2 Sharable Content Object Reference Model (SCORM)

The SCORM integrates a set of related technical standards, specifications and guidelines designed to meet the high-level requirements of accessibility, reusability, interoperability and durability of content and systems (Advanced Distributed Learning (ADL) initiative, 2011). The SCORM presents a technical standard for writing e-learning content (Chou & Liu, 2005; Northrup, 2007: p. 126). It is for standardizing the way web based content works with the systems that use the content and the Virtual Learning Environments (Warwick Bailey, 2005; Collier & Robson, 2002). It is a set of technical standards for e-learning products that tells developers how to write code so that it works with other e-learning software (Iverson, 2015). The SCORM is all about creating units of online educational materials that can be shared across Learning Management Systems (LMSs) (Aroyo, Pokraev & Brussee, 2003; Balci & Inceoglu, 2007; Vossen & Westerkamp, 2006; Welsch, 2002).

Table 2.1: SCORM High-Level Requirements (ADL initiative, 2011)

Requirement	Explanation	Example
Accessibility	Contents can be located and accessed from multiple locations and delivered to other locations.	A content author can search the ADL Registry, other registries, and repositories, and identify relevant content that has already been developed, possibly even by another organization, and deploy that content on an LMS to learners anywhere in the world.
Interoperability	Content operates across a wide variety of hardware, software, operating systems, and web browsers regardless of the tools used to create it and the platform on which it was initially delivered.	Contents packaged for delivery in one SCORM-conformant LMS can be loaded into another SCORM-conformant LMS for delivery to learners.
Durability	Content does not require modification to operate as versions of software systems and platforms are changed or upgraded.	Upgrades to local computers, such as changing to a new computer operating system, or server-side changes, such as upgrading to new versions of the LMS should have no impact on the delivery of content to learners.
Reusability	Content is independent of learning context and is able to stand alone. It can be used for many different learners.	E-learning contents designed for one organization can be easily redeployed, rearranged, repurposed, or rewritten for or by other organizations that have similar learning needs.

Standards provide the opportunity to coordinate and make independently created and run infrastructure, products, and systems compatible. Learning content is one of important components for e-Learning. The SCORM is widely accepted for establishing a distributed learning environment model that fosters the interoperability of learning tools and course content that should be universal, usable and accessible (Iorio, Feliziani, Mirri, Salomoni, & Vitali, 2008; Vossen & Westerkamp, 2006). Learning objects created and shared in a content creation module of a Learning Management System can easily be accessed, shared and reused (Balci & Inceoglu, 2007; Leong & Liu, 2007).

Table 2.2: What SCORM does and does not inform (ADL Initiative, 2011)

Topic	SCORM Does Not	SCORM Does
E-learning design	Dictate any particular instructional design methodology, pedagogy, design pattern, or any particular organization of content. Enable a designer, to create e-learning that could not be created using some other method. Refer to a file format, authoring tool, or programming language. Provide any guidance on any functional or instructional elements that make up and define the content, like learning objectives, assessments, or knowledge checks. Dictate the formatting or look and feel of screens and the elements on them.	Allows to implement instructional design in an interoperable way, including traditional teaching and testing strategies as well as complex simulations. Provide some affordances for design, but doesn't change the design process. Instructional systems designers (ISDs) will still create learning objectives that drive the design of the course.
Content reuse	Dictate the ways in which contents should be reused. Require that all contents be reused.	Enable the reuse of contents by defining standards for how content is structured.

Development tools	Recommend any specific tool, programming language, system, or learning technology architecture.	Simply defines the structure that the content you are placing inside an LMS should have, and how the LMS delivers that content.
	Define the additional features an LMS may have, such as authoring, classroom management, competency management, knowledge management, certification or compliance training, testing, personalization, mentoring, video conferencing, chat, and discussion boards.	Defines a technical organization, not an instructional organization. This technical organization is taken care of by the programmer or authoring system.

2.3 Virtual Learning Environment (VLE)

A Virtual Learning Environment is a collection of integrated web based tools empowering the administration of online learning, providing a delivery approach, student management and tracking, evaluation and access to online digital contents (Follows, 1999; Whitelock, Romano, Jelfs, & Brna, 2000). It is a set of teaching and learning tools designed to enhance a student's learning practice using computers, mobile devices and the Internet in the learning process (Stephen Brown, 2010; McKimm, Jollie, & Cantillon, 2003; Owston, 1997). It is a form of Learning Management Systems (LMS) designed to act as a focus for students, learning activities and their management and facilitation, along with the provision of content and resources required to help make the learning process more successful (Johnson & Aragon, 2003; Mimirinis & Bhattacharya, 2007; Mioduser, Nachmias, Lahav, & Oren, 2000). The principal components of a VLE package include curriculum mapping (breaking curriculum into sections that can be assigned and assessed), student tracking, online support for both teacher and student, electronic communication (e-mail, threaded discussions, chat, Web publishing), and Internet links to outside curriculum resources (Bower, Hedberg, & Kuswara, 2010; Brown, 2010; Dabbs, 2012; Hadjerrouit, 2010; Johnson & Aragon, 2003; Mimirinis & Bhattacharya, 2007; Mioduser et al., 2000). The most common examples of the VLE software packages are Blackboard and Moodle.

2.4 Content Management System (CMS)

The use of CMS essentially focuses on creating, reusing and locating, delivering, managing and improving content. A content Management system is a software platform that enables users to upload, modify, manage, and or delete digital content online (Baker, 2011: p. 54). It is a

computer application used to create, edit, manage, search, and publish various kinds of digital media and electronic text (Dobecki & Zabierowski, 2010; Naik & Shivalingaiah, 2009; Niederman, 2015). A CMS is responsible for the collection, management, and publishing of chunks of information known as content components (Naik & Shivalingaiah, 2009). The content management systems (CMS) are data repositories that may also contain authoring, sequencing, and content aggregation tools, with an objective to simplify the creation and administration of online content (Grant, 2010). A CMS is a software application that facilitates these tasks without the need for knowledge of HTML, Cascading Style Sheets (CSS), or any other web programming language (Kim & Moon, 2012; Naik & Shivalingaiah, 2009; Ogbuji, 2003; Sclater, 2008). The CMS can support content being created once (content components or Reusable Learning Objects) and used many times (Niederman, 2015). The CMS provide tight integration between authoring and the repository (i.e., a database that stores and manages pieces of information or learning) along with a powerful publishing engine (Lust, Juarez Collazo, Elen, & Clarebout, 2012). They can store and distribute the right content to the right learner at the right time. According to Samuels (Samuels, 2013), the term CMS is like the term "vehicle." Vehicle might actually refer to a bus, a tractor, a limousine, or a hovercraft–they are all machines that take people from one place to another. In the same way, a CMS is something that manages contents, but each type of content management system manages them for a different purpose and for different reasons. A CMS enables a variety of centralized technical and de-centralized non-technical staff to create, edit, manage, and finally publish in different formats, variety of content like text, graphics, video, documents etc. (Bergstedt, Wiegreffe, Wittmann, & Moller, 2003; Naik & Shivalingaiah, 2009; Niederman, 2015).

2.5 Learning Content Management Systems (LCMS)

The LCMS is a web-based e-learning application that allows an instructor to deliver standards-based learning content to communities of learners (Greenberg, 2002; Lugo, 2014). LCMS represents a multi-user environment where developers can create, store, reuse, manage, and deliver digital learning content from a central object repository (Grajek, 2013; Lugo, 2014; Samuels, 2013). The primary role of the LCMS is to manage digital contents used for developing learning artefacts. The LCMS provides a database called a learning content object repository that will save work done by authors as learning objects, which can be accessed by the same or other authors to develop new learning (Jurubescu, 2008; Prakash, Saini, & Kutti, 2009). An LCMS

allow online content to be stored, managed, and reused through integrated database functionality (Dobecki & Zabierowski, 2010). It is also considered as an environment where developers can create, store, reuse, manage and deliver learning content from a central object repository, usually a database (Ninoriya, Chawan, & Meshram, 2011). Using learning objects, the LCMS could deliver targeted learning and shortens a learner's time to proficiency (Jurubescu, 2008). Some good examples are Xyleme (http://www.xyleme.com/), Kenexa (http://www.kenexa.com) and AContent (http://www.atutor.ca/acontent/) are some examples of learning content management systems. An advanced LCMS tracks the user's interactions with each learning object and uses this detailed information to deliver highly personalized learning experiences while providing authors with rich reports for analysing the clarity, relevance, and effectiveness of content, so it can be improved on an on-going basis.

2.6 Learning Management Systems (LMS)

An LMS essentially helps manage an institutional learning activities and competencies. The activities managed by the LMS could vary from teacher-led classroom practices to educational seminars to Web-based online learning. From an end-user point of view, an LMS provides an effective way to keep track of individual skills and competencies, and provides a means of easily locating and registering for relevant learning activities to further improve the learner's skill levels ((Rengarajan, 2001). An LMS also provides access to online resources for which the user registers. Administratively, an LMS makes it easy to enter, track, manage, and report on learning activities and competencies in institutions. A learning management system (LMS) is a software application or web-based technology used to plan, implement, and assess a specific learning process (Alias & Zainuddin, 2005; Watson & Watson, 2007b). Typically, a learning management system provides an instructor with a way to create and deliver content, monitor student participation, and assess student performance online (Cavus, 2013; Mijatovic, Cudanov, Jednak, & Kadijevich, 2013). The LMS may also provide students with the ability to use interactive features such as threaded discussions, video conferencing, and discussion forums (Alias & Zainuddin, 2005). An LMS delivers content but also handles registering for courses, course administration, skills gap analysis, tracking and (Watson & Watson, 2007a) reporting. The LMS manages people's interactions with learning content. In other words, it allows learners to take courses and attend online events, instructors to track learners' progress and scores, administrators

to check reports, and more (Mijatovic et al., 2013).The LMS can support delivery, assessment, and reporting on the online training programs. In many cases, the learner can receive his or her LMS-generated certificate at the end of a course (Lugo, 2014).

2.7 Brief differences between LCMS, CMS and LMS

Learning Content Management Systems (LCMS) and Learning Management Systems (LMS) embody two different but matching product categories. Each has unique strengths and value propositions, and one does not replace the other. At the same time, a tightly integrated LCMS and LMS solution may offer unique benefits that surpass the value offered by each system separately (Rengarajan, 2001). LCMS allows the organization using it to create, store, reuse, and manage courses and training materials all in the same program (Grant, 2010). In short, with an LCMS you typically get all the features of an LMS plus the added benefits of a Content Management System (CMS) (Greenberg, 2002). The CMS are more focused on content, with a purpose to storing information and provide access to the information (Lugo, 2014). CMS is best at managing content, providing a database and capability to search for the content and a way to locate and deliver the content to the appropriate user (Samuels, 2013). The CMS stores and manages the content, but does not analyze, organize, or distil content into knowledge (Pérez-Montoro, 2011). Those tasks are the function of a Learning Management System (LMS) and/or Learning Content Management System (LCMS) (Ninoriya et al., 2011). Most LCMS provide basic LMS functionality, and many LMS include some aspects of content management systems as well (Jurubescu, 2008). Therefore, straight LCMSs do not offer the user interface that allows learners to interact with the content; usually they are accomplished via the LMS that is associated with the LCMS (Ninoriya et al., 2011). The LCMS provides a platform to manage all learning objects, organize them according to taxonomy, record metadata about each object and more (Lugo, 2014).

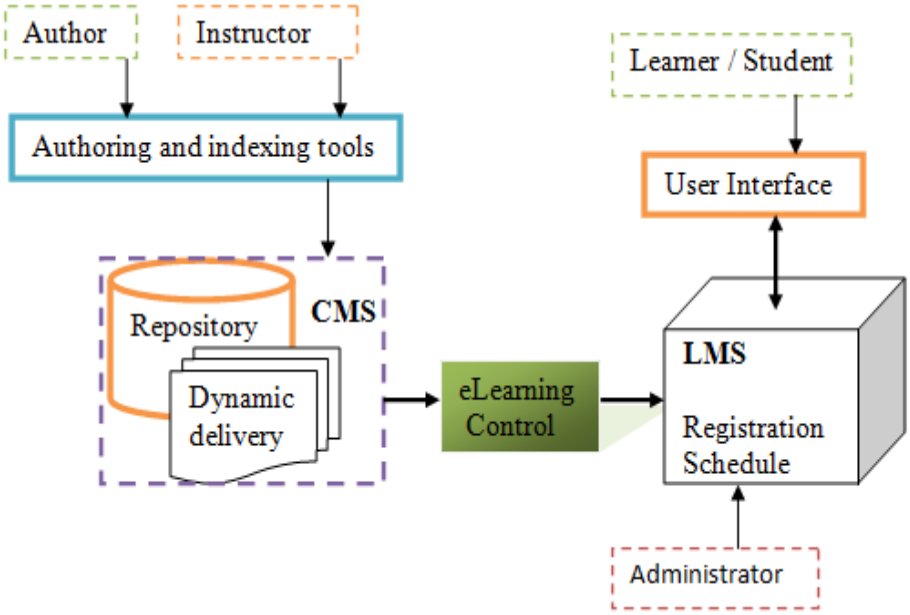


Figure 2.1: LMS and CMS Integration (Ninoriya et al., 2011)

According to Rengarajan (2001), an LCMS helps create, reuse, locate, deliver, manage, and improve learning content. Content is typically maintained in a centralized content repository in the form of small, self- describing, uniquely identifiable objects, or learning objects, each of which satisfies one or more well-defined learning objectives. Each learning object may have been created from scratch or by re-purposing existing knowledge documents in other formats. An LCMS may locate and deliver a learning object to the end-user as an individual unit to satisfy a job-specific need or deliver the learning object as part of a larger course, curriculum, or learning activity defined in an LMS. The LMS target user is the learner, while the LCMS target user is the learning content creator and the content itself (Dubowy, 2013). Content management systems create the framework in which content is stored and displayed on a website (Yang et al., 2008). These systems manage various content forms, including files, images, electronic documents, audio files, and many more. The CMS functions allow distributors to decide which content is displayed privately or publicly (Lust et al., 2012; Niederman, 2015). Content can be easily tagged using metadata, which is best for searching and using content quickly and efficiently (Dubowy, 2013). As opposed to a CMS, an LCMS is specialized for the creation and management of learning content.

2.8 E-learning and its Dimensions

The technological and infrastructural developments today support the argument that the future demands anywhere (mobile and ubiquitous) and anytime access to multiple resources online to almost inconceivably huge knowledge and learning space. With access to appropriately designed e-Learning approaches to any aspect of a target curriculum can provide significant opportunities for learners to create and acquire knowledge for themselves (Holmes & Gardner, 2006: p. 28).

E-learning offers new opportunities for teachers and students to enrich their teaching and learning experiences, through virtual environments that support not just the delivery but also the exploration and application of information and the promotion of new knowledge. E-learning is referred to as a form of web-based learning, online learning, distributed learning, computer-assisted instruction, or Internet-based learning (Piskurich, 2006). Studies show that, it has been difficult to distinguish the term "e-Learning" with "virtual learning", "network learning", "online learning", "multimedia-based learning", "Web-based learning", "Internet-enabled learning", and virtual learning environment (Alonso, López, Manrique, & Viñes, 2005; Brown & Voltz, 2005; Daniel, 2009; Downes, 2005; Knox, 2014; Mohan, 2004; Welsh, Wanberg, Brown, & Simmering, 2003; Zhang & Nunamaker, 2003). In e-leaning contents can be delivered via the Internet, intranet/extranet, audio or video tape, satellite TV, and CD-ROM (McPherson & Nunes, 2008). Computer-assisted instruction (also called computer-based learning and computer-based training) uses computers to aid in the delivery of stand-alone multimedia packages for learning and teaching (Henry, 2001). E-Learning is often seen as learning that depends on the Internet and the Web as enablers, it is also employed in a broader sense, as learning that any electronic technology could use, but it excludes aspects that might fit under "distance learning", but are not electronic, such as textbooks (Hadjerrouit, 2007).

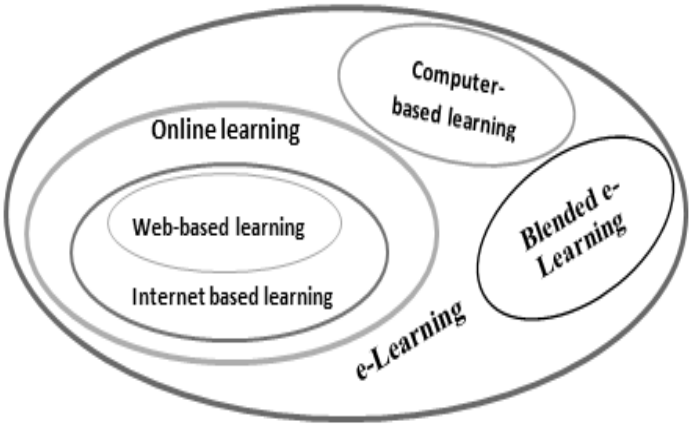


Figure 2.2: Technological dimensions of e-learning (Hadjerrouit, 2007)

E-Learning is therefore no more and no less than the combination and convergence of the most advanced features of digital information and communication technologies. For example, live broadcasts, mobile video and audio telecommunications, three dimensional (3D) graphics, email, the Web and object-oriented interfaces, all of which can be designed to support, create, and deliver significant educational experiences and environments (Holmes & Gardner, 2006: p. 29). As the technological dimensions of e-learning comprise (Figure 2.2 above) , the term e-Learning, can be defined based on the relationships between e-Learning and some closely related concepts: Internet-based learning, Web-based learning, online learning, and computer–based learning (Hadjerrouit, 2007): The concept of internet-based learning is broader than Web-based learning. The Web is only one of the Internet services that use HTML, web browsers, and the Universal resource locator (URL). Learning may take place via any electronic medium, not necessarily connected to a network. E-learning enables learners to have as much choice as is practically and economically possible.

Hence, e-Learning includes both network-based (online learning, Internet-based learning, and Web-based learning) , blended learning and non-network-based learning or computer-based learning (Brown, 2010; Queirós & Leal, 2010) . The cconcept of e-Learning is employed in a broader sense, as learning that takes place via a combination of face-to-face and e-Learning (Chinyio & Morton, 2006; McKimm et al., 2003). A mixture of face-to-face and e-Learning is known as hybrid or blended e-Learning (Armstrong, 2012; Christensen et al., 2013; Wood et al., 2003). E-Learning comes in many variations and often a combination of the following: Purely online - no face-to-face meetings, blended learning (online and face-to-face synchronous,

asynchronous, instructor-led group, self-study, self-study with subject matter expert, Web-based, Computer-based (CD-ROM), and Video/audio tape) (Lwoga, 2014; Sbihi & Kadiri, 2010; Zhang & Nunamaker, 2003).

2.9 Blended learning

The term blended learning has been defined as a formal education program in which a student learns at least in part through online learning, with some elements of student control over time, place, path, and /or pace (Staker & Horn, 2012a). Blended curriculum is the guide for practical implementation of blended learning. There are many definitions of blended learning yet no single accepted definition (Falconer & Littlejohn, 2007; Pankin, Roberts, & Savio, 2012). The Massachusetts Institute of Technology defined blended learning as a structured opportunities to learn, using more than one learning or training method, inside or outside the classroom (Pankin et al., 2012). Blended learning, includes different learning or instructional methods (lecture, discussion, guided practice, reading, games, case study, simulation), different delivery methods (live classroom or computer mediated), different scheduling (synchronous or asynchronous) and different levels of guidance (individual, instructor or expert led, or group/social learning) (Hughes, 2007).

The most important aim of a blended learning design is to find the most effective and efficient combination of learning modes for the individual learning subjects, contexts, and objectives (Marsh, 2012: p. 11). The major aim of blended learning is not to choose tools that are right, best or innovative as opposed to the traditional; but to create a learning environment that works as a whole. The blended learning toolkit (Table 2.3) categorized tools according to their purpose and design (Intel Corporation, 2012).

Table 2.3: Blended Learning Tools and Classroom use

Category	*Classroom Use*	*Tool Examples*
Curriculum Presentation Tools	Introduce course content through multiple learning modes.	Screencasts, Videocasts and Online Video Editors ,Podcasts and Audio Recording, Screen Sharing and Whiteboarding, Simulations, Web Conferencing , Photo Editing, Narrated Slideshows ,Bookmarking sites
Collaboration and Social Media Tools	Foster online communities of learners to enhance course content.	Blogs, Wikis ,File Sharing Sites, Collaborative Documents, Project Management, Concept Maps, Web Conferencing ,Social Networks and Microblogs,

		Bookmarking Sites
Digital Media Tools	Provide students with opportunities to create multimedia projects that showcase learning processes and outcomes.	Drawing and Graphics Creation, Photo Editing, Concept Maps, Videocasts and Online Video Editors ,Podcasts and Audio Recording, Presentation Tools, Animation and Comic Generators, Narrated Slideshows
Teacher Productivity Tools	Help teachers organize and manage blended learning environments.	Task Management, Online Calendars, Assessment Resources, File Sharing Sites, Wikis, Social Networks and Microblogs, Data Collection, Bookmarking Sites, Blogs.

(*Source: Intel Corporation, 2012)*

According to Aceto et al.(2013) there are clusters of blended learning supporting infrastructures and technologies. The cluster networked collaboration includes (Audio-Video-Web Teleconferencing, social networking, social software, social media, blogs and micro-blogging, online collaboration platform and tools, web 2.0, wikis, web 3.0, Semantic Web). The cluster content includes (Video/DVD, Digital Radio, TV/Digital TV, Podcasts, Repositories, Open Educational Resources, Content Management Systems, eBooks, Apps for Content Creation, Management and Sharing; eContent). Other potential tools are desktop computers, mobile devices, games and serious games, media creation and editing software, virtual reality, office suite software, simulations and animations software, cloud computing and the enabling infrastructure (broadband, Internet, Wi-Fi).

2.10 Blended Curriculum

Integrating technology in the classroom helps teachers to achieve the learning outcomes defined by the curriculum. Blended Curriculum (BC) allows the mixture of both traditional (face-to-face), and some online oriented activities and possibly flipping classroom learning techniques (Fryer, 2005: p. 7). Blended curriculum takes advantages of traditional face-to-face classroom methods and modern computer-mediated activities with technology-based materials playing a supporting role to face-to-face instruction (Henkel, 2010; Mulholland, Wolff, Zdrahal, & Collins, 2008; Shen, Wang, & Pan, 2008). It is the most prominent means for empowering leaner centered approach (Rose & Gravel, 2012; Wong, 2013).

2.11 Flipped Classroom-a Model for Blended Learning Curriculum

The flipped classroom, sometimes called the inverted classroom, is a pedagogical model which reverses what typically occurs in class and outside the classroom (Tucker, 2012). It is but one model of blended learning. Students prepare for class by watching video, listening to podcasts, or contemplating questions that access their prior knowledge; then class time is used to engage in activities such as problem solving, discussion, and analysis (Bart, 2014; Berrett, 2012). This is a learner centered teaching and learning approach where much work is done by the students (Borgen, 2013). Figure 2.3 summarizes components of flipped classroom.

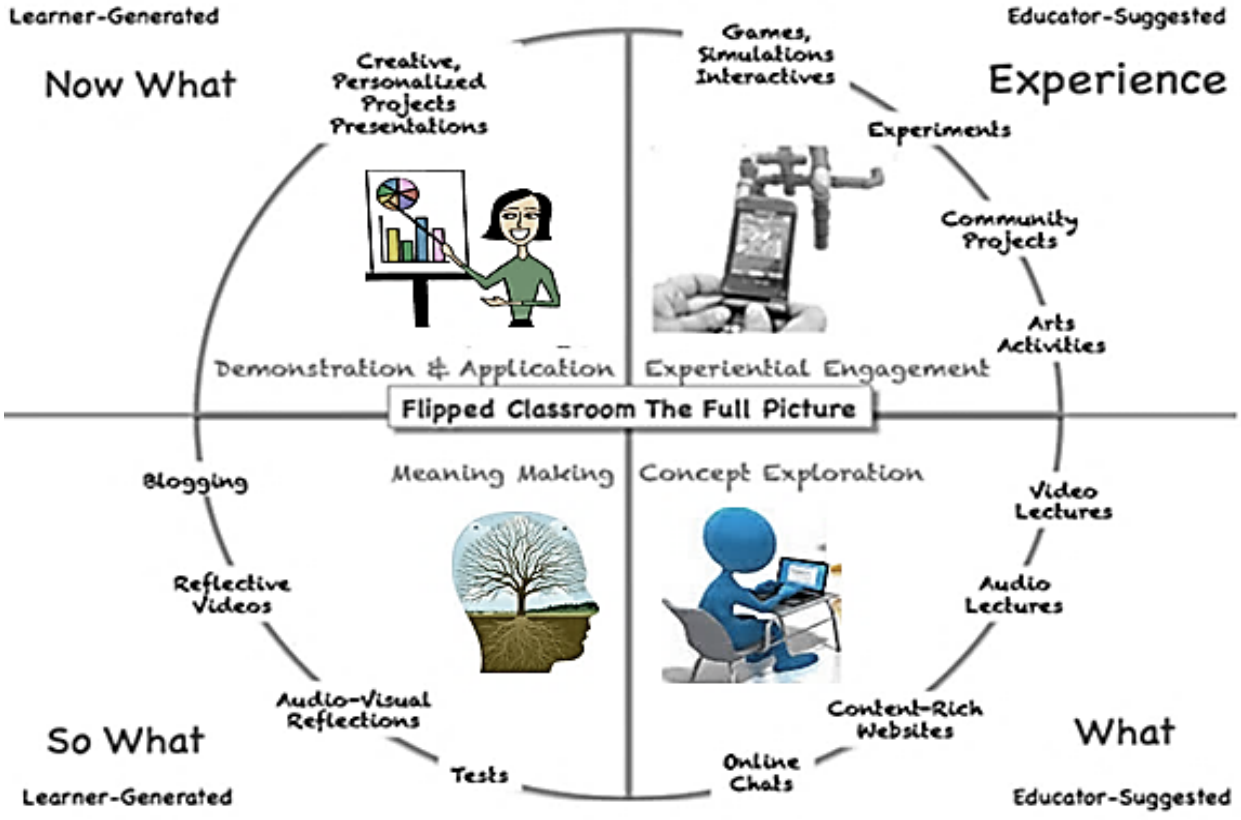


Figure 2.3: The Context of Flipped Classroom Components (Gerstein, 2012).

Flipped classroom model is the one initiated by the teacher with experiential engagement (in class) and concept exploration (online content) that leads to student-generated meaning, demonstration and application (project creation) (Berrett, 2012; Tucker, 2012). A flipped classroom experience has the potential to engage students where they are and with what they are interested to do (Ash, 2012). Taking these ideas a bit further, audio and video material can be

burned to CDs/DVDs so they can be accessed for students' home DVD players (Highfill, 2013). Classroom time is used for questioning and to deepen the knowledge, in a more personalized learning environment (Gerstein, 2013). The purpose of flipping the classroom is to shift from passive to active learning to focus on the higher order thinking skills such as analysis, synthesis, and evaluation (Bloom) (Datig & Ruswick, 2013; Hood, 2012; Musallam, 2013).

2.12 Web–Based Educational Resources

New web technologies have drove a revolution, not only in the way students consume and schools deliver education, but in the very idea of what makes a knowledge sharing (McArthur, 2002). At its heart is a move to make educational materials, from seminar notes to podcasts and videos of lectures, available online. Web-based educational resources (WBERs) are potentially powerful e-learning tools for enhancing teaching and learning processes in schools' education (Hanson & Carlson, 2005). They can provide teachers and learners with a wide range of new and exciting experiences that are not possible in a traditional classroom. They include materials for instructor-led classes, materials for self-directed computer-based training (CBT), Web sites that offer interactive tutorials, materials that are coordinated with distance learning, such as live classes conducted over the Internet, Videos for use individually or as part of classes (Tsai & Machado, 2012).

2.13 Cloud Computing

Cloud computing is a paradigm for accessing computing resources that can be grouped into three categories: software as a service, platform as a service, and infrastructure as a service (Armbrust et al., 2010; Grossman, 2009; Weave, 2013). It provides an innovative alternative to bricks-and-mortar schooling, enabling personal learning, interactive and collaborative learning and many-to-many learning regardless of geographical location (Cruz, 2011; Walter Bailey, 2012). Internet is the resource that cloud computing depends on, it delivers software and educational materials, hardware resources and services to students and educators without the need for advanced IT expertise at those locations (Stein, Ware, Laboy, & Schaffer, 2013; Weave, 2013).

2.14 Educational Technology

Educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources

(Association for Educational Communication and Technology (AECT), 1977; Hlynka & Jacobsen, 2009). As an academic discipline, educational technology prepares individuals to acquire a deeper understanding and mastery of learning resources (messages, people, materials, devices, techniques and settings), processes for analysing and devising solutions to those problems through research, theory, design, production, evaluation, utilization and the processes involved in organization and personnel management (Akkoyunlu, 2002; Spector, 2001; Wayne State University, n.d.). Within educational technology other domains of Instructional technology (IT) and instructional systems design (ISD) exits (Pershing, Molenda, Paulus, Lee, & Hixon, 2000). The terms in Figure 2.4 refers to: ET = Educational technology, IT = Instructional technology and ISD = Instructional systems design.

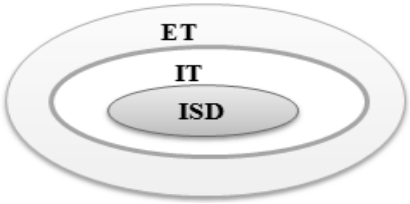


Figure 2.4: ISD, IT and ET Relationships (Pershing et al., 2000)

Educational Technology implies the use of all educational resources – Men, Materials, Methods and Techniques, Means and Media in an integrated and systematic manner for optimized learning (Parankimalil, 2015).

Instructional Technology is the theory and practice of design, development, utilization, management, and evaluation of processes and resources for learning (Aagaard, 1976; Anderson, 2009; Pershing et al., 2000; Wayne State University, n.d.). Instructional Technology's goal is to understand how people learn and how to best design instructional systems and instructional materials to facilitate that learning (Braden, 1995; Heinich, 1984; Kimmel & Deek, 1995). Instructional Technologists looks to understand performance problems and design solutions to those problems. Teachers could be introduced to various types of instructional software and web sites to learn how to effectively use them in the classroom (Kimmel & Deek, 1995; Smaldino, Lowther, & Russell, 2008: p. 9). As teachers gain momentum on how to integrate technology as an instruction tool, they could use multimedia, word processing, spreadsheets, digital cameras, scanners, web pages, electronic grade books, Internet, and e-mail more efficiently and productively.

2.15 Instructional Design Theory

This is the theory and practice of utilization, design, management, evaluation, and development of processes and resources (Dicks & Ives, 2008; Kanuka, 2006). Instructional design (ID) is an iterative process of planning performance objectives, selecting instructional strategies, choosing media and selecting or creating materials, and evaluation (Branch, 2009: p. 17). The ID process encompasses a set of interdependent phases including analysis of learners, contexts and goals, design of objectives, strategies and assessment tools, production of instructional materials, and evaluation of learner performance and overall instructional design effort (Chen, 2011). It is not just limited to software or hardware and not even on Internet applications. Instructional design can comprise a single set of instructional materials, one course, or an entire program or curriculum (Young, 2009: p. 19). The design begins with an needs assessment and task analysis data that are used to identify the areas of skill and knowledge gaps in which target users require training (Schade, 2000: p. 230). The discipline of instructional design is a branch of knowledge concerned with research and theory about instructional strategies and the process for developing and implementing those strategies (Goodman, 2009: p. xii). An instructional system is an arrangement of resources and procedures to promote learning (Edmonds, Branch, & Mukherjee, 1994; Fardoun, Montero, & López Jaquero, 2009). Instructional technology is the systematic application of theory and other organized knowledge to the task of instructional design and development.

2.16 Instructional Designer

An instructional designer is a person who creates and delivers educational training materials (e.g., eLearning courses, videos, manuals, hand-outs, etc.) for businesses, educational institutions and other organizations (Rowland, 1993; Seels, 1989). Instructional designer, designs instructional materials and helps people to make sense of these materials and online resources (Smaldino et al., 2008: p. 7; Christy Tucker, 2007). The purpose of the instructional designer is to draw the attention to all the small details and analyse all the bits, so the learners can see the bigger picture (Branch, 2009). In some cases the terms instructional designer, educational technologist, curriculum designer, and instructional technologist are interchangeably used to mean the same person (Reiser, 2001; Rogers, 2002; Seels, 1989; Young, 2009). Instructional designers and instructional technologists have similar job roles, functions, and career paths.

2.17 The Systems Approach to Instructional Design

The systems approach views a system as a set of interrelated parts, all working toward a defined goal. Instructional Systems Design, as the name implies, is a systems approach. As a single component of a system changes, other components in the system also have to change. Instructional systems design (ISD) is a field related to the application of technology for advancing human learning (Kirby, Hoadley, & Carr-Chellman, 2005). The instruction can be viewed as a systematic process in which every component contributes in achieving the goal of successful learning that may comprise of the learner, instructor, instructional materials, and the learning environment (Chen, 2011: p. 84). The most traditional instructional design approach is the ADDIE (Analyze, Design, Develop, Implement, and Evaluate) model. Another instructional design approach is the Agile model, whereby there are several variations, including rapid application development and rapid content development (Chen, 2011: p. 84). The ADDIE (Analyze, Design, Develop, Implement, and Evaluate) systematic approach to instructional development focused on construction of performance-based learning (Chyung, 2008: p. 90). The educational philosophy for ADDIE is that intentional learning should be student centered, innovative, authentic, and inspirational (Armstrong, 2004: p. 73).

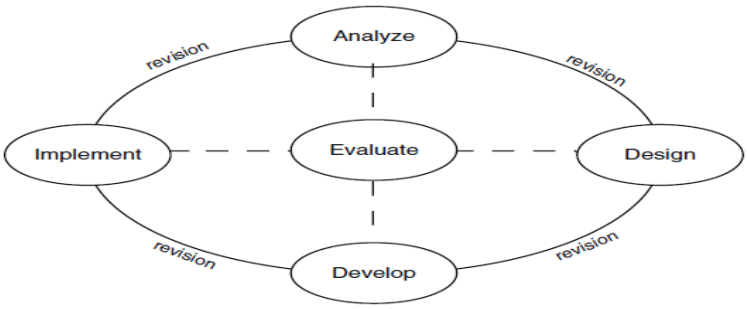


Figure 2.5: Non Linear ADDIE concept (Chyung, 2008: p. 91)

Each of the ADDIE process carried has to meet specific objective that adds value to the instructional design process. Figure 2.6 summarizes activities performed in each part of the ADDIE model.

	Analyze	Design	Develop	Implement	Evaluate
Concept	Identify the probable causes for a performance gap	Verify the desired performances and appropriate testing methods	Generate and validate the learning resources	Prepare the learning environment and engage the students	Assess the quality of the instructional products and processes, both before and after implementation
Common Procedures	1. Validate the performance gap 2. Determine instructional goals 3. Confirm the intended audience 4. Identify required resources 5. Determine potential delivery systems (including cost estimate) 6. Compose a project management plan	7. Conduct a task inventory 8. Compose performance objectives 9. Generate testing strategies 10. Calculate return on investment	11. Generate content 12. Select or develop supporting media 13. Develop guidance for the student 14. Develop guidance for the teacher 15. Conduct formative revisions 16. Conduct a Pilot Test	17. Prepare the teacher 18. Prepare the student	19. Determine evaluation criteria 20. Select evaluation tools 21. Conduct evaluations
	Analysis Summary	*Design Brief*	*Learning Resources*	*Implementation Strategy*	*Evaluation Plan*

Figure 2.6: Common ADDIE instructional design procedures (Branch, 2009: p. 12)

Applying the systems approach to instructional design allows the design process to be descriptive and prescriptive (Branch, 2009: p. 4). Using an instructional systems design process that is both conceptual and an application process means that different groups will apply the process differently although the fundamental components of the process remain the same (Ackoff, 1971; Gagne, Wager, Golas, Keller, & Russell, 2005; Martin & Clemente, 1990; Schiffman, 1986; Seels, 1989).

2.18 Web 2.0 Tools and Education Benefits

Web 2.0 tools and services allow web users to contribute as much as they can access, read and use. The term emphasizes on user-generated content, usability, and interoperability (Alexander, 2006; Jones & Cuthrell, 2011; Thomas & Li, 2008; Wanago, 2013). Media coverage of Web 2.0 concentrates on the common applications/services such as video sharing tools, social networking, podcasting, Wikipedia, Audio Editing tools, Bookmarking & Online Collaboration tools,

Blogging, online games & quizzes , instructional videos, online storage and sharing tools, photo editing tools and social networking tools—a more socially connected Web in which people can contribute as much as they can consume (Alexander, 2006; Anderson, 2007: p. 4).

Some other related terminologies are teacher 2.0 , student 2.0, classroom 2.0 both referring to the situation where Web 2.0 tools and social networking technologies are being used to support teaching and learning in classrooms (e.g. blogs and podcasts) (Banister, 2008; Light & Polin, 2010). The term E-learning 2.0 represent web 2.0 tools based on a process consisting of four iterative steps which are: grouping, collaborating, validating and publishing content that leaners can be engaged (Cristea & Ghali, 2011; Downes, 2005; Sbihi & Kadiri, 2010). School 2.0 and Education 2.0 refer to the web 2.0 tools that involves the development of ways of teaching and learning aligned with a sense of play, expression, reflection, exploration, and creating rather than consuming content only (Selwyn, 2012). Learning 2.0 means using social networking tools and opportunities for learning and/or education and training (Redecker & Punie, 2010).

2.19 Blooms Digital Taxonomy

The Bloom's taxonomy described educational objectives with levels of intellectual behavior that are important in learning (Forehand, 2010). The Bloom's digital taxonomy is an update to the Bloom's Revised Taxonomy, which lacked components that address the digital generation activities and behaviors (Churches, 2008). The Blooms taxonomy is made up by lower order thinking skills that adds value to the adjacent skill towards a higher order thinking skills.

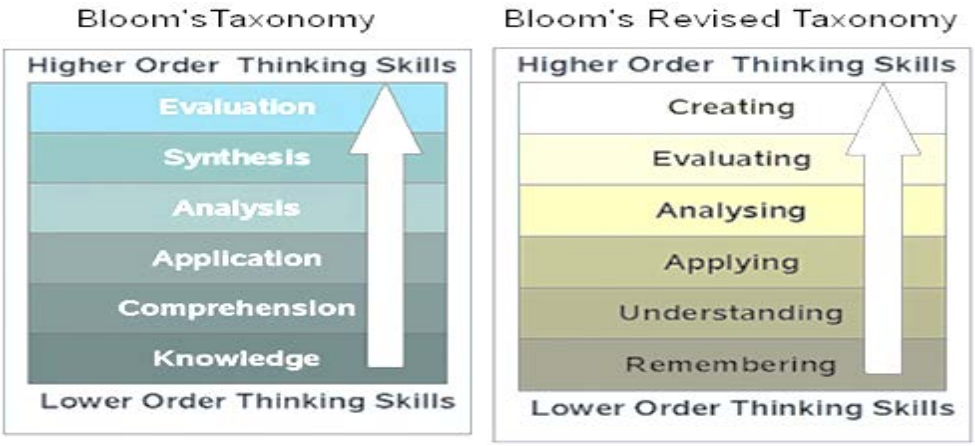


Figure 2.7: Bloom's Taxonomy and Bloom's Revised Taxonomy (Churches, 2009)

The Bloom's Revised Taxonomy describes traditional classroom practices, behaviors and actions, but does not account for the new processes and actions associated with Web 2.0 technologies, increasing global personal technologies or cloud computing (Krathwohl, 2002). The digital taxonomy describes new behaviors and actions emerging from technology usage in the learning process (Munzenmaier & Rubin, 2013). Bloom's Taxonomy in its various forms acknowledges the understanding of a concept as a source of remembering, similarly knowledge application, and concepts comes after understanding (Munzenmaier & Rubin, 2013). The Bloom's digital taxonomy added value to each cognitive level in Bloom's revised taxonomy, as shown in Figure 2.8. For example, retrieving information by bookmarking a site is a way of remembering, commenting on a blog post is a way of evaluating, and Blogging is a way of creating. What determines cognitive level is not the tool itself, but how the technology is used (Halawi, McCarthy, & Pires, 2009; Munzenmaier & Rubin, 2013; Skiba, 2013).

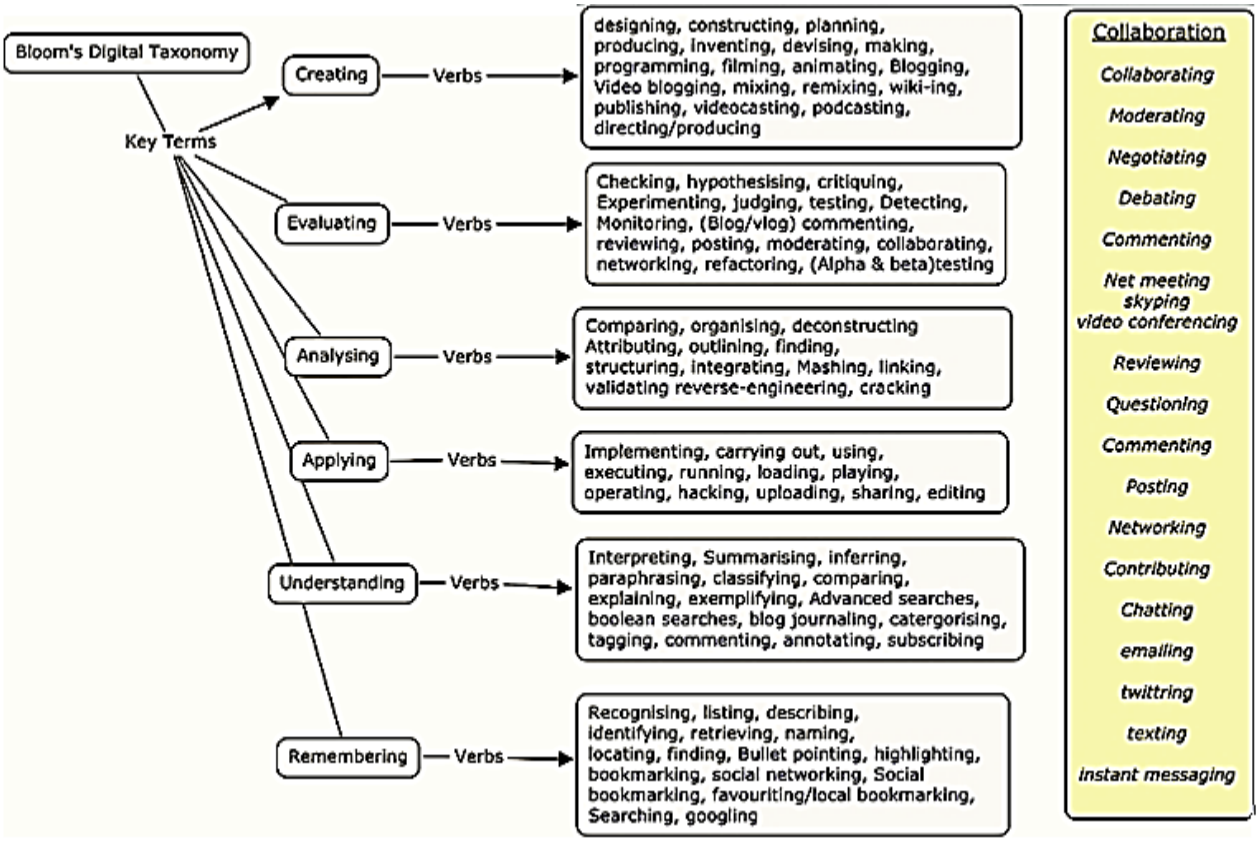


Figure 2.8: Blooms' Digital Taxonomy (Churches, 2008)

The Bloom's Revised Taxonomy (Churches, 2009; Forehand, 2010) from Lower Order Thinking Skills (LOTS) to the Higher Order Thinking Skills (HOTS) sub categories explained below are:

- Remembering - recognising, listing, describing, identifying, retrieving, naming, locating, finding
- Understanding- interpreting, summarizing, inferring, paraphrasing, classifying, comparing, explaining, exemplifying
- Applying- implementing, carrying out, using, executing
- Analysing- comparing, organizing, deconstructing, attributing, outlining, finding, structuring, integrating
- Evaluating- checking, hypothesizing, critiquing, experimenting, judging, testing, detecting, monitoring
- Creating - designing, constructing, planning, producing, inventing, devising, making

The digital age we live, demands learning in a collaborative environment where access to information is ubiquitous, involving active engagement of the student when comprehending information and recreating it into knowledge.

2.20 New Skills and Pedagogy for the 21st Century

The use of modern technologies in the teaching and learning approaches of today are on high demand. The 21st century learners are relational and demand quick access to new knowledge beyond the traditional reading, writing, and arithmetic (Blair, 2012; Wehling, 2007). They should develop critical thinking, creativity, communication, and collaboration (Brown, 2001; Turiman, Omar, Daud, & Osman, 2012). The 21st century demand knowledge and skills of information and communication, thinking and problem-solving, interpersonal and self-directional, and the skills to utilize numerous ICTs (JISC, 2006; OECD, 2006; Wehling, 2007).

2.21 Traditional Learning Approaches

In traditional learning a teacher and student physically interacts and sees each other, allowing the student to ask appropriate questions about the subject being taught. The most tools used as teachings aids include chalks and chalkboards, posters and physical demonstration. Traditional pedagogies, very often result in students being capable of solving “textbook problems” but unable to apply the knowledge to solve real life problems (Chang & Lee, 2010; Lam, Cheng, & Choy, 2010; Miller, 2013). Primarily, textbooks and workbooks are used while teachers disseminate information to students and students become recipients of knowledge (Chen, 2014; Sun, Flores, & Tanguma, 2012).

2.22 Project/ Problem-Based Learning (PBL)

Because technology is both highly customizable and inherently inspiring students, it is predominantly well-suited to expand the learning experience. According to the Ministry of Education Malaysia (2006), PBL is a model for classroom activity that shifts away from the usual classroom practices of short, isolated, teacher-centered lessons. Technology can equip students to independently organize their learning process. Therefore, instead of being passive recipients of information, students using technology become active users (Moeller & Reitzes, 2011: p. 6). In PBL, students explore, make judgments, interpret, and synthesize information in meaningful ways (Miller, 2013). PBL is a pedagogical strategy with the potential for posing significant, contextualized, real-world situations, providing resources, guidance, and instruction to learners as they develop content knowledge and problem-solving skills (Hogue, Kapralos, & Desjardins, 2011; Roy, Suhonen, Kihoza, & Vesisenaho, 2012).

2.23 Inquiry-Based Learning

It is being viewed as both a pedagogical process and a set of skills which can empower students in exploring, discovering, and ultimately reaching a higher level of understanding (Vajoczki, Watt, Vine, & Liao, 2011; Wu & Hsieh, 2006). Inquiry-based instruction requires the learner to search a problem space for problem-relevant information (Kirschner, Sweller, & Clark, 2006). This approach can foster deep and meaningful learning as well as significant gains in student achievement on standardized tests (Coffman, 2009; Minner, Levy, & Century, 2010; Vajoczki et al., 2011).

2.24 The Link between Learning Theories and Pedagogical Principles

Teaching strategies and classroom activities are designed to respond to students learning and knowledge attainment in various ways. Learning, involves actual or potential changes in behaviour that result from experience (Lefrancois, 2000: p.313; Pritchard, 2009: p.2). Traditional education is described as passive transmission of content from teacher to the learner and the subsequent recitation of content by the student at the cue of the instructor (Fryer, 2005). Human learn in four VARK system models (visual, auditory, reading and kinaesthetic) (Pritchard, 2009: p. 45). There are seven sub learning styles supported by an e-learning model known as blended learning such as: (1) Visual (spatial) prefers using pictures, images, and spatial understanding (2) Aural (auditory-musical) prefer using sound and music (3) Verbal (linguistic) prefer using

words, both in speech and writing (4) Physical (kinaesthetic) prefer using body, hands and sense of touch like sitting still while studying may be difficult, but writing things down makes it easier to understand (5) Logical (mathematical) prefer using logic, reasoning, and systems (6) Social (interpersonal) prefers to learn in groups or with other people and (7) solitary (intrapersonal) prefer to work alone and use self-study.

Authentic learning focus on the real-world complex problems and their solutions, using role-playing exercises, problem-based activities, case studies, and participation in virtual communities of practice. Learning theories are a set of concepts about how people learn and to some extent; they identify strategies underlying cognitive processes involved in learning (Donachy, 2014; Koschmann, 2011; Schunk, 2012). Behaviorism, cognitivism, and constructivism are the three broad learning theories that were developed in the absence of information. Four broad orientations could identify the position of technology in human learning theories that arouse from the traditional divisions of psychological theory. Behaviorism and cognivitism are more teachers focused while constructivism and connectivism are more students focused (Lefrancois, 2000: p. 314; Pritchard, 2009: p. 17; Raina, 2011). Behavioristic theories deal with investigation of relationships among stimuli, responses, and the consequences of behavior (Pritchard, 2009: p. 5). The cognitive psychologists are less interested in stimuli and responses, but more in processes that are intellectual like problem solving, decision making, perception, information processing, concept formation, and memory (Ashman & Conway, 2002: pp. 41–42; Lefrancois, 2000: p. 314).

The constructivism is a philosophical and theoretical foundation which provides answers to the questions of why and how specific pedagogy, including the application of technology, should be employed (Adams, 2006; Doolittle & Hicks, 2003; Elkind, 2004). The connectivism is a learning theory for the digital age that addressed learning and knowledge as rests in diversity of ideas connecting specialized information sources. In connectivism the capacity to know more is more critical than what is currently known, nurturing and maintaining connections is needed to facilitate continual learning and ability to see connections between fields, ideas, and concepts is a core skill (Bell, 2010; Kop & Hill, 2008; Siemens, 2005).

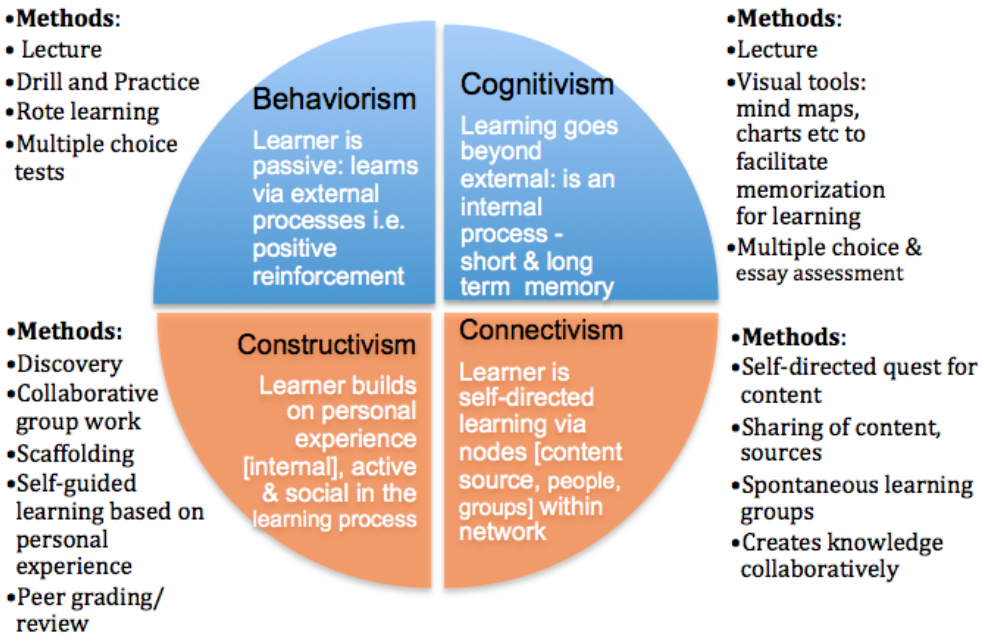


Figure 2.9: Four Perspectives on Learning based upon Theoretical Principles (Soozie, 2013)

Figure 2.9 above illustrates four learning perspectives based upon theoretical principles. Instructional methods associated with each theory are identified adjacent to the respective quadrant. The orange quadrant represents a student focused learning approach while the blue quadrant represent instructor focused approach (Soozie, 2013) . There is strong evidence that the choice of instructional materials has large effects on student learning, effects that rival in size those that are associated with differences in teacher effectiveness (Chingos & Whitehurst, 2012: p. 5).

The classroom practices are based on goals and understanding of students as complex and diverse human beings (Armstrong, 2012). Teaching responsibly in a digital age requires discovery to what technology tools can do to help students learn effectively, and what tools alone cannot do. Examples of learning approaches are blended learning that transformed learning experience using technology that has performed better when mixed with common learning methods (Bliuc, Goodyear, & Ellis, 2007; Bonk et al., 2002; Dalsgaard & Godsk, 2007; Levenberg & Caspi, 2010; Miller, 2012). The use of Inquiry-learning is based on asking questions that intrinsically motivate learners to start delving deeper when searching for answers; they explore new knowledge and insight (Capobianco & Lehman,2006). Problem-based learning (PBL) model is about students connecting disciplinary knowledge to real-world problems that motivate them to learn (Bridges, Botelho, & Tsang, 2010). The use of discovery learning is a

kind of teaching that is based on the student finding things out for themselves, looking into problems, and asking questions (Alfieri, Brooks, Aldrich, & Tenenbaum, 2011). Cooperative learning involves working in teams to accomplish a common goal, as members do set group goals, periodically assess what they are doing well as a team (Bandiera & Bruno, 2006). Project-based Learning (Bell, 2010; Chang & Lee, 2010; Thomas, 1999; Vega, 2012) is an instructional approach built upon authentic learning activities that engage student interest and motivation.

CHAPTER THREE

An Assessment of Teachers' Abilities to Support Blended Learning Implementation in Tanzania Secondary Schools [1]

Abstract

The purpose of this study was to describe instances of pedagogical practices of teachers using ICTs and the enhancement of practices using traditional methods to more fundamental changes in their approach to teaching. Using a mixed method, the research examined the impact of increased education level on the perception of ICT use competence and the influence of ICT knowledge level and skills on the adoption of blended learning contents. Four schools were used for this study; two picked out of 50 that are endowed with ICT infrastructure while other two were picked from schools without ICT infrastructure. Three research questions guided the research process. Data were collected from sources which included teachers, schools' inspection officers, curriculum development experts, teacher trainees and policy makers' interviews, questionnaires, classroom observations and document review. Data analysis concentrated on the central questions of the study. The results suggested that teachers' education level could not determine their ICT knowledge level. The ICT knowledge level has influences in the decision to use blended. Barriers to ICT use in education were revealed as: internal -more of personal attitudes and perceptions about a technology; and external-lack of availability and accessibility to the relevant resources (hardware and software), lack of framework that address integration of ICTs in teaching and learning and unreliable Internet connection. Subsequent to the results, this study suggests a goal oriented teacher training framework which should address a complex integration of technology, content, pedagogy, school infrastructures and the overall objectives of the education systems as constituents of ICT use determining factors.

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Keywords: Blended learning; teachers' ICT knowledge level; teachers' ICT use; teachers' ICT competence; ICT in education.

3.1 Introduction

Current generation is born into a media-saturated world of television, personal computers, mobile devices, radio, films, magazines, newspapers, textbooks, e-books, e-readers, Internet and the World Wide Web that can enhance the quality and effectiveness of education. The Internet with shared global resources has brought a more flexible and dynamic learning environment beyond the traditional book-teacher-model which regarded classrooms as the only dominant environment for formal education (Felvégi & Matthew, 2012). Effective classroom ICT use requires not just content, technology and pedagogy but teachers' knowledge and capabilities to enhance desired social interactions using their relationship. As technology connects more teachers and students, education changes for the better. Realization of the net effect of computer use in classrooms depends on whether computers displace other learning activities or increases the overall time that is spent learning (OECD, 2015: p. 148). Technology integration fails when there are no instituted strategies for covering the gap between the intended educational objectives viewed as the outcomes of a technology-enhanced education environment for teaching and learning (Buabeng-Andoh, 2012; Joke Voogt, Knezek, & Roblin, 2015). The World Bank Group (2003: p. 2) referred ICT to hardware, software, networks, and media for collection, storage, processing, transmission, and presentation of information (voice, data, text, images). However, it is not logical to consider the use of ICT in education as a general term. The use of ICT in education is described with four modalities: (1) when ICT relates directly to proper curriculum goals as an integral part, (2) when ICT relates directly to other subsequent classroom activities; (3) when the use of ICTs are separated in place from other learning activities; and (4) when the choice of ICT is proportional to the pedagogical practices and students learning styles (Avidov-Ungar & Iluz, 2014; Ham et al., 2002; Lim, 2006). Some typical examples of the transformative ICT use in education are computer-assisted instruction (also referred to as computer-based learning) uses computers to aid in the delivery of stand-alone multimedia packages for learning and teaching (Stephen Brown, 2010; Henry, 2001). The use of e-learning also referred to as online learning, Internet-based learning, and Web-based learning delivers teaching and leaning over the internet (Brown, 2010; Queirós & Leal, 2010). In other cases, ICT use in education has been referred to as network learning, multimedia-based learning and virtual

learning environment referring to the knowledge delivered virtually where a teacher and a learner do not meet physically (Alonso et al., 2005; Daniel, 2009; Knox, 2014; Welsh et al., 2003; Zhang & Nunamaker, 2003). In this study, the use of ICT in education is referred to as the availability of both mobile (e.g laptops, mobile phones, tablets, projectors) and non-mobile technologies that could enhance effective teaching and learning. However, technology alone does not guarantee occurrence of deep learning. The use of ICT resources that supports instruction (e.g. CD-ROM based video, projectors, moving images, video conferencing, bulletin boards for discussion etc) has more impacts on students learning than technology applications that provide direct instruction (e.g. Internet services, multimedia learning content) (Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011). The availability of committed teachers, supportive learning environment and the technology use enhanced infrastructures guarantees learners moving from 3Rs (reading, writing and arithmetic) competencies to the deep learning and broader skills of 4Cs (creativity, communication, collaboration and critical thinking) of which using ICTs have the ability to develop (Cox et al., 2003: p. 31; Keane, Keane, & Blicblau, 2014; Markauskaite, 2007).

The rapid advances in information and communication technologies (ICTs) have positive impacts on the effectiveness of pedagogical methods and knowledge delivery. The growing number of alternatives for ICT usage, with their multiple media text, visual, voice and their capacity that could extend interaction over time and space are transforming teaching and learning. The use of blended learning (a model of e-learning) enhances the mix of ICT based and traditional approaches where digital contents can be used offline or online accessed, downloaded or distributed as electronic media (e-books, media graphics, images, podcasts, videos files, simulations, animations, online tutorials and assignments, subject related webpages and Web 2.0 tools)(Intel Corporation, 2012; Jia et al., 2013; Pankin et al., 2012; Saliba, Rankine, & Cortez, 2013). Blended learning is a structured opportunity to learn, using more than one learning methods, carried out inside or outside the classroom and supported by technology and tradition methods (Pankin et al., 2012). The aspects in the use of blended learning are based on supported instructional methods, delivery methods, scheduling and different levels of guidance (Thorne, 2003: p. 29). Its use increases flexibility, quality and effectiveness of learning process subsequent to an improved productivity of both teachers and learners (Holt, Segrave, & Cybulski, 2012: p. 30; IICD, 2014).

The complexities in the availability of ICT infrastructure in many schools and characteristics of teachers' personal knowledge, abilities and competencies to use ICTs do not lend them to easy or sophisticated solutions. The UNESCO ICT framework for teachers described ICT use competences among professional teachers' as: (1) Beginner (with abilities to integrate technology as pedagogy and use ICT basic tools in teaching). (2) Average user (with abilities to demonstrate a general competency in a number of computer applications), and (3) advanced user (with abilities to competently use a broad diversities of ICT devices and tools) (UNESCO, 2011: p. 17). Teachers become active blended learning users when they can prepare activities for teaching (browsing to prepare lessons, preparing tasks for students, preparing presentations, collecting online resources to be used during lessons) (European Union, 2013: p. 80).

The opportunities afforded by the use of ICTs in education are many; the ineffectiveness of teachers' ICTs practices and the unsupportive philosophies of traditional teaching methods have been made unrealistic (Mckensey &Company, 2011). Recently, it was reported that teachers' digital literacies, educational ICT training, and ability to access the Internet are among important determinants of their belief on importance of the instructional benefits of digital technologies (Badia, Meneses, Sigalés, & Fàbregues, 2014). Critical challenges to technology adoption in education could either be internal (e.g. personal attitudes and perceptions about a technology) or external (e.g. availability and accessibility to the relevant hardware and software, institutional support, staff development program and training) (Albugami & Ahmed, 2015; A. Andersson & Grönlund, 2009; Mumtaz, 2000). A study by Straub (2009) reported that for technology use in education to remain sustainable, personal factors (e.g skills, knowledge, competencies, readiness etc), characteristics of the innovation (e.g. personal experimentation), and influences of the individual's context should never be ignored as part of the planning process. However, teachers have a central role in developing new learning models in schools; moving them from gaining basic ICT skills to conducting ICT-focused lessons and eventually appropriate ICT integration should start from institutions that nurture them (Schibeci et al., 2008).

3.2 Tanzania's initiative for ICT use in Education

The ICT Policy for Basic Education (United Republic of Tanzania, 2007: p. 15) recognized the use of ICT devices in education (such as personal computers, digital cameras, scanners, projectors, telecommunications equipment, Internet resources, radio and TV) as potential for

improving quality and effectiveness of teaching and learning. However, few teachers use ICTs in classrooms irrespective to the investments made in the ICT supportive infrastructures in teachers training colleges and few secondary schools (Andersson et al., 2014: p. 28). The ICT initiatives in Tanzania primarily ensured that schools had access to sufficient hardware, through specified computer-to-school laboratory target ratios, and be networked. The eSchools forum in 2005 proposed a phased approach with Phase I (2006 to 2008) projected to have more than 2000 schools with ICT tools by 2015 (Hooker et al., 2011; Nyirenda, 2013). The National Programme for ICT for Secondary Schools' Teachers initiative 2005 to 2008 targeted to eradicate ICT illiteracy among teachers and enhance its use in teaching (Hooker et al., 2011). To its completion, the project supported 50 secondary schools and all 34 government teachers' colleges with blended learning infrastructures and digital learning contents (Andersson et al., 2014: p. 6). The SME (Science, Mathematics and English)-ICT project offered digital materials for teaching Science, Mathematics and English subjects on DVDs and CDs where selected schools were supplied with LCD projectors and laptops and also teachers trained on the use of ICTs (GESCI, 2011a). The SME –ICT project had twofold objectives: first, to train teachers on how to use ICTs as pedagogical tools and, second, to create access and availabilities of blended curriculum contents for teaching science, basic mathematics and English. However, in the teacher training colleges there is much good practice in teaching ICT as a subject, but less pedagogical ICTs practices and effective teaching strategies using ICTs . However, both external and internal limitation may exist, the only challenges reported to have limited tutors (Teachers training college trainers) ICT use are insufficient availability of ICT resources and lack of sustainable internet connection and power supply. The ICT knowledge and skills teacher trainees receive from tutors have impact on their transitive future use of pedagogical ICTs when they enter job markets as qualified teachers. However, recently Ndibalema (2014) reported low usage of ICTs among secondary school teachers in Tanzania that were attributed to the ease of use, teachers' background in formal training and teachers' attitudes towards technology.

In most cases, the use of ICTs among teachers in secondary schools in Tanzania has been perceived as general practices. In teacher training practices, ICTs have often being assumed to mean only internet and computers, while there are many teacher training needs that ICTs could offer as a solutions to deliver e-learning models to pre-service and in-service teachers (Baker, Bliss, Chung, & Reynolds, 2013: p. 18). However, availability of hardware and software has

been given more priorities when compared to the accessibility of localised curriculum relevant e-contents. The notion of previous investments on educational ICTs being relied much on ICTs as infrastructure and less on pedagogical ICT applications still exist in most Sub-Saharan Africa (Dumont & Istance, 2010; Farrell et al., 2007). Over the past few years ago, private schools were more advantaged when compared to public schools which suffered from ICT resources unavailability and teachers' ICT use incompetence's (Swarts & Wachira, 2010). However, public schools and private schools receive teachers graduated from the same colleges and universities, studies do not tell why internal barriers should exist when both are given equal chances to practice technological, pedagogical and contents Knowledge's comprehensively. By gathering evidence about the education environment and the desired interactions for the classroom and analysing and evaluating them, will determine the level of technology and training strengths as well as the areas in which improvements should be made (Patnoudes, 2014). A project evaluation on ICT use in teaching and learning in teachers training colleges found only 44% as active ICT users, regardless of the ICT infrastructures and training which were being offered (Andersson et al., 2014, p. 6). However, initiatives for ICT use in secondary education in Tanzania focused on ICTs as a general term without specifying the model of ICT integration. There should be a model and an education objective to achieve. In a study by Olson et al (2011: p. iv) , it was reported that blended approach can provide the highest learning outcomes in African countries where secondary teachers have little prior experience with computers or similar technologies, because of its ability to support mixing face-to-face classroom methods with technology-mediated activities. There are few literatures on how teachers can be shaped to use and deliver education using ICTs as pedagogical tools compared to how teachers can and should be trained in the use of ICTs. However, they are both important. Without a defined ICT use and teacher training models with ICT pedagogical application relevance, teachers will lack important skills, competencies and the understanding of the ICT as a solution and hence becomes ineffective (Baker et al., 2013: p. 18). This study focused on assessing teachers' ICT knowledge level, skills, and their transitive impacts on the ICT pedagogical practices.

3.3 Research Objective

The lack of a well-defined pedagogical ICT application focus to most of professional teachers and teacher trainees in the teacher training colleges reflects the lack of a common understanding of the specific ways the technology can enhance teaching and learning. This is further affected

by the constantly changing face of the technology itself. When the existing syllabi focus more on teaching ICT as a subject rather than using it as a learning tool, it is a high time to redefine the model of ICT use initiatives where the digital generation should be guided to use technology as their own and move with it into the future. However, teachers must develop knowledge and skills on current technologies order to gain the experience necessary to understand the potentials of digital technologies in education, teachers training colleges should be the major vehicle for developing their pedagogical ICT competencies pertinent to the endowed knowledge. Teachers should be responsible for developing the attitudes necessary for pedagogical ICT capabilities and practices.

Given that some of the precise and detailed knowledge of teaching using ICT that teachers must retain after departing from training colleges may be short-lived, this study assessed the knowledge, skills, understanding and experiences teachers have that signify continued ICT use in teaching. Currently, it is unknown how the professional teachers in the field and teacher trainees graduating from teachers' training colleges use their ICT knowledge and skills in teaching ICT in schools and practically use ICTs as pedagogical tools. This study discloses ICT knowledge, skills, and competences of teachers and the existing model of ICT in education integration. The study also reveals the most relevant model of pedagogical ICTs practices most relevant for secondary schools in Tanzania. Three key research questions were of primary use:

- What are the teachers' perceptions in relation to the personal ICT use competences?
- Could teachers' education level determine their ICT use knowledge level and skills?
- How teachers ICT knowledge level and Skills have contributed to the classroom practices of blended learning contents?

To answer those questions, the study focused on teachers and teacher trainees whose specialties were Basic Mathematics and Science. Two of the previous ICT in education initiatives in Tanzania focused on the use of ICT in teaching Mathematics, Science and English (Andersson et al., 2014; GESCI, 2011b). The science subjects include Physics, Chemistry, and Biology. Parameters used in this study to answering the research questions are:

- teachers' ICT knowledge level and the implementation of blended learning,
- the digital educational resources and how teachers use them,
- teachers' preparedness for using and digital educational resources in classrooms, and
- The factors limiting technology use in schools.

The following hypothesis supported parameter (2) for teacher trainees, Null Hypothesis (N_o): "The increase in teacher trainees' education level leads to increased ICT knowledge level (competence)". Alternative Hypothesis (N_1): "The increase in teacher trainees' education level does not lead to increased ICT knowledge level (competence) ". In addition, parameter (2) for teachers was assessed using Null Hypothesis (N_o): "Teachers education level leads to increased ICT knowledge level (competence)". Alternative Hypothesis (N_1): "Teachers education level does not lead to increased ICT knowledge level (competence).

3.4 Research Methodology

3.4.1 Design of the Study

This was a survey research design employed to collect data using both questionnaires and interviews. This study involved 235 participants made by groups of actors in the areas of secondary education practices, quality control, management and policy formulation. The five data sources were: (1) teachers from four secondary schools, (2) secondary schools Central Zone Inspectorate Division, (3) Tanzania institute of education (Government agency for curriculum development), (4) Teacher Trainees from one teacher training college and one University and (5) Ministry of education and vocational training (MoEVT) officials. Teachers and teacher trainees specialised in basic mathematics and science subjects individually were given the option of not participating. No incentives were given for participation. Assumption made was, despite that teacher trainees are not yet assigned to schools, at least once or more they have participated in a one or more than one month field practice of teaching where they should have used or exposed to pedagogical ICT tools application to demonstrate their ICT use competences and knowledge levels.

Data were collected using structured questionnaires, formal interviews, document reviews and observation. Three separate questionnaires were used in this study, namely technology level of use developed by Al-Zaidiyeen, Mei, & Fook (2010), professional teachers ICT knowledge levels identified by UNESCO (2011: p.7), in-service teachers and teacher trainees perceived abilities toward classroom technology integration by Spaulding (2007) and the barriers to implementation of ICT use in secondary education adopted from Jones (2004). The first questionnaire included seven items used to measure teachers ICT knowledge level and ICT tools

practices. The ICT tools practices were grouped as either online ICT tools or offline ICT tools. A four Likert scale format was used to assessing teachers ICT knowledge level and ICT tools use frequencies (1= never use, 2=rarely use, 3=sometimes use, 4=often use). The ICT use competences were assessed based on knowledge level perception, where teachers and teacher trainees had three choices- beginner, average and advanced users (UNESCO, 2011: p.7). The second questionnaire contained 13 items measuring teachers and teacher trainees' perceived preparedness on the use of specified ICT tools or practices as an indication of the abilities toward classroom technology integration (Spaulding, 2007). However, some teachers and teacher trainees may have gained ICT use skills out of formal education; in this study, assumption was made that they should base their response on the formal education they have received. The questionnaire was designed as three-point Likert's scale, where 1= prepared, 2= poorly prepared, 3= not prepared. The third questionnaire contained seven lists of items measuring perceived barriers faced by teachers for classroom technology integration (Jones, 2004). The questionnaire was designed as five-point Likert's scale, where 1=strongly disagree, 2=disagree, 3=uncertain, 4=agree, and 5=strongly agree. The MoEVT officers' interviews, which took place a week after followed completion of the survey. The study arranged and scheduled the interview sessions to take place within a free time to avoid interruptions that could have happened during busy time. Interview questions were not issued to responds before the session to avoid preparing of answers that would have misled the study. Document review was only conducted in secondary schools that involved examining ICT lending book to identify the frequencies of ICT tools lending among teachers and the subjects areas they teach. The use of observations involved a school visit and classroom walk-in in which about 2 randomly selected classes were observed for roughly 15 minutes each to obtain a perspective on routine teaching practices that involved pedagogical ICTs. The classes visited were selected based on the records which existed in the ICT lending book.

3.4.2 Population and Sample Distribution

A list of 50 secondary schools that had previously participated in ICT projects was recalled from the Ministry of Education and Vocational Training (see Section "Blended Curriculum Content Initiatives in Secondary Education" of this paper). The list guided us to identify schools which had received supportive ICT use infrastructures and training offered to some teachers. In total the study assessed four secondary schools, among which two schools were randomly selected from

the 50 schools and other two schools were randomly selected out of more than 2000 public schools that had never participated in any ICT projects. Teacher participants were randomly selected from two rural schools and two urban schools both from Morogoro region, of which three were day schools and one was boarding school. We used strata (categorical) of individuals to ensure that we focused on all diverse characteristics in the sampling process representation according to Kothari (Kothari, 2004: p. 36). The mutual influence was that all four schools used the same curriculum, though had different supportive infrastructures, management and teachers creativity when using available teaching resources differs. The study population sample included three employees from the Ministry of Education and Vocational Training representing policymakers, 24 teachers from four secondary schools, 194 teacher trainees were made by 158 from Morogoro TTC and 36 from Mzumbe University, four zone inspection officers specialised in Basic Mathematics and Science subjects and 10 curriculum developers from the Tanzania Institute of Education. We dealt with science and mathematics specialised participants as a way to find out how science and mathematics learners in Tanzania can benefit from the rich pedagogical digital educational resources that are available offline and online.

Table 3.1: Distributions of Respondents

Respondents	**Frequency**	**Percentage (%)**
Teachers	24	10.2
Inspectorate Division	4	1.7
Curriculum Developer	10	4.3
Teacher Trainees	194	82.6
MoEVT	3	1.3
Total	**235**	**100.0**

Three MoeVT officials participated in the interviews; one from the teacher training department, one from the commissioners' departments and one from the secondary school education department. The secondary schools and teacher training institutions that participated were all public located in Morogoro region. Conditions for teachers participation was that, he/she should be teaching basic Mathematics or Science subjects. Out of 24 participant teachers' school wise distributions were nine from Kilakala (37.5 %), six from Mongola (25.0%), five from Kipera (20.8%) and four from Lupanga (16.7%). Generally, targeted population for data collection was in-service teachers, teacher trainees, curriculum developers, policy makers and school inspectors.

3.4.3 Data Analysis Procedures

Teachers and teacher trainees received a survey questionnaire, which was filled out under the research team loose supervision in each school and teacher training institutions. Time allocated for the questionnaires completion was one hour, which they were collected after. Respondents were allowed to ask questions for anything that needed elaboration; however, they were not allowed to discuss for obtaining collective responses among themselves. The data collected was processed by using Statistical Package for Social Science (SPSS) program, version 17. It was used to analyze data as follows:

1. The Pearson's correlation coefficients were used to identify the relationships between the ICT knowledge level of ICT use and the selected factors.
2. The descriptive statistics was used in summing the data included frequency percentages, means, and standard deviations.

3.4.4 Issues of Validity and Reliability

To increase validity, five data sources were used to combine and cross reference the findings from these sources. Key sources of data were:

- Secondary school staff teachers regardless of their working experiences.
- Teacher trainees (those pursuing diploma in education as TTC students and Bachelors in education university students specialising in Mathematics and Sciences)
- Central zone secondary schools' inspectors who by default must have practiced teaching before being assigned to be inspection officers
- Public servants working as curriculum developer experts
- Ministry of Education and Vocational Training employees from the secondary education department, Education commissioner's office and teacher training department both considered as policy makers and planning officers.

For example, in practice survey questionnaires provided background information about the participants and an indication of their ICT knowledge levels with various digital educational resources' practices. Observations revealed teachers' actual technology use in the classroom and the availability of infrastructural support from the schools we visited. Both formal and informal interviews were conducted to schools' inspectors and few teachers to understand how teachers' beliefs, altitudes and social behaviour influenced technology classroom practices. This enhanced

validity of the data that were collected and used for this study. Cronbach's alpha test of reliability and internal consistency was conducted on each of the items assessed and the results revealed perceived digital educational resources usage (α = 0.778, n=7), context for use that supports blended learning (α=0.899, n=13) and the perceived barriers to technology readiness (α=0.722, n=7). The Alpha coefficients (α > 0.70 are considered acceptable and (α > 0.8 is Good (Bland & Altman, 1997; Santos, 1999).

3.5 Findings

3.5.1 Linkage of ICT Knowledge Level and Education Level/ Study Year

The association between ICT knowledge level and the education level for teacher trainees was assessed using a cross tabulation followed by a Pearson chi-square test. Null Hypothesis (N_o): "The increase in teacher trainees' education level leads to increased ICT knowledge level (competence)". Alternative Hypothesis ($_{N1}$): "The increase in teacher trainees' education level does not lead to increased ICT knowledge level (competence)". The results of a survey of 194 teacher trainees are presented in Table 3.2 below while Pearson chi-square test is in Table 3.3 below.

Table 3.2: Teacher Trainees Study level and ICT Knowledge Level Cross Tabulation (N= 194)

	ICT Knowledge Level			
Year of Study	**Beginner f (%)**	**Average f (%)**	**Advanced f (%)**	**Total f (%)**
1st Year	(63) 32.5	(18) 9.3	(10) 5.2	(91)46.9
2nd Year	(60) 30.9	(24) 12.4	(9) 4.6	(93)47.9
3rd year	(2) 1.0	(7) 3.6	(1) 0.5	(10)5.2
% of Total	(125) 64.4	(49) 25.3	(20) 10.3	(194)100.0

The Chi-square test was carried out to test if there is a relationship between the education level (increased in the year of study) and the teacher trainees ICT knowledge level.

Table 3.3: Chi-Square Tests Outputs

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.485[a]	4	.014
Likelihood Ratio	11.105	4	.025
Linear-by-Linear Association	2.169	1	.141

N of Valid Cases	194		

a. 2 cells (22.2%) have expected count less than 5. The minimum expected count is 1.03.

A Pearson chi-square test was conducted to examine whether there was a relationship between teacher trainees' increased education level (year of study) and the ICT knowledge level (Competencies). The results revealed that there was no significant relationship between the two variables (Chi square value =12.49, N= 194, df =4, $p < 0.05$). The null hypothesis is rejected, since $p < 0.05$ (in fact $p = 0.014$). A significantly larger proportion of teacher trainees (64.4%) reported of being beginner users with majority (32.5%) from 1st year and (30%.9) from 2nd year of study (see Tables 3.2 and 3.3)

This study also assessed if there was any relationship between ICT knowledge level and the education level of teachers. A cross tabulation was performed followed by a Pearson chi-square test. Null Hypothesis (N_o): "Teachers' education level leads to increased ICT knowledge level (competence)". Alternative Hypothesis (N_1): "Teachers' education level does not lead to increased ICT knowledge level (competence) ". The results of a survey of 24 teachers are presented in Table 3.4 while Pearson chi-square test is in Table 3.5.

Table 3.4: Teachers' Education level and ICT Knowledge Level Cross-Tabulation (N= 24)

Education Level	**ICT Knowledge Level**			
	Beginner f (%)	**Average f (%)**	**Advanced f (%)**	**Total f (%)**
Masters/Postgraduate	(2) 8.3	(1)4.2	(0) 0.0	(3)12.5
Bachelor/Adv.Diploma	(7) 29.2	(5) 20.8	(3) 12.5	(12) 62.5
Diploma Certificate	(4) 16.7	(2) 8.3	(0) 0.0	(6) 25.0
% of Total	**(13) 54.2**	**(8) 33.3**	**(3) 12.5**	**(24) 100.0**

The Chi-square test was carried out to test if there was a relationship between the teachers' education level and their ICT knowledge level. However, a chi squared test was conducted on a sample with a smaller size, to avoid making conclusion on inaccurate inference it was supported by the cross tabulation results.

Table 3.5: Chi-Square Tests Outputs

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.215[a]	4	.696
Likelihood Ratio	3.225	4	.521
Linear-by-Linear Association	.127	1	.722
N of Valid Cases	24		

a. 7 cells (77.8%) have expected count less than 5. The minimum expected count is .38.

A Pearson chi-square test was conducted to examine whether there was a relationship between teachers education level and the ICT knowledge level (Competence). The results revealed that there was a significant relationship between the two variables (Chi square value =2.22, N= 24, df =4, p =0.696). The null hypothesis is accepted, since $p > 0.05$ (in fact $p = 0.696$). A significantly larger proportion of teachers (54.2%) reported of being beginner user comprising majority (29.2 %) with Bachelor's degree /Adv. Diploma and (16.7%) with Diploma Certificate. However, teachers with Bachelor's degree admitted to have advanced competence, this was not true for those with masters and Postgraduate degree who are expected to have advanced skills. The differences in chi-square results and the cross tabulation leads to the rejection of the null hypothesis (see Tables 3.4 and 3.5).

3.5.2 Teachers' rate of online based digital educational resource practices

This part focused on online and offline based digital educational resources that positively support blended learning curriculum implementation. Teachers and teacher trainees were assessed differently in each aspect and the results compared. After teachers had completed rating their personal ICT knowledge level (competence) in which 1 represented beginner, 2 represented average and 3 represented advanced , they were asked to rate their ICT use behaviour (level of frequencies) with a range of ICT resources that depend on connectivity being provided. A rating of 1 represented never use, whereas the rating of 4 represented often use. Figure 3.1 provides summary of the teachers' ICT knowledge level against the ICT tools use frequency.

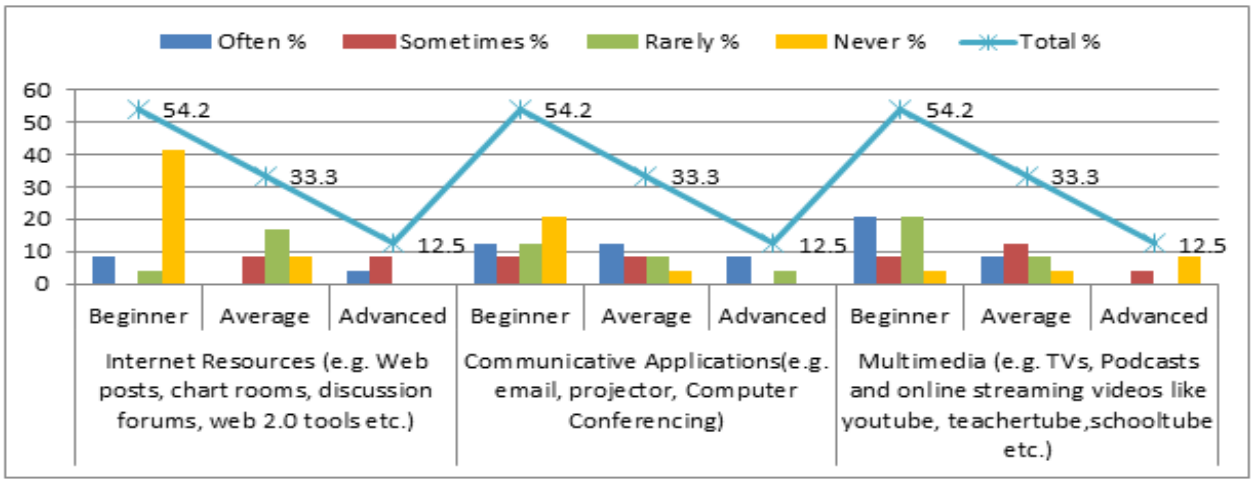

Figure 3.1: Teachers' ICT Knowledge Level and The Rate of Online Based ICT tools Practices (N= 24)

Results in Figure 3.1 above revealed that, majority (41%) of beginner teachers reported to have never used Internet resources;, and communicative applications (20%), while 20% reported to have often and rarely used multimedia respectively.

In addition, after teacher trainees had completed rating their personal ICT knowledge level (competence) in which 1 represented beginner, 2 represented average and 3 represented advanced , they were asked to rate their ICT use behaviour (level of frequencies) with a range of ICT resources that depend on connectivity being provided. A rating of 1 represented never use, whereas the rating of 4 represented often use. Figure 3.2 provides a summary of the teacher trainees' ICT knowledge level against the ICT tools use frequency.

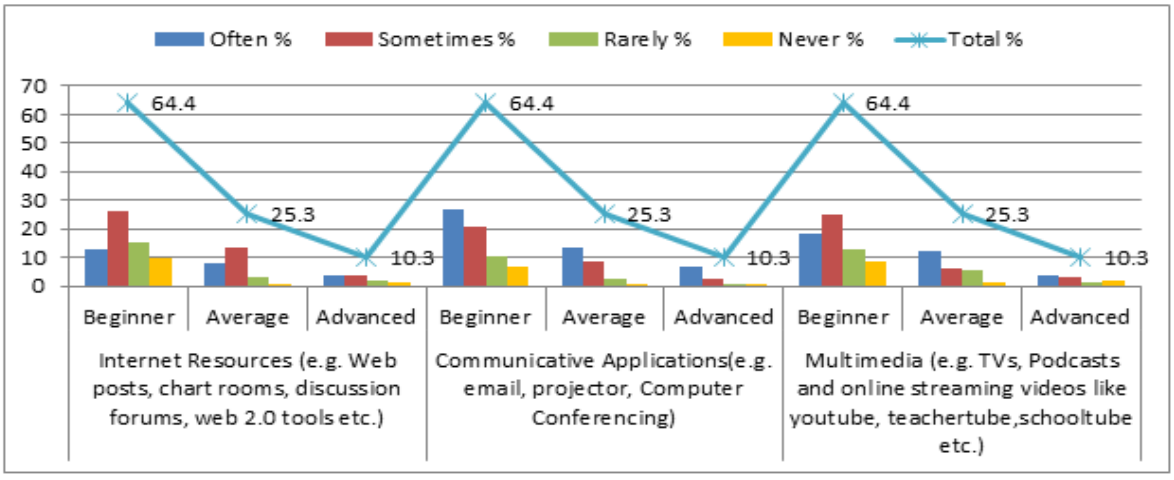

Figure 3.2: Teacher Trainees ICT Knowledge Level and The Rate of Online Based ICT tools Practices (N = 194)

Results in Figure 3.2 above revealed that majority of teacher trainees reported to have often or sometimes used the ICT tools assessed. Up to 25.0% of beginner teacher trainees reported to have sometimes used internet resources; 25.3 % beginner had often used communicative applications and 22.0 % beginner sometimes used multimedia tools. Both average users and advanced users who reported to have often, sometimes used internet resources, communicative applications and multimedia tools were very few.

3.5.3 Teachers' Rate of Offline Based ICT tools Practices

After teachers had completed rating their personal ICT knowledge level (competence) in which 1 represented beginner, 2 represented average and 3 represented advanced , then they were asked to rate their ICT use behaviour (level of frequencies) with a range of ICT resources that do not necessarily depend on connectivity being provided. A rating of 1 represented never use, whereas the rating of 4 represented often use. Figure 3.3 provides summary of the teachers' ICT knowledge level against the ICT tools use frequency.

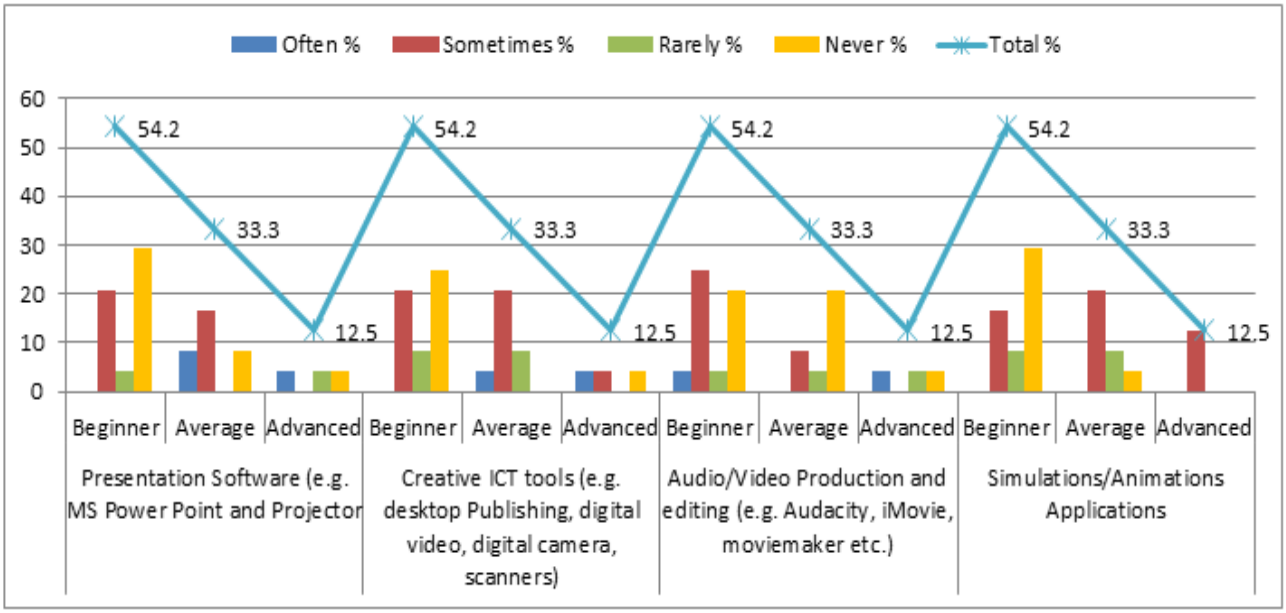

Figure 3.3: Teachers' ICT Knowledge Level and the Rate of Offline ICT Practices (N=24)

Results in Figure 3.3 show that majority of teachers who reported to have often and sometimes used almost all the ICT tools were either beginners or average users. However, the number of beginners who had never used presentation software (approximately 29%), creative ICT tools (Approx. 24%), audio or video production (20%) and simulation / animations applications (29%)

were reported as above average and advanced users. Relatively equal percentages of beginners and average users sometimes used presentation software (20% and 15% respectively) and creative tools (both 20%). However, there were a relatively big number of beginners and average users who had rarely or never used most of the ICT tools that were asked.

The study also assessed teacher trainees on the group of ICT tools that could be used offline (Uses which do not necessarily need internet access/ connectivity). Users ICT knowledge level was used as a key measure of how frequently beginner, average user and advanced user can be engaged with ICT tools in classroom. After teacher trainees had completed rating their personal ICT knowledge level (competence) in which 1 represented beginner, 2 represented average and 3 represented advanced, they were asked to rate their ICT use behaviour (level of frequencies) over a range of ICT resources that do not necessarily depend on connectivity being provided. A rating of 1 represented never use, whereas the rating of 4 represented often use. Figure 3.4 provides summary of the teacher trainees' ICT knowledge level against the ICT tools use frequency.

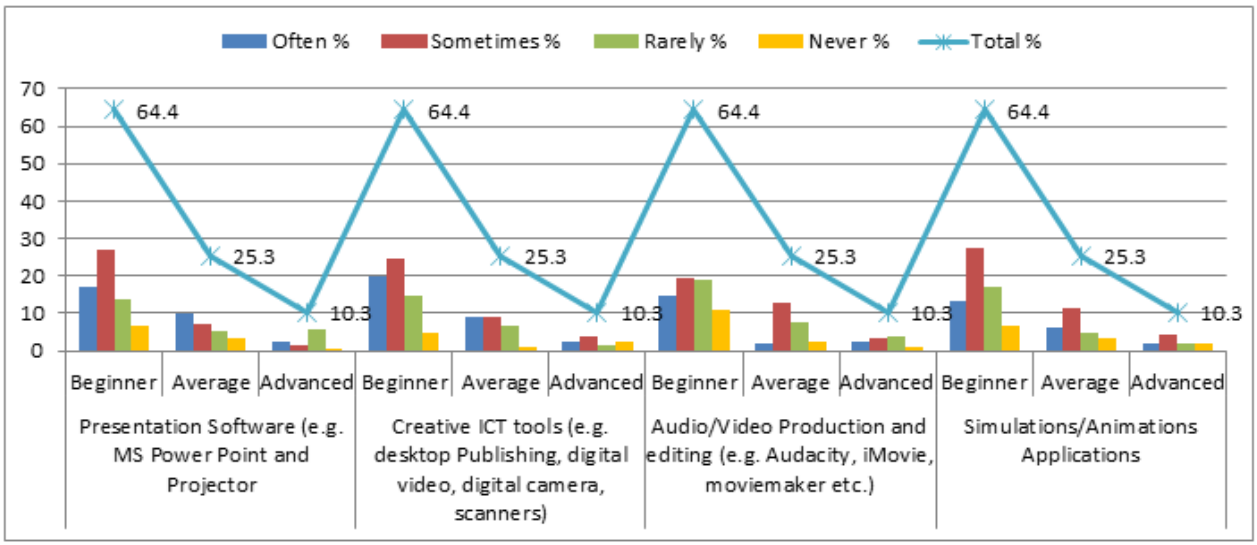

Figure 3.4: Teacher Trainees ICT Knowledge Level and the Rate of Offline Based ICT Practices (N= 194)

Results in Figure 3.4 show that, majority of teacher trainees who were beginners (64.4%) had often or sometimes used all the four categories of ICT tools. Majority of beginners (approximately 27%) had sometimes used presentation software; 25.3 % had sometimes used creative ICT tools, and approximately 19% had sometimes used audio/video production and

editing tools while approximately 28% had sometimes used simulation/animation applications. The number of average users who reported as often and sometimes was small.

3.5.4 Teachers' Abilities to Use Digital Educational Resources as Pedagogical Tools

The study asked teachers and teacher trainees to rate their level of preparedness in the use of ICT resources as part of their teaching practices. A list of ICT tools covering numerous areas and practices were provided for them to write the relevant choices. A rating of 1 represented prepared, 2 represented poorly prepared and 3 represented not prepared. Table 3.6 provides a summary of the mean and Standard deviation on the level of ICT use preparedness.

Table 3.6: Teachers' Preparedness on ICT tools Classrooms Practices (N=218)

Digital educational resources and pedagogical practices	Teachers N= 24		Teacher Trainees N= 194	
	Mean	*STD*	*Mean*	*STD*
Create multimedia presentations with scanners and digital cameras	2.04	.908	2.84	1.111
Use office applications (e.g. word processors, spreadsheets, etc.)	1.58	.654	2.35	1.179
Communicate and access online resources (e.g., e-mail, Internet resources)	1.54	.721	2.39	1.187
Teach with presentations using computers and projectors	1.71	.955	2.55	1.147
Enhance professional productivity using interactive media	2.17	.702	2.86	1.071
Use simulation/ animation/ applications that enhance content for a lesson	2.17	.482	2.68	1.125
Enhance research- based practices (project and problem-based learning)	2.13	.741	2.86	1.033
Support individuals and group learning activities using technology	1.83	.637	2.42	1.075
Assess students' performance using technology	1.96	.859	2.46	1.097
Use ICT resources for teaching and learning Basic Mathematics and Science independently	1.88	.797	2.44	1.110
Use ICT that enhance the teaching approaches for a lesson	2.25	1.032	2.51	1.044
Use ICT that enhance students learning for a lesson	1.83	.761	2.41	1.103
Teach using technology and non-technology resources	2.04	.624	2.21	1.096

Preparedness mean level: 1= Prepared, 2= Poorly Prepared, 3= Not Prepared,

Results in Table 3.6 show that majority of the respondents were prepared to use numerous digital educational resources that support blended learning implementation. Three mean levels of preparedness were established by the researcher for easy interpretation such as: prepared (1 <= Mean > = 2.45), poorly prepared (2.45 < Mean >= 2.75) and Not prepared (2.75 < Mean <=3.0). Teachers reported as prepared in all the ICT tools and classrooms practices that were asked at the means range (1.54 < = Mean >=2.25). Majority of teacher trainees at a mean range (2.21 <=Mean >=2.44) reported as prepared in office applications (e.g. word processors, spreadsheets, etc.), communicate and access online resources (e.g., e-mail, Internet resources), support individuals and group learning activities using technology. The same mean range of teachers also reported the use ICT resources for teaching and learning Basic Mathematics and Science independently, use ICT that enhance students learning for a lesson and teach using technology and non-technology resources.

In addition, teacher trainees reported as poorly prepared to teach with presentations using computers and projectors (Mean = 2.55, SD = 1.147), use simulation/ animation/ applications that enhance content for a lesson (M=2.68, SD = 1.125), assess students' performance using technology (Mean = 2.46, SD = 1.097) and use ICT that enhance the teaching approaches for a lesson (Mean =2.51, SD = 1.044). Majority of teacher trainees reported not prepared to create multimedia presentations with scanners and digital cameras (M =2.84, SD = 1.111), enhance professional productivity using interactive media (M=2.86, SD = 1.071) and enhance research-based practices (project and problem-based learning) (M=2.86, SD = 1.033).

3.5.5 Perceived Barriers on Teachers Digital Educational Recourses Usage

As noted earlier, there exist internal and external limitations that hinder teachers from using educational ICT resources. Curriculum developers with influence on government's decision to integrate curriculum and ICT resources were assessed based on how they ranked various challenges that could limit the use of blended learning in schools. Ratings of 1 represented strongly disagree, 2 represented disagree, 3 represented uncertain, 4 represented agree and 5 represented strongly agree. Table 3.7 provides a summary of the mean and Standard deviation on the challenges as rated by curriculum deployment experts.

Table 3.7: Descriptive Statistics on ICT use Challenges Facing Secondary Schools (N =10)

Barriers to successful ICT use	Mean	Std. Dev.	Minimum	Maximum
Insufficient number of computers in schools	4.70	0.483	4	5
Lack of focus in the curriculum on the application of ICTs	3.00	1.333	2	5
Teachers' lack of computer skills	4.40	0.699	3	5
Teachers' lack of interest in using ICTs for teaching	2.60	0.843	1	4
Teachers' lack of experience of using ICTs	3.90	0.568	3	5
Unreliable Internet connection	4.20	0.632	3	5
Lack of a framework that would address integration of ICT in teaching and learning	3.70	1.252	2	5

Mean: 1 = Strongly Disagree, 2=Disagree, 3=Uncertain, 4=Agree, 5=Strongly Agree

The results in Table 3.7 reveal that the most serious challenges respondents faced in ICT adoptions were the lack of computers in schools, lack of computer skills among teachers and unreliable Internet connection, with mean score range 4.20 to 4.70. The uncertain challenges were lack of curriculum and syllabi support on the use of blended curriculum contents, lack of ICT use framework, and teachers' lack of experience of working with ICT, both with mean range 3.00 to 3.90.

3.5.6 Adopting Technology and Embracing Change

The Ministry of education and Vocational Training (MoEVT) is the main body for initiating all the policies, future plans and innovations strategies for the education system. The study interview session to the MoEVT officials was guided by two major questions: (1) What are the success and failure of the past ICT in education initiatives?; and (2) what are the future plans for facilitating sustainable ICT use in secondary education across the country?. However, respondents presented different opinions; two statements were of value for this study. A reporter from the secondary school department stated that "videos *on sciences practical have been developed and distributed to schools to be used as alternatives in areas where resources and teacher run short*". The study found that copies of DVDs collected from the department were valid to the syllabi but were not known to most of science teachers in the schools. Another reporter stated that "*the increased number of students and shortage of teachers could be solved by using ICTs in schools with let say one teacher in mathematics; ICT can be used to supplement*

such deficits". However, the cause of lacking sustainability of the ICT in education implementation was thrown to the shortage of funding sources since most of the past initiatives depended heavily on donors.

The results on observation reveal two schools (Kilakala and Lupanga) having received computers, LCD projectors, and multimedia systems; however, only Kilakala secondary school had teachers and students actively used basic ICT resources in teaching and learning (see Figure 3.5). Teachers at Lupanga were not actively using the ICT tools, they complained of lacking enough time for setting up the devices and making preparations.

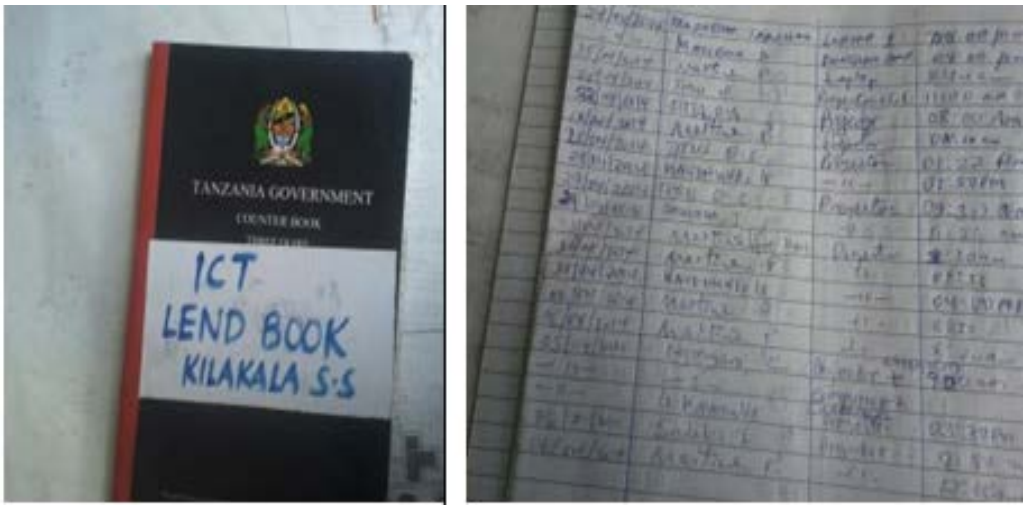

Figure 3.5: Snapshot of ICT tools lending records at Kilakala Secondary school

The other two schools (Kipera and Mongola) had no ICT infrastructure except for one lap top and one photocopier machine in the headmasters' offices used for managerial issues such as examinations processing only.

3.6 Discussions of Findings

Teachers' ICT use knowledge, competencies and skills to use numerous digital educational resources for teaching are important aspects for the education system to meet the educational objectives that demand technology application. However, teachers and teacher trainees' increased education level have not significantly contributed to their perceptions on an increased ICT use knowledge, competencies and skills. Teachers with higher education could not perceive themselves as advanced users of ICT tools, and the same applied to teacher

trainees whose year of study did not determine their perception on the ICT knowledge level. The results concur with Ndibalema (2014) which investigated teachers' attitudes towards the use of pedagogical ICT tools in Tanzania Secondary Schools and found that low familiarity with ICTs use as pedagogical tools among teachers was a big problem. When teachers fail to acknowledge the pedagogical importance and applications of ICT tools, the teachers training institutions have failed to consider technology adoption, as opposed to Straub (2009) who considered technology use as a complex, developmental process that both the training institutions and teaching environment have to cultivate when addressing the cognitive, emotional, and contextual concerns of three key knowledge attributes of content, pedagogy and technology. Reasonably, Badia et al.(2014) argued that, digital literacy, educational ICT training, and Internet access are key predictors of teachers' perceptions of the instructional benefits of digital technology. The study by Voogt et al.(2015) also addressed the importance of professional teachers development which is aligned with ability to integrate technology in ways that facilitate both creativity and enhanced learning opportunities.

The use of blended learning is attributed by the ability to support mixing traditional approaches and technology enhanced teaching and learning approaches that allow learners to learn at their own pace and time. The uses of digital educational resources as blended learning enabler are either offline accessed on the CD, DVD or online accessed over the internet. The lack of significant relationship between the education level and ICT knowledge level (competence) was associated with a large number of teachers and teacher trainees who reported as beginner users regardless of their education level. However, the distribution of beginner users, average users and advanced users was evenly distributed throughout numerous online and offline digital educational resources. Regardless of existing ICT knowledge level and the number of digital educational resources teachers are able to use, given appropriate supports, they can gradually adjust their level of ICT use knowledge (Schibeci et al., 2008). Hence, teachers need to be assisted along the journey to ICT integration. Teachers and teacher trainees' perceptions on the offline based ICT tools' practices were dissimilar in nature; high percentage of beginners' users who are teachers reported on often and sometimes use while beginners who are teacher trainee at high percentages reported rarely and non-use. However, the amount and range of ICT resources available to the teachers have influence on the use made of ICT in subjects and classes; many teachers cannot use some forms of technology, hence progressively

limiting the education system from harnessing the ICT benefits (Cox et al., 2003: p. 3). High frequency of digital educational resources application among teachers and teacher trainees motivates students to learn using ICTs and also attracts the government to invest in the use of blended learning (an e-learning model). The training teachers have obtained did not have clear impact on the level and diversity of technology use. Studies by Haydn & Barton (2007) who assessed how trainee teachers make progress in their ability to use ICT in subject teaching and Barton & Haydn (2006) who assessed trainee teachers' on what helped them to use ICT effectively in their subject teaching both reported that trainees' experiences and resources which they had encountered in the course of their training had not been helpful. In this study we find, no relationship between the ICT knowledge level perceived by most teachers and teachers trainees and the ability to use more ICT tools in classroom.

Respondents' perceptions on the preparedness in the adoption of digital educational resources and their abilities to efficiently carry out ICT pedagogical practices in classroom indicated a wide gap between teachers and teacher trainees. Majority of beginner user teachers believed they were prepared in an extensive range of ICT resources and practices compared to teacher trainees who reported as beginners prepared in few ICT resources perceived as poorly prepared. In this study we assumed some of the perceptions as caused by lack of confidence. The study by Al-Senaidi, Lin, & Poirot (2009) assessed the barriers to adopting technology for teaching and learning; the study reported lack of confidence in ICT use among teachers as a reason for lack of competence. The weakness revealed by teacher trainees on the application of technology in teaching is an indication of the weakness in their trainers' competence in technology use and inability to transfer such practices to their peer teacher trainees. Tamim et al. (2011) argued that, one of technology's main strengths lie in supporting students' efforts to achieve rather than acting as a tool for delivering content. However teachers' preparedness could be contributed to availing negative factors that are related to ICT resources availability, lack of competence and pedagogical models or unclear goals for using ICT. The teachers' attitudes levels towards the use of ICT need to have direct relationships with the use of ICT for educational purposes (European Union, 2013: p. 16). This means teacher trainees needs to be trained in the ICT practices environment to be able to use ICT; as reported by Kalogiannakis (2008) on training with ICT for ICT from the trainee's perspective that there was positive preparedness when teachers were trained to use ICT using ICT practices. It is more likely that

teacher trainees may enter job market with incompetent of pedagogical ICT use which may arise more training needs and expenses in later days. This means personal characteristics (computer training background) have impact in the future ICT use (Albirini, 2006).

This study identified both internal and external critical barriers. The internal barriers include teachers' lack of basic computer skills, experience to use ICTs and teachers' fear of technology. Tanzania's external challenges relates to financial constraints for funding ICT in education initiatives; this attributes to lack of curriculum and syllabi contextual support to the use of blended learning contents, unreliable Internet connectivity, teachers' lack of motivation to use technology, and insufficient number of computers in schools. Similar situation is also reported by (Buabeng-Andoh, 2012) as among critical challenges in Ghana. However, resistance to change was also revealed by a number of teachers' turn up for using ICT resources in schools where training and basic ICT resources that had been provided by the government. Most of the available ICT tools in schools were offered through donor-funded ICT projects, which mean that the government support is more political than a reality.

3.7 Conclusion and Recommendations

This study has demonstrated that teachers were passionate to know and use the blended curriculum contents in classrooms, however, few of them failed to use ICT tools due to the prevailing avoidable and unavoidable limitations. That teachers' education level cannot be used as the measure to determine how ICT resources can be used to teach students in secondary schools. That ICT resources invested, availability and accessibility in some schools can become a burden if other factors are not well managed. That the level of ICT knowledge among teachers and teacher trainees and its linkage to the use of blended learning contents determines how users were trained and prepared to use the ICT resources pedagogically. The challenges secondary schools face in relation to ICT use are complex and they should not be looked at from single point. This study visualises a domain of technology integration in secondary education, points to teachers, teacher trainees, technology use, teacher training institutions and the teaching and learning environment as complex as planning for harmonisation of them. The ability for teachers to use technology as pedagogical tools is influenced by many factors, that if one is not well planned others could lead to wastage of

resources and thus failure in the educational objectives. Major limitation to this study could be that, the study conclusion is based on the perception and if experimental research design is carried out may add more strength to these results. A combined review of literatures and the empirical data analysed identified a range of practices which should enhance teachers' pedagogical practices that effectively integrate ICT into teaching, learning and the curriculum. These included teachers' characteristics such as:

- Subject contents knowledge and the relationship between a choice of ICT resources and the concepts, processes and skills to use them as pedagogical tools
- Ability to select appropriate ICT resources which will help them meet the specific teaching and learning objectives for the particular level of learners
- Confidence to walk in a class and decide on using a range of ICT resources, via frequent practice and use beyond one or two familiar applications.
- Ability to prepare lessons plans that involves tasks where ICT is used in ways which will motivate learners and challenge them to understanding and promote greater thinking and creativity

Based on the findings of this study, it is recommended that a technology-goal oriented model of teachers' training be developed. Teacher training should focus on realizing among others things, the competences in the technological, pedagogical and content Knowledge (TPACK) as inseparable factors. The use of ICT in teacher training institutions and secondary schools should seek to solve problems that are aligned to the objectives of the education system rather than deploying ICT for the sake of general perception that ICT serves purpose. While ICTs continue to emerge, the significance impact on teaching and learning should be harnessed in the teachers training programme, both as a subject, a practical pedagogical tool and a resources. In addition, we recommend for further experimental study for testing teachers and tutors in field to determine training needs and the existing gap. The use of mobile devices and curriculum based mobile apps which has not been emphasised in this study should also be considered as most relevant.

CHAPTER FOUR

Classroom ICT Integration in Tanzania: Opportunities and Challenges from the Perspectives of TPACK and SAMR Models.[2]

Abstract

The expectations of the teaching professional have changed; teacher trainees and future tutors are expected to graduate with computer applications competencies appropriate for teaching relevant practices. This study assessed classroom ICTs integration opportunities and the challenges in relation to Technological Pedagogical and Content Knowledge (TPACK) and SAMR (Substitute, Augmentation, Modification and Redefinition) models. The case study involved tutors and teacher trainees (N=206) from teacher training colleges. Results indicated that, majority of respondents have low pedagogical ICT competencies. However, tutors exhibited good knowledge level in all TPACK and SAMR constructs that we assessed; teacher trainees' revealed poor skills and inefficient support on the use of basic ICTs (hardware, software, and associated peripherals). The impacts of TPACK and SAMR models' characteristics related to the technology use in planning and redesigning of learning tasks was evident. Most of the challenges identified are associated with the lack of infrastructures, readiness to change and lack of competencies on pedagogical ICT applications. Among others, we recommend the government to work on a harmonized framework for ICT in education integration; that considers the existing opportunities and challenges facing Tanzanian teacher training systems. Further work should focus on carrying out an experimental research to unfold the existing ICT use realities.

Keywords: Classroom ICT; ICT Pedagogy; Tanzania; Teacher education; Teacher trainees; TPACK; SAMR

4.1 Introduction

The knowledge and competencies of teachers' ICT pedagogical application are key attributes for the future of secondary education success. The goal for use of any new technology in classrooms

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should always be to support enhancement of effective education as the highest priority (Brás, Miranda, & Marôco, 2014; Loveless & Ellis, 2003: p. 43). A shift in teacher roles from an ICT user to a facilitator retains the need for teachers to serve as leaders in technology enhanced classroom (lesson planning, preparation and follow-up) (Cubukcuoglu, 2013; Kreijns, Van Acker, Vermeulen, & van Buuren, 2013). Integrating ICT into the teaching and learning process should be seen as beyond the technology use only; it is what new technologies could do to promote learners understanding (Ertmer & Ottenbreit-Leftwich, 2010; Spector, Elen, Merrill, & Bishop, 2014). Using new tools, starts from finding a best fit, followed by experimentation and then practices (Somekh, 2008). Teaching with technology demands deep knowledge of processing subject matter contents and enhance learning (Mishra & Koehler, 2007; Turunen & Tuovila, 2012). Teachers' ICT use competencies is a collection of knowledge, skills, understandings and attitudes that are inseparably guaranteed with context of use and pedagogy (Doyle & Reading, 2012). The UNESCO's ICT competency framework for teachers (UNESCO, 2011: p. 17) reported basic characteristics of professional teachers as (1) ability to learn using ICT, (2) ability to solve complex real world problems using ICTs and (3) ability to create new knowledge using ICTs.

However, the TPACK and SAMR models have significant differences; they are mostly used to guide the planning, assessing, evaluating and use of technology in education (Jude, Kajura, & Birevu, 2014; Pamuk, 2012). The TPACK encompasses the connections between Technological Knowledge (TK), Pedagogical Knowledge (PK) and Content Knowledge (CK) (Harris & Hofer, 2011; Voogt, Fisser, Pareja Roblin, Tondeur, & van Braak, 2013), that contribute to teacher awareness and competencies needed for effective classroom technology integration (Brantley-Dias & Ertmer, 2013). The TPACK is a tool for examining the pedagogically sound ways in which technology can support teachers' and students' knowledge while keeping pace on the technology, content and pedagogy contexts (Brantley-Dias & Ertmer, 2013; S. H. Khan, 2014). The SAMR model is a tool for assessing and evaluating technology practices and impacts in a classroom setting by looking into students, teachers and the changes (Lund, 2015; Myers, 2014; Puentedura, 2012). The impacts of SAMR could be revealed by teachers' abilities to redefine old or traditional tasks using new technological tools (Hos-McGrane, 2014). Teachers can determine their technology level as they experience small shifts in the design of technology based learning artefacts and application of technology driven learning to achieve the next level (Ahrens &

Zaščerinska, 2014). In order to produce TPACK and SAMR-ready teacher trainees, teacher training institutions must integrate relevant tools within the teacher training curriculum that considers a continuing change as a process (Thomas, Herring, Redmond, & Smaldino, 2013).

Information and communication technology is a fundamental tool that is mostly and widely integrated in the teaching and learning process at all levels. The ability of teachers to practice pedagogical ICTs is highly influenced by the knowledge, competences and skills they received during college years (Thomas et al., 2013). In Tanzania, however, existing policies support the use of ICT in education(United Republic of Tanzania, 2003b, 2007, 2010c); there is a low intake of the pedagogical ICTs among tutors in teacher training colleges (Andersson et al., 2014: p. 9). The current syllabi focus more on teaching ICT as a subject and less on using ICT as a pedagogical tool. In addition, technology uses in secondary education suffer from lack of proper documentation proven practical. When majority of education systems around the world are shifting from teacher-student-textbook model to the blended learning model empowered by digital educational resources, it is a big challenge for a developing country to succeed without axis rigor planning. However, the TPACK and SAMR models have influenced ICT use in education; they have faced both critics and compliments. There is no framework globally accepted and applicable to all the education systems. This stand as a challenge to the future planning of what and how to enhance and transfer practical technology use skills among young teacher trainees. While TPACK has been the only framework referenced in the ICT use in Tanzanian education, it is unclear if training received by tutors could enhance sufficient TPACK characteristics on the teacher trainees (Andersson et al., 2014; Hare, 2007; Hooker et al., 2011: p. 45). Examining the impacts of TPACK and SAMR models on the current technology use practices, will build a foundation for future classroom ICT Integration in Tanzania secondary education. This study stands as a road map for teachers' classroom technology use, practices and a planning tool for technology use in secondary education.

4.2 Background to the Study

4.2.1 Teachers' Use of Technology in Tanzania Education

The Tanzania's Ministry of Education and Vocational Training (MoEVT) report addressed teachers' training priority areas as: (1) pedagogical skills for creativity and innovation, and (2)

knowledge and mastery of selected subjects, skills, and technologies (MoEVT, 2009). Technology application knowledge acquired during college could positively affect the future of technological pedagogical practices (Komba & Nkumbi, 2008; Margerum-Leys & Marx, 2002). Teachers' decision to use technology in classroom is mainly influenced by access to resources, quality of software and hardware, ease of use, incentives to change, commitment to professional learning and background in formal computer training (Mumtaz, 2000; Rastogi & Malhotra, 2013). ICT infrastructure and digital contents accessibility were improved and users were trained; however, ICTs usage in Tanzania teachers' training colleges was reported as being low (Andersson et al., 2014: p. 15; Kessy et al., 2006). The Tanzania policy for basic education addressed priority areas for ICT use improvement such as: (1) provision of ICT training to students, teachers and administrators, (2) use of ICT resources in schools and colleges, and (3) development and use of ICT as a pedagogical tool in teacher trainees (United Republic of Tanzania, 2007). In schools, pedagogical practices are not determined solely by the characteristics of the teachers, such as their academic qualifications and ICT- competencies, but by supportive infrastructure that is available in schools and system level factors (UNESCO-UIS, 2009: p. 22).

Teacher trainees' view of the technology integration has to be identified as an important aspect (Niess, 2005; Ronau, Rakes, & Niess, 2012: p. 16). Both first-order barriers − lack of adequate access, time, training and institutional support − and the second-order barriers − teachers' pedagogical beliefs, technology beliefs, willingness to change still exist (Ertmer, 1999; Tsai & Chai, 2012). In order to produce TPACK and SAMR -ready teacher trainees, teacher training institutions must integrate relevant tools within the teacher training curriculum that involves a continuing change process (Thomas et al., 2013).

4.2.2 Teachers' Technological Knowledge and Competencies

Teaching with technologies demands deep knowledge of processing subject matter contents and enhanced learning (Mishra & Koehler, 2007; Turunen & Tuovila, 2012). The UNESCO ICT competency framework for teachers (UNESCO, 2011: p. 17) reported basic characteristics of professional teachers as: (1) ability to learn using ICT, (2) ability to solve complex real world problems using ICTs and (3) ability to create new knowledge using ICTs. However, for teachers, the reasons for and the ways of using ICT in the classroom are underpinned by their

overall pedagogical vision and competence (UNESCO-UIS, 2009: p. 22). A study by Jung (2005), reports four scopes of teachers training on ICT use (see Figure 4.1) as: (1) teachers learning how to use ICT, (2) teachers trained via ICT, (3) ICT being used as a core technology and (4) ICT being used as Complementary technology.

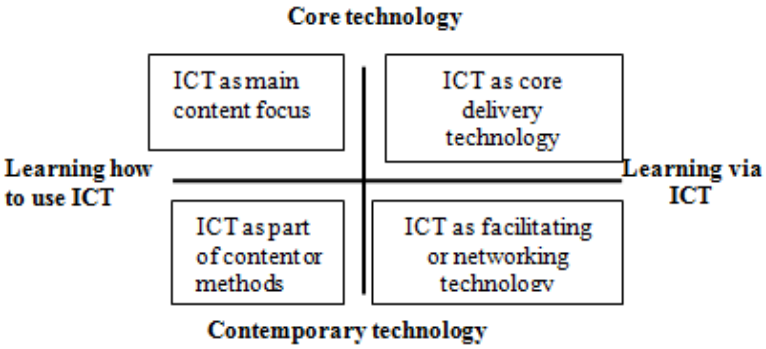

Figure 4.1: ICT Teacher Training Taxonomy (Jung, 2005)

The majority of teachers are faced with lack of knowledge on how and when to incorporate new technologies in teaching and learning, whereas their pre-college and college education have not prepared them with knowledge in these digital technologies (Ronau et al., 2012: p. 3). Three major characteristics differentiate ICT frameworks: (1) promoting technology use based on learning enhancement capabilities, (2) technology use technical knowhow, for instance general knowledge of how to use hardware and software and, (3) infrastructure and institutional capacity for instance availability of computers, software and Internet access devices (Hornack, 2011; Tondeur, Van Braak, & Valcke, 2007; Yuen, Law, & Wong, 2003).

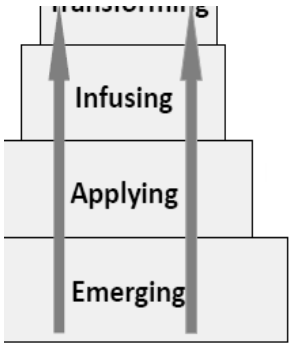

Figure 4.2: Model of stages of teaching and learning with and through ICT (Majumdar, 2009)

The use of technology in education should be a step by step guided by research, testing, and evaluation. Studies identified emerging, applying, infusing, and transforming (Figure 4.2) as broad approaches through which educational systems and individual schools should follow to effectively adopt use of ICT (Majumdar, 2009; Olakulehin, 2007).

4.2.3 The TPACK Framework

The TPACK framework is a generative framework that guides course design and evaluation for pre-service and in-service teachers' intention to integrate ICT into classrooms (Chai, Koh, Tsai, & Tan, 2011). The framework arose in the context of teacher education (Oliver, 2011), with the complex interplay of three primary forms of knowledge – Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK) − that goes beyond seeing these three knowledge bases in isolation (Koehler & Mishra, 2009). The reviewed studies (Chai, Koh, & Tsai, 2011; Koh, Chai, & Tsai, 2010) report TPACK as a multiplicative framework that continue to guide course design and evaluation for teachers' preparation to integrate ICT into classrooms. A study by (Chai, Koh, & Tsai, 2011) reported that TK, PK and CK have positive influences on TPACK while TK and PK have positive influences on TPK leading to TPK positively influencing TPACK (see Figure 4.3).

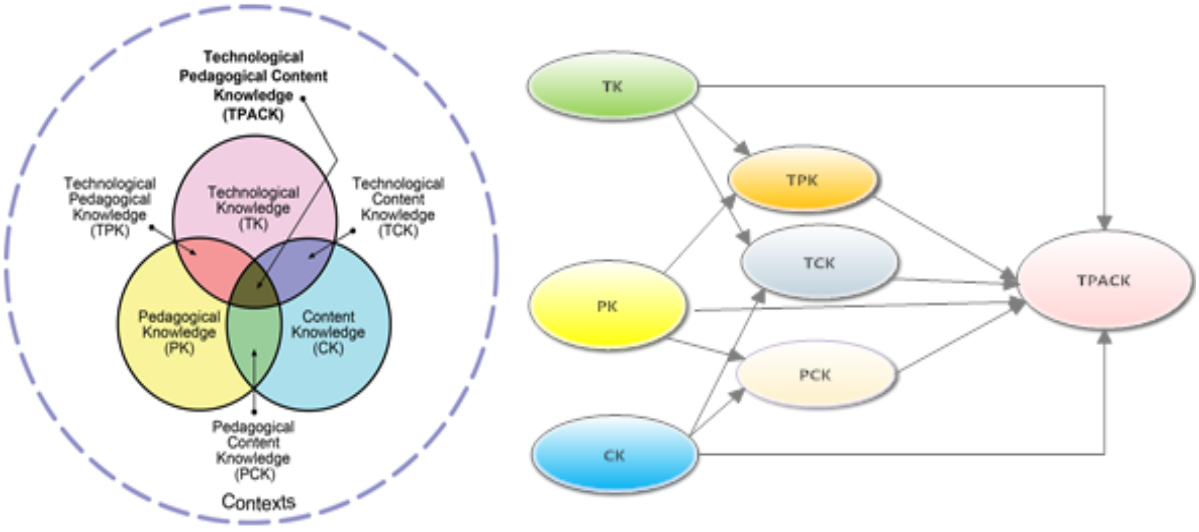

Figure 4.3: TPACK components and the extract of interrelationships among TPACK construct (Koehler & Mishra, 2009)

The Pedagogical Content Knowledge (PCK) defines teacher's ability to pedagogically adapt content to students of diverse abilities rather than just delivering subject content knowledge (Abbitt, 2011). Content Knowledge (CK) refers to the body of information that teachers teach to students in a given subject area such as facts, concepts, theories, and principles (Ball, Thames, & Phelps, 2008; Kleickmann et al., 2013). A Content Knowledge (CK) as strategic thinking incorporates knowing when, where, and how to use domain-specific knowledge and strategies for guiding students' learning with appropriate digital, information and communication technologies (Ronau et al., 2012: p. 5). The TPACK constructs − TK, PK, CK, TPK, TCK and PCK − are the basic inputs used to explore pre- and in-service teachers' technology use and can be used to adjust training to improve areas that face limitations. Three subsets of the TPACK constructs are shown in Figure 4.4.

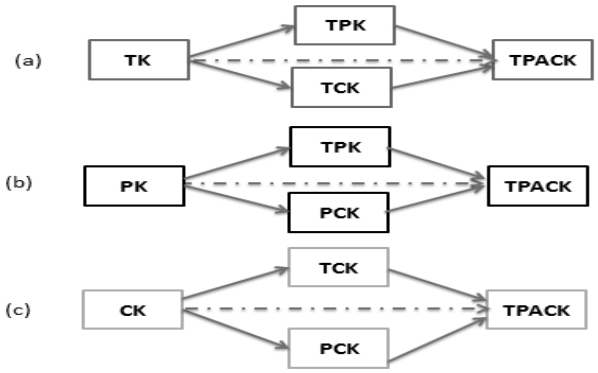

Figure 4.4: TPACK subsets mapping (modified as extracts from Koehler & Mishra, 2009)

Figure 4.4 above presented TK, PK, and CK constructs contributions to the formation of TPACK. In each set, if one member can cause a failure to realize the TPACK, resolution can be made by adjusting changes to a relevant member from within the same set. For example, in teacher trainee education course content can be adjusted to meet the inadequacies in TPACK as a whole, caused by areas that are more problematic within the set members. For instance, teacher trainees may have adequate Content and Pedagogical Knowledge, but cannot prepare a Power Point presentation, although they can use flip charts. In this case, adjustment should be made in the curriculum to make them practice the use and preparation of Power Point presentations. The TPACK alone cannot advocate for the kinds of pedagogical approaches needed to maximize learning through the effective appropriation of relevant technology tools; more aspects and frameworks are required beyond what TPACK can provide (Brantley-Dias & Ertmer, 2013).

4.2.4 The SAMR Model

Understanding the ultimate goal of technology integration means redefining how teaching and learning should be carried out using educational technologies to do things that could have never been accomplished without technology. The goal of the SAMR model (Cavanaugh, Hargis, Kamali, & Soto, 2013; Puentedura, 2012; Romrell, Kidder, & Wood, 2014) is to guide moving from substitution to redefinition and to switch from enhancement to transformation while exploring the impact of integrating technology on both teaching and learning (Figure 4 .5).

Figure 4.5: The SAMR model (Puentedura, 2010)

The classroom applications of SAMR model are as follows: (1) Substitution is used as a novel reading in online versions like e-books; for example, replacing something that could have been done locally with technology, like instead of coming with a poster into a classroom, information could be displayed using PowerPoint and a projector. (2) Augmentation focuses on dictionaries, study guides, history sites linked to online text. (3) Modification focuses on textual, visual, and audio tools for construction of shared knowledge.(4) Redefinition focuses on visualization of narrative and structural aspects of text (Jude et al., 2014; Lund, 2015; Myers, 2014; Puentedura, 2010, 2012).

The goal of the SAMR model is to guide moving from Substitution to Redefinition and to switch from enhancement to transformation (see Figure 4.5) while exploring the impact of integrating technology on both teaching and learning (Cavanaugh et al., 2013; Puentedura, 2012; Romrell et al., 2014). The SAMR emphasizes on how technology can encourage learners to think

differently. The model offers a method of seeing how computer technology might impact teaching and learning by outlining a progression that educators follow in their journey towards redefining teaching and learning with technology (Catlin Tucker, 2013). Within the SAMR model constructs, Substitution and Augmentation, represent technology usage that enhances effectiveness on existing non-digital resources whereas the Modification and Redefinition constructs describe when a technology or application leads to transformation (Hudson, 2014).

4.2.5 TPACK and SAMR Models Relationships and their Impacts

Both TPACK and SAMR models focus on technology integration in classroom. TPACK looks at the relations between Technology, Pedagogy and Content, and argues that teachers need knowledge of all three components (Abell, 2008; Moroder, 2013). TPACK presents a graphical framework for teachers to comprehend the effective integration of technology in classroom (Koh, Chai, & Tay, 2014). The SAMR model stands on the theory that classroom technology integration is fabricated on the transformation or enhancement of traditional pedagogies to the use of new efficient technologies, either through the substitution, augmentation, modification or redefinition of educational tasks (Moroder, 2013). The SAMR model is used to describe the different levels of technology integration. The lowest aspect of integrating technology, substitution, is replacing a computer or device for another technological tool without significant change to the tool's function (Cavanaugh et al., 2013; Foster, 2014; Jude, Kajura, & Birevu, 2014). It is the replacement of the older technology with the new technology. Augmentation occurs when a computer replaces another technological tool and there is a significant change in the tool's function. Modification occurs when the use of a computer results in a redesign of parts of the task. Redefinition occurs when the use of computer creates new tasks that would otherwise have not been possible without computers.

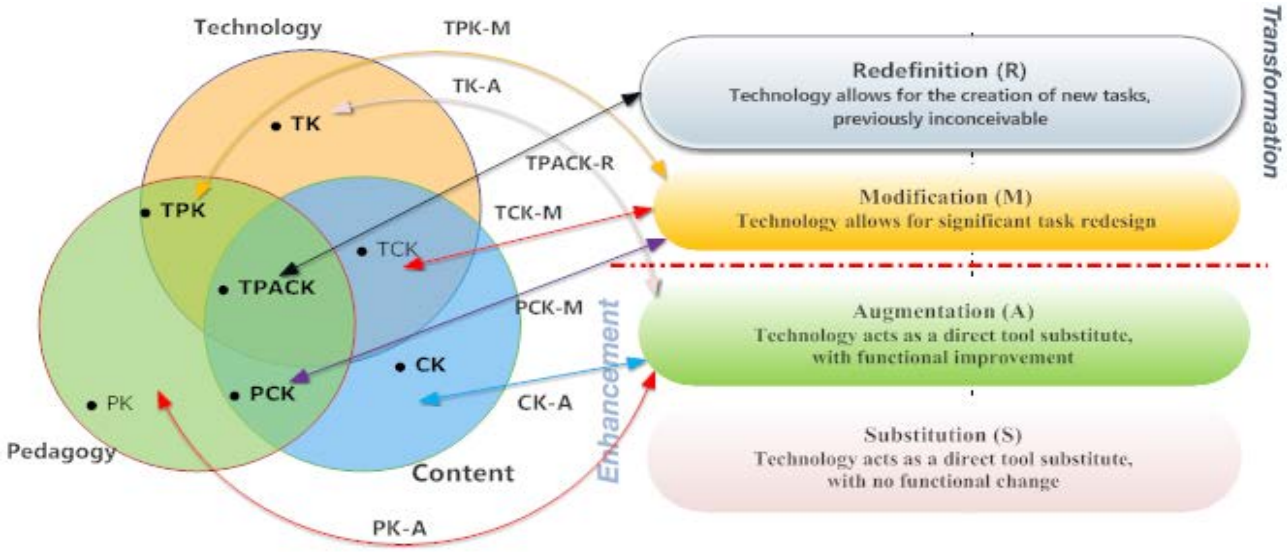

Figure 4.6: TPACK and SAMR models Correlation

The SAMR model stand on the theory that classroom technology integration are fabricated on the transformation or enhancement of traditional pedagogies to the use of new efficient technologies, either through the substitution, augmentation, modification or redefinition of educational tasks (Hockly, 2012) . The TPACK alone has been reported as "too big" and with "too small" constructs (Brantley-Dias & Ertmer, 2013). Using TPACK alone demands for additional clarification and conversation to adequately guide future educational technology use efforts (Brantley-Dias & Ertmer, 2013). Each component of SAMR which deals with technology is marched with the TPACK framework constructs that address technology as part of the construct such as TK, TPK and TCK because SAMR models does not deal with contents and pedagogy alone but deals with how technology can sustain the two.

4.2.6 Descriptions of TPACK and SAMR construct matches

The following descriptions of the TPACK and SAMR model marches come from Figure 4.6 above.

- *TPK-M*: The TPK and Modification supports TK, TPK and TCK. With modification, traditional classroom tasks can be accomplished using computer technology. For example, writing a report and share it with friends using emails address can be done using Google doc to share and work on document collaboratively.
- *TK-A:* The TK and Augmentation are related to TK, TPK, and TCK. Augmentation

acknowlegdes new technologies that extends the old ways of practices. For example, a regular power point presentation could be embedding with a sound and moving image clip just to clarify a point and enhance more knowledge.

- *TCK-M:* The TCK and modification are related to CK, TCK, and PCK. With modification, common classroom tasks are being accomplished using computer technology. The modification may assess limitations brought by lack of TCK and suggest for transformation. For example, if teachers could mark students' essays using a pen and pencil, they can start receiving a softcopy and marking by making comments, using Microsoft words tools.
- *PCK-M:* The PCK and modification supports CK, TCK, and PCK. If teachers cannot use content learning management systems to upload and download materials, the system could be installed and teachers allowed sharing knowledge, experiences, and materials with learners. Transformation could be made by assessing the TCK to eliminate the limitation and then include the commenting service in Google Docs, for instance, to collaborate, and share feedback on a given task.
- *CK-A:* The CK and Augmentation supports CK, TCK and PCK. Augmentation suggests that new technology may be used to increase efficiency adjacent to the old technology practices. For example if teacher and students could only use Ms-word to write document and save it manually and share it with others on a memory stick, enhancement can be made on TCK to enable teachers and student to use Google Docs to utilize extra services like auto saving, auto syncing, and auto sharing in the cloud.
- *PK-A:* The PK and Augmentation supports PK, TPK, and PCK. Augmentation suggests that new technology may be used to increase efficiency adjacent to the old technology practices. For example if teacher and students could only use Ms-word to write document and save it manually and share it with others on a memory stick, enhancement can be made on TPK to enable teachers and student to use Google Docs to utilize extra services like auto saving, auto syncing, and auto sharing in the cloud.
- *TPACK-R:* The TPACK and Redefinition supports all the components of TPACK. Redefinition when related to the TPACK as a whole, suggests for the overhaul; for example migrating from traditional teaching or blended learning that mix traditional with some online technology enhanced learning and completely implement full online courses

(e-learning).Old ways designed by examining TPACK will be redefined using the SAMR morel and come up with a new practices.

The equivalences between the constructs from the two models, TPK-M, TK-A, TCK-M, PCK-M, CK-A, PK-A and the TPACK-R proves that they can be used to achieve common goals using different approaches. None of the two models is alone sufficient to influence technology use in education.

4.3 Purpose of the Study

This study examined tutors' and teacher trainees' individual characteristics that revealed the opportunities and challenges faced when implementing pedagogical ICTs. Precisely, the study assessed technological knowledge, competences, skills, attitudes, beliefs, and readiness to integrate classroom technology. In addition, two frameworks (TPACK and SAMR) were used to present the evaluation aspects they embodied. The aspects of TPACK constructs were adopted from Koehler and Mishra (Koehler & Mishra, 2009) and the aspects of SAMR features were adopted from Puentedura (Puentedura, 2010). Table 4.1 indicates the frameworks constructs linkage and the aspects of variables that were used to assess tutors and teacher trainees' individual characteristics. However, these TPACK-related instruments are used; there is not yet a widely accepted instrument for measuring TPACK (Figg & Jaipal, 2012).

Table 4.1: The TPACK and SAMR Modes Attributes and the Tasks Examined

TPACK + SAMR constructs	*The Attributes Assessed by this study*
	Tutors' and teacher trainees' skills and preparedness to use technology
Technological Knowledge + Augmentation	- Creating multimedia presentation using scanners, digital cameras and video cameras; - Using office applications (e.g. word processors, presentations, spreadsheets etc.) - Accessing online resources communicating by use of computers (e.g. e-mail, Internet) - Making presentations using computers and LCD projectors. - Carrying out professional productivity using interactive media - Using animations/simulations that enhance the content of a lesson
	Tutors' and teacher trainee's knowledge and frequency of technology use
Technological Content Knowledge	-Video streaming (e.g. TeacherTube, YouTube etc.) -Blogs related to key subject areas -Interactive whiteboard software (e.g. Promethean, SMART Notebook etc.) -Audio/video editing (e.g. iMovie, Movie Maker etc.)

+ Modification	-Simulation/ animation applications -Analytical tools (e.g. statistics, charting, graphing) -Internet (e.g. Chart rooms, forums, Web 2.0 tools etc.) -Presentation software -DVD Player, Video, TV, radio, audio tapes etc. -Creative IT tools (e.g. desktop publishing, digital video, digital camera, scanners) -Spreadsheets and Microsoft Mathematics -Content specific applications (e.g. Math, Science, Social Studies, music etc.) -Informative (e.g. Internet, CD-ROM, forums) -Communicative applications (e.g. email, LCD projector, computer conferencing) -Organizational software (e.g. database, spreadsheets, record keeping, lesson planning tools)
	Teacher trainees' ability to learn classroom technology integration
Technological Pedagogical Knowledge + Modification	-Using Internet for general information searching -Searching for content specific of particular subject -Using office productivity software (Word, PowerPoint, Spreadsheet) -Teaching or sharing technology use in a classroom to others -Learning to use new piece of software -Locating learning opportunities that advances technology skills -Using technology to support curriculum standards -Integrating technology in into lessons -Designing activities that integrate technology
	Tutors' and teacher trainees' competences of technology use
Technological Pedagogical Content Knowledge + Redefinition	- Combining technology and non-technology resources in teaching - Using information technology that enhances students learning for a lesson - Supporting learning activities for individuals, small and large groups using technology - Using information technology resources for teaching and learning Mathematics independently - Assessing students learning using technology - Using information technology that enhances the teaching approaches for a lesson - Applying technology in research based practices (project/ inquiry-based / collaborative learning)

The study explored ICT functional skills that include skills relevant to pedagogical ICTs and the ICT skills for learning. The ICT skills for learning, in their turn include skills that combine both cognitive abilities or higher-order thinking skills with functional skills for the use of ICT applications in classroom settings (Ananiadou & Claro, 2009: p. 8). In this study, we answered the following research questions.

(1) Do tutors' and teacher trainees' competences and knowledge characteristics enhance their classroom technology integration?
(2) Do tutors' and teacher trainees' beliefs, readiness, and ICTs skills influence their classroom technology integration?
(3) Do the TPACK and SAMR constructs have impacts on the ICT abilities, beliefs, readiness, and classroom ICT practices of tutors and teacher trainees?

4.4 Method

The design of this case study involved quantitative and non-experimental research. It employed survey questionnaires to obtain descriptive data about the relationships between TPACK, SAMR, and current pedagogical ICT practices in teaching and learning. The study examined tutors' and teachers trainees' technology use competencies, knowledge, skills, abilities, and readiness to use ICT. We focused on pedagogical ICTs that have the potential to be used, in line with the TPACK and SAMR model constructs, to enhance teaching practices. This study believed tutors and teacher trainees with greater confidence for performing TPACK-related activities and behaviours in their classrooms, makes measure of TPACK confidence potentially useful as an indicator for the opportunities and impacts on technology use behaviour (Figg & Jaipal, 2012) which also could lead to the SAMR model practices in teacher preparation. We focused on pedagogical ICTs, which have potential influence on TPACK and SAMR models' constructs. The Practices, abilities, and skills to use numerous technologies were used for assessing the impacts of these two models; conceptually TPACK is distributed across individuals (teachers, technologists, learners) and artefacts (websites, lesson plans, books, software, technology based practices etc) (Blas, Paolini, Sawaya & Mishra, 2014).

4.5 Participants

The study involved 206 respondents from Morogoro Teachers' Training College and Mzumbe University (Morogoro campus) with 12 (5.8%) tutors and 194 (94.3%) teacher trainees comprised 158 (76.7%) pursuing diploma in education teacher trainees specialized in a pair combination of Mathematics, Physics, Chemistry, Biology, Information Technology, Audiology, and Geography, 36 (17.5%) teacher trainees from Mzumbe University pursuing bachelor's degree in education specialized in economics, and mathematics. Among the respondents 15

(7.3%) were female and 191 (92.7%) were male. The ratio of females in the study was very few, because the respondents were tutors and teacher trainees in basic Mathematics and Science subjects which generally comprised less females than males (UNESCO, 2012a).

4.6 Instruments for Data Collection

Data were collected from tutors and teacher trainees using questionnaires, observations and interviews. We adopted questionnaire parameters from previous studies (Holden & Rada, 2011; Milbrath & Kinzie, 2000; Wang, Ertmer, & Newby, 2004). The questionnaire had two sections. The first section was intended to collect demographic information such as gender, education level, technology competence level, and career specialization. The second section examined current practices and classroom ICT integration parameters. For data analysis, we used statistical software SPSS version 21.0. We employed multiple response definition of variables to formulate collective responses, reduce the density of information for each category. The data analysis was followed by frequency table generation to present consolidated variables in figures and percentages.

Cronbach's alpha test of reliability and internal consistency adopted from (Cronbach, 1951; Ferketich, 1990) was conducted on each of the items assessed. The results on Technological Knowledge and Augmentation (TK+A) attributes was ($\alpha = 0.802$, n=6), Technological Content Knowledge and Modification (TCK + M) attributes was ($\alpha=0.863$, n=15), Technological Pedagogical Knowledge and Modification (TPK + M) attributes was ($\alpha=0.877$, n=9) and the Technological Pedagogical Content Knowledge and Redefinition (TPCK + R) attributes was ($\alpha = 0.873$, n=7). The Alpha coefficient $\alpha > 0.8$ was considered good (Gliem & Gliem, 2003; Santos, 1999; Tavakol & Dennick, 2011).

4.7 Results and Discussion

4.7.1 Participants ICT Knowledge Level

The levels of competence assessed in this study were drawn from the UNESCO teacher professional framework (UNESCO, 2011: p. 39) ranked as (1) beginners (ability to perform basic functions in a limited number of computer applications), (2) average users (ability to use a number of computer applications), (3) and advanced user (ability to competently use a broad

devices and tools). Results of the assessment of ICT use competence levels of tutors and teacher trainees (N= 206) are given in Table 4.2.

Table 4.2: Tutors and Teacher Trainees ICT use Competence Levels

Categorical Groups	**ICT Competence Level**		
	Beginner (%)	*Average (%)*	*Advanced (%)*
Tutors	1.0	3.4	1.5
Teacher Trainees	60.6	23.8	9.7
Total	61.7	27.2	11.2

Results in Table 4.2 show that the majority of respondents reported their levels as beginners (61.7 % of respondents out of which 1.0% were tutors and 60.6% teacher trainees). Those who assessed their levels as average ICT users were 27.2 % (3.4 % of tutors and 23.8 % teacher trainees). The advanced ICT users were 11.2% (9.7 % teacher trainees and 1.5 % tutors). These results show that the majority of tutors considered themselves as either beginner or average users regardless of the number of years in the field. This may signal low levels of classroom ICT integration among tutors as the low level of Technology Knowledge leads to low usage (Andersson et al., 2014).

4.7.2 Respondents' Skills and Preparedness for Classroom Technology Integration

The Technological Knowledge and Augmentation attributes were used to assess tutors' and teacher trainees' readiness to integrate ICTs in classrooms. The study explored participants' knowledge and classroom use of hardware, software, and associated peripherals that intersects the TPACK and SAMR models in the attributes of Technological Knowledge (TK) and Augmentation (A). We used multiple response definition of variables followed by frequency generation that assisted to compare tutors' and teacher trainees' preparedness as shown in Figure 4.7.

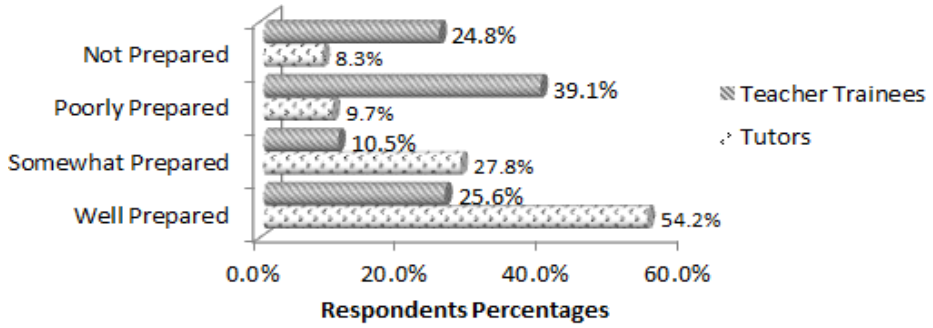

Figure 4.7: Respondents' percentages of the levels of preparedness to integrate ICTs in teaching

Figure 4.7 shows variations in the level of preparedness to integrate technology in a classroom among tutors and teacher trainees. The majority of tutors 54.2 % reported themselves as well prepared followed by 27. 8% reported themselves as somewhat prepared. Only 25.6 % of teacher trainees reported themselves as prepared while the majority (39.1%) reported themselves as poorly prepared followed by 24.8% who reported themselves as not prepared at all. Although tutors were supposed to transfer classroom technology integration to their peer teacher trainees, some of them (8.3%) did not prove to be prepared to do so. This may lead to lack of professional teachers who could transfer technological knowledge to students after they graduate and start working in schools. This means that the poorly prepared teachers could fail to mix digital and non-digital technologies in classrooms. By combining the two frameworks this drawback can be rationalized. The impact of TK would be the visualization of the digital tools, how they can accommodate contents and merge with pedagogical strategy used by teachers (Brantley-Dias & Ertmer, 2013). The Augmentation construct of SAMR would be used to evaluate old practices, reinvent technology based practices and add value to the teaching process (Hudson, 2014).

4.7.3 Respondents' Classroom Technology Use Frequencies

The TCK and Modification (M) attributes were used to assess tutors and teacher trainees' classroom rate of technology integration. Results for the percentages of use frequencies are presented in Figure 4.8.

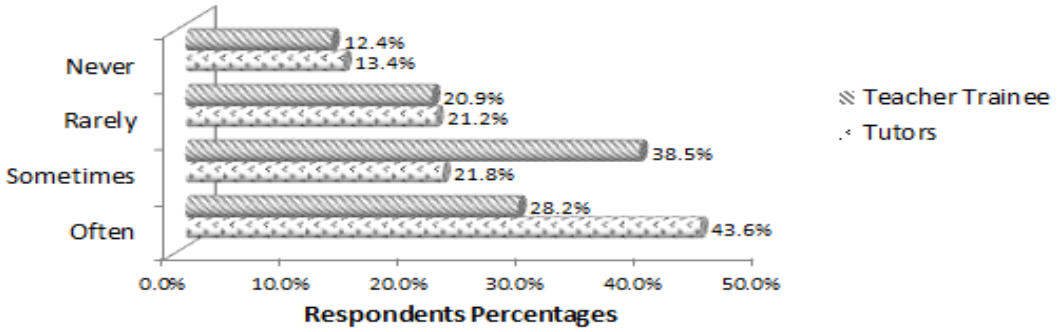

Figure 4.8: Respondents' percentages of classroom technology use

Figure 4.8 shows that there is a correlation on the frequencies of technology use among tutors and teacher trainees. The majority of tutors (43.6%) reported that they used technology often, 21.8% reported that they used it sometimes, 21.2% rarely, and 13.4 % never used technology in classroom. In addition, the majority of teacher trainees 38.5% reported that they used technology sometimes, 28.2% often used, 20.9 % rarely used, and 12.4% never used. Most of the ICT tools used were pedagogical ICT tools, either Internet based or offline. Our results match with results reported by Andersson et al.(2014: p. 9), who observed 44% of tutors used ICT for teaching and learning. The impact of the TPACK and SAMR model is of three facets:

1) The TPACK can help to uncover the affordances of pairing appropriate technology to the content teachers teach and eliminate resistance to change tutors face.
2) The TPACK could help tutors to understand which specific technologies are best suited for addressing subject-matter within their domains that can motivate teacher trainees to use technology as well (Pamuk, 2012).
3) The SAMR model (Modification) provides the best visualization for significant tools used to redesign the tasks that are more practiced traditional into technology based tactics. Good teaching facilitates learners by leveraging relevant ICT resources as meaningful pedagogical tools for building quality and effective knowledge (Ertmer & Ottenbreit-Leftwich, 2010).

4.7.4 Teacher trainees' ability to learn classroom technology integration easily

Sometimes technology is not efficiently employed because users are slow to learn and adopt the technology. The Technological Pedagogical Knowledge (TPK) and Modification aspects were used to measure teacher trainees' perception on the ability to learn the use of new ICT tools. The percentages of teacher trainees' perception on how easy they could learn technology are shown in Figure 4.9.

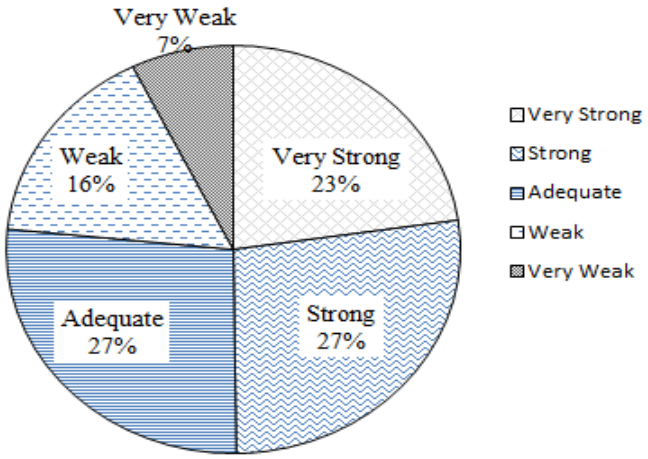

Figure 4.9: Percentages of teacher trainees' perception on personal abilities to learn new technologies

Figure 4.9 shows that 27.0% of teacher trainees reported their personal abilities as strong; 27.0% as adequate, 23.0% as very strong, and 7.0% as week. This means that the majority of teacher trainees could easily learn new skills if they were enabled with necessary tools. A study by Tsai & Chai (2012), however, reported first-order barriers (external) such as lack of adequate access, time, training and institutional support. The second-order barriers (internal) were teachers' pedagogical beliefs, technology beliefs, and willingness to change as major cause of many teacher failures to use technology. The opportunity TPK provide might be impacted negatively by the lack of pedagogical experience could limit development of appropriate technology integration approaches (Pamuk, 2012). The low number of weak teachers means that if the infrastructure (hardware and software) is at place and the organizational culture is supportive (the point of view derived from SAMR), teacher trainees could learn technology easily and would be able to perform traditional tasks using technology in different ways.

4.7.5 Respondents' Competencies on Classroom Technology Integration

The TPACK and SAMR constructs assessment focused on tutors and teacher trainees' competences based on how they prepared to integrate technology in classroom. The TPCK and Redefinition (R) constructs were used to assess various practices that involved technology to perform a task. Percentages of respondents' preparedness for classroom technology integration are shown in in Figure 4.10.

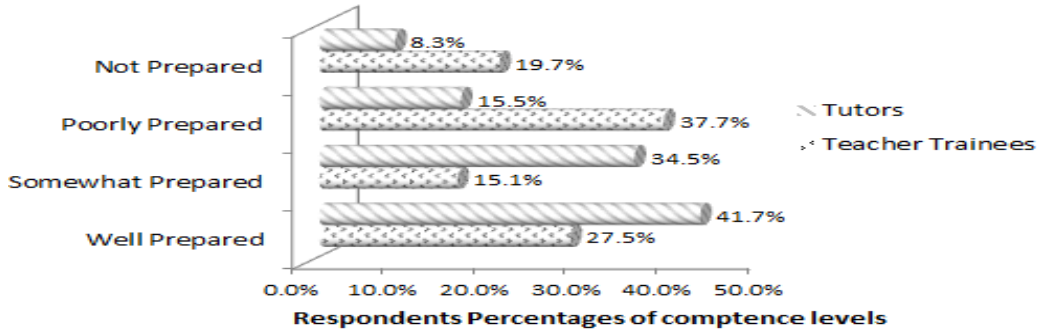

Figure 4.10: Respondents' Preparedness for Classroom Technology Integration

Figure 4.9 shows that majority of teacher trainees (37.7%) reported as poorly prepared and 19.7% as not prepared; thus more than 50% of teacher trainees were unprepared. The majority of tutors (41.7%) expressed themselves as well-prepared; and 15.1% as somewhat prepared. The percentage of those who reported themselves as poorly and not prepared taken together is 23.8%. This may lead to the situation where new teachers leave colleges without sufficient technological practice background. Developing Pedagogical Content Knowledge (PCK) is considered as an important factor over all technology integration (Pamuk, 2012); however, lack of Technological Knowledge for the 21st century teacher would make knowledge transferred to learners obsolete. True classroom technology integration can be attained when understanding and negotiating the relationships between the three components of knowledge −TK, CK, and PK (Thomas et al., 2013). The benefits and impacts TPACK and SAMR can offer are beyond competences enhancements. Redefinition stage of the SAMR model calls on all three knowledge areas− the PK, CK, and TK − in order to redefine the task (Hos-McGrane, 2014).

4.8 Conclusion

In Tanzania, local researches have focused much on teaching and learning theories and ignored teachers' classroom ICT integration and ICTs based instructional design. Today, educational information technology and pedagogical practices are inseparable fields. In this study, the competencies, and ICT knowledge characteristics of tutors and teacher trainees, was between beginner and average and could not sufficiently enhance their classroom technology integration. Both respondents categories classroom ICT integration was low. However, to some extent, the implementation of TPACK and SAMR as educational technology frameworks was noticeable. The usefulness of these two frameworks in the on-going teachers' professional development of

teacher trainees depend much upon an understanding of the technology tools and what technology by the teacher. Majority of tutors and teacher trainees have low uptake of classroom technology integration and do not sufficiently emulate the impacts of TPACK and SAMR constructs in education.

We recommend that, further work should focus on the localized classroom ICT integration framework; that consider critical limitations facing Tanzania technology use like infrastructure, curriculum support, readiness to change and financial setback. We propose on the choice of blended learning that borrows attributes of traditional learning, scaffolding, computer based learning with some attributes of online learning.

CHAPTER FIVE

An ICT Framework for fostering eLearning in the Tanzania Secondary Education[3]

Abstract

The existence of ICT policy for basic education in Tanzania influenced ICT initiatives in secondary education. For instance, few schools have received basic ICT tools and training; however, practical classroom ICT uses are more than just availing facilities. Thus, education system should focus on how to practice ICT in education initiatives for achieving effective eLearning. This paper focuses on key factors that enhance sustainable eLearning initiatives planning and implementation. It reviews relevant literatures about successful ICT use, narrates the obstacles and the requirements to the effective use of ICT. The findings indicate that ICT in education initiative should start with educational problem identification, build a vision, make a strategic implementation plan and deciding what the education system wants to achieve, not with the provision of technology. The ICT use in education becomes significant when is linked to teachers pedagogical knowledge. We developed the "Online Resources and eLearning Implementation (OREI)" framework which is a roadmap for planning, implementing, designing and delivering of eLearning. It is a framework for online educational resources use and e-learning implementation in secondary schools. The framework entails government support, stakeholders' involvements, guidelines and policies, training and recruitment, technology and infrastructures as key components. The framework expected beneficiaries are instructional designers, education policy makers, eLearning experts, teachers, and students.

Keywords: education, eLearning, ICT, ICT in education, ICT planning, secondary education, Tanzania.

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5.1 Introduction

This research paper presents a framework for fostering eLearning implementation strategy in Tanzania secondary education. Most e-Learning programs in developing countries are still often small, experiential pilot projects with little documented history of their successes and impacts (Olson et al., 2011: p. iii; Oroma, Kiden, Maghendha, & Ntiyani, 2013; Trucano, 2015; UNESCO, 2012b). An eLearning strategy is a subset of an ICT in Education policy which works as a roadmap for eLearning architecture, curriculum issues, manpower development, infrastructure and affordable connectivity planning and the design of contextualized contents whilst fostering innovation and creativity in the education sector (Manji et al., 2015: p. 8). The eLearning involves both e-content (curriculum relevant) and instruction (pedagogy) and the technology (electronic devices and the supporting services). The term eLearning refers to the instruction accessed through computerized electronic technologies, such as the Internet, intranet, compact disc, mobile devices, or other digital media; it can be combined with other teaching methods, such as printed materials and instructor-led training to reinforce learning (Centers for Disease Control (CDC), 2013: p. 4; Sangrà, Vlachopoulos, & Cabrera, 2012).The term ICT refers to hardware, software, networks, and media for collection, storage, processing, transmission, and presentation of information (voice, data, text, images) (The World Bank Group, 2003: p. 2). Four categories of ICT in education integration exist, the curricular integration (ICT activity relates directly to appropriate curriculum goals), temporal integration (a given ICT activity relates directly to other subsequent classroom learning activities), spatial integration (the use of ICTs are separated in place from other learning activities) and pedagogical integration (the choice of particular ICT is consistent with and between the pedagogical philosophies and the learning styles of the students) (Avidov-Ungar & Iluz, 2014; Ham et al., 2002; Lim, 2006). Best practices for an e-learning implementation in the education system starts by addressing distinct goals, and expectations for encountering contrasting challenges, and operate in a local and specific educational and policy context (Patil, Thomas, Michalchik, & Moorthy, 2014). An integrated eLearning replicates elements from face-to-face learning, distance education, and some forms of structured practical work that make up best elearning approach. Integrated e-learning refers to a web-based learning approach and use of online resources in such a way that it is an effective part of a well-designed educational system with pedagogical, technological and organizational features that contribute to achieving

education goals (Jochems, Merriënboer, & Koper, 2004: p. 5). Elearning success needs the e-environment, study technologies, the teacher's competence and activities, and the teaching process and its elements (Bouhnik & Carmi, 2012). The planning and implementation of eLearning should intend to deliver answers to the why integrate technology, how ICT implementation could be effective, and the key determinants of whether ICT implementation improves teaching environment, particularly, teachers' effectiveness and learners knowledge (Al-harbi, 2014). In the era of information, abundance, diversity, and distribution, organizations must put things in order by defining standards for everything (Varlamis & Apostolakis, 2006a). In most of developing countries, scarce resources are increasingly allocated to hardware that is, poorly maintained, underused, badly used, or even, in the worst cases, not used at all because the most basic and essential support services have not been well planned and made available to schools and teachers (Asian Development Bank (ADB), 2012; Ottevanger, Akker, & Feiter, 2007: p. 24). The Malaysian education blue print 2013-2025, prioritizes teachers training on the use of ICT in teaching and learning, increasing the number of computers and reducing student-to device ratio as among the best practices for the ICT in education initiatives (Malaysian Government, 2012b: p. 177). The position of monitoring and evaluation used as a unique framework or strategic plan helps realization of the ICT in education master plan by assessing the performance level, risks to be managed, and critical success factors (Rodríguez, Nussbaum, López, & Sepúlveda, 2010).

In a country with an annual intercensal 2002-2012 growth rate of 2.7%, the population in Tanzania is expected to double by 2038 (United Republic of Tanzania, 2013a). The efforts on ensuring better education for all need to be scaled up by all means necessary including the use of ICT and skills imperative to transform information into knowledge. The Internet penetration hit at 14.0% in 2014 (Manji et al., 2015: p. 124). The government's willingness to enhance ICT use in secondary education is addressed in the policy of ICT in basic education as pedagogical, communication, management and e-content enhancement tools (United Republic of Tanzania, 2007). Three major components co-exist to create the conditions for a new generation of digital learners that make eLearning – the digital pedagogy, the digital content (including eCurriculum) and eLearning spaces. However, the Tanzania government and stakeholders have invested in number of ICTs in education projects, the uptake of ICT in teaching and learning among teachers and students have remained very low (Andersson et al., 2014; Ndibalema, 2014; Oroma

& Mduma, 2013; Swarts & Wachira, 2010). When planning for elearning, the most critical challenge is to ensure that teachers and learners have the skills to use available technologies to maximize learning (Misko, Choi, Hong, & Lee, 2004: p. 2). In this paper, a research that focused on developing a framework needed to guide the planning and implementation of eLearning initiatives. The developed framework, "Online Resources and eLearning Implementation (OREI)", underpins the key components that constitute a typical eLearning implementation cycle in Tanzania, and proposes how they should be interrelated for ensuring sharing and access to relevant online education resources, collaboration, and quality in the delivery of knowledge through integration and harmonization of ICT in education practices. Specifically, the integrated ICT framework will enhance planning that use specific strategies and set implementation plans for enhancing use of appropriate hardware, software and e-contents, provide and improve ICT infrastructures, training and recruitment, working e-learning models, develop guidelines for e-learning curriculum, integrate ICT in management functions, and promote ICT research and development domains.

5.2 Background

5.2.1 ICT in Education Practices in Developed Countries

The Central and West Asia basic education assessment of ICT in education policies and implementation strategies reported that, no single developed country with ICT in education framework and practices that could directly be replicated in less developed countries (Asian Development Bank (ADB), 2012). The case studies in Canada, Europe and USA reported key features for the eLearning implementation practices as: training teachers to have basic ICT skills, developing local curriculum relevance curriculum and make use of some blend of print, audio, video, television, computers, internet, small group face-to-face, and traditional classroom-based learning (Baker, Bliss, Chung, & Reynolds, 2013: p. 19). The Intel education transformation research carried out in nine countries (Argentina, Bosnia, Brazil, Turkey, South Korea, Malaysia, Portugal, China, and Macedonia) reported two standard practices for ICT in education initiatives as: (1) Plan and design, and (2) Implementation (Chatterjee, Patil, Light, Momoh, & Pierson, 2014: p. 15,39). The planning and design should comprise vision clarification, setting of practical and measurable goals, design of an effective technology usage model, creating digital curriculum and resources (modernize curriculum and assessment), build and develop leadership at all levels, modernize policies to align with goals , and encourage

stakeholders support and collaborations (Chatterjee et al., 2014: p. 15). The implementation phase address seven principles such as: infrastructure studies and pilot projects, plan logistics of mass rollout, training and recruitment, technical support, provide opportunities for monitoring and evaluation, plan for sustainability and, navigate the changing environment created as a result of the political context generated by the initiative (Chatterjee et al., 2014: p. 39). Reporting the uptake of ICT in education in Australia and Korea, Misko et al.(2004: p. 9) showed strategic framework, and associated national, state and territory action plans for education and training for schools as general rules for best practices that creates the appropriate environment to enable the development of e-learning.

5.2.2 ICT in Education Practices in Sub-Saharan Africa

In sub-Saharan Africa, the rate of ICT in education integration is of low priority when compared to other objectives and they occur relatively slowly (UNESCO, 2015). For example many have increased the number of schools and student enrolment in response to achieving universal primary education for all stated in the Millennium development goals (Andersson et al., 2014; Basic Education Statistics in Tanzania (BEST), 2012; GESCI, 2011b; Nengo, 2012; UNESCO, 2012a, 2012b; United Republic of Tanzania, 2013b). The most addressed factors in the ICT and education policies are the vision and planning, infrastructure, teachers training, skills and competencies, learning resources, technology deployment, monitoring and evaluation, research and innovation and the equity, inclusion and safety (Trucano, 2012). Most developing countries have placed hardware provision by itself as the solution to a range of educational problems, while the provision of hardware and software is not the same thing as its effective educational use (Bailey, Schneider, & VanderArk, 2012; Bauer & Kenton, 2005; Bax, 2003; Brunello, 2010; Kessy et al., 2006; Oroma et al., 2013; Trucano, 2010, 2015). Some of the previous ICT in education worst practices in developing countries are: dumping hardware in schools without relevant educational e-contents, transferring ICT-related practices from developed countries classrooms to the less developed education systems and lack of users contextualized details and the training and manpower development on technical , pedagogical and management issues related to ICTs (Trucano, 2010). When implementing the eLearning, the unexpected may always happen thus a framework helps resolve issues and move the process forward without much delays and deviations (Rush & Huang, 2012: p. 6).

5.2.3 E-learning Developmental Projects in Tanzania

The Tanzania Development Vision 2025 which lead to the development of the National Strategy for Growth and Reduction of Poverty (NSGRP), identified education as a priority segment and ICT as a powerful and critical tool in the fight against poverty (United Republic of Tanzania, 2010a: p. 66). The completion of the SEACOM project and the Eastern Africa Submarine Cable System (EASSY) networks in 2009-10 and the launch of the National ICT Broadband Backbone (NICTBB) (2010-2012) contributed much to the Tanzania ICT sector (Esselaar & Adam, 2013). They reduced internet broadband connections tariffs that education sector has also benefited (Materu-Behitsa & Diyamett, 2010). Both the Tanzania National Secondary Education Development Programme II (SEDP-II July 2010–June 2015) and the ICT policy for basic education acknowledged ICT as of high priority for leveraging many challenges Tanzania needs to overcome to provide quality education for all (United Republic of Tanzania, 2007: p. 14,15, 2010d: p. 15). The e-Schools forum initiative 2006 forecasted more than 2000 schools to have ICT tools by 2015, but has never achieved it (Hooker et al., 2011; Nyirenda, 2013). The National Programme for ICT for Secondary Schools' Teachers initiative 2005 to 2008 targeted to eradicate ICT illiteracy and improve ICT infrastructures in all public teacher training colleges (Hooker et al., 2011). Only 50 secondary schools and 34 government teachers' colleges were supplied with computers, projectors and the digital learning contents (Andersson et al., 2014: p. 6), however the ICT use remained low and unsustainable. Recently, the Science, Mathematics and English (SME) ICT project by the Global E-Schools and Communities Initiative (GESCI) offered few schools with e-contents, projectors and laptops and trained teachers on ICT use in classrooms (GESCI, 2011b). Despite of all these efforts, the use of ICT in education in both secondary schools and teacher training colleges has remained very low.

5.2.4 The challenges of eLearning implementation in Tanzania

The biggest challenge to effective implementation of eLearning is poor ICT in education initiatives practices and lack of good understanding to the overall end-to-end chain of eLearning projects. Much effort were put to hardware and software availability while potential factors of strategic planning and implementation framework of the relevant ICT policy do not exist. Reported challenges that inhibited ICT in education, particularly eLearning implementation are: lack of ICT infrastructures, technology affordability and accessibility, curriculum irrelevance that do not clearly define the roles and possibilities of ICT at different levels of learning and lack

of strategic ICT in education implementation plans (Hare, 2007, p. 28; Mtebe, 2013; Muhoza, Tedre, Aghaee & Hansson, 2014; Tedla, 2012). The local development of e-contents is inadequate leading to the lack of e-contents that are aligned to the existing curriculum (Andersson et al., 2014; Muhoza et al., 2014; Oroma et al., 2013). The reason that existing ICT syllabi have focused more on teaching ICT as a subject and less on using ICT as a pedagogical tool is an obstacle to ICT pedagogical skills (Nihuka & Peter, 2014; Nyirenda, 2013). Other challenges are lack of appropriate software and educational learning environments that provide the right kind of teacher and user-friendly e-materials in local languages, lack of clear guidelines for effective management of ICT projects, lack of adequate financial support, teachers lack of ICT skills and knowledge to apply in classroom, lack of Government ICT4E policy awareness (Barakabitze et al., 2015; Kessy et al., 2006; Mtebe, 2013; Muhoza et al., 2014). Further, challenges include unreliable power supply, unreliable Internet connection, lack of affordable maintenance and support services and, teachers' attitudes and beliefs about ICT (Andersson et al., 2014: p. 6; Kisalama & Kafyulilo, 2012). The chain of existing recursive challenges cannot be solved if the root courses have not been resolved. For example, recent Science, Mathematics, and English (SME) ICT project invested in hardware, software, multimedia, user training, and adopted e-contents from elsewhere local contextual and teachers could not use them sustainably. The project was planned and implemented based on ICT policy for basic education; the project proposal lacks the guiding principles that could only be mapped from the policy strategic plan and the implementation framework.

5.3 Problem statement

Effective eLearning application in African countries could only be realized when the ICT in education policies, the policy vision strategic plan and the implementation framework are well mapped (Manji et al., 2015: p. 9). The concept of eLearning integration into an education system begins with the teacher and the ways in which teachers teach. In Tanzania, the penetration of ICT has significantly increased; however, it has been slow to integrate ICT as classroom pedagogical tools. The inhibiting obstacles to the ICT in education initiatives have been mostly related to: (1) policy, (2) economical, (3) social change, belief and dynamics, (4) technical know-how, (5) pedagogical-technological integration deficiency and (6) technology-infrastructures support. Recently, the UNESCO Institute for Statistics (UIS) reported Tanzania as among twenty one countries in sub-Saharan Africa without policy implementation strategic plan on ICT in

education (UNESCO, 2015: p. 9). Across the country, there is teaching and learning about the ICTs but less of classrooms ICT pedagogical applications. However, few secondary schools were provided with hardware and e-contents adopted from elsewhere; traditional teaching and learning approaches that do not borrow modern technologies have prevailed. In all teacher training colleges ICT user training was offered, e-contents adopted in DVDs, power supply provided, personal computers supplied, projectors and other multimedia tools provided; but still there are low classroom ICT usage (Andersson et al., 2014: p. 9).

In the previous studies, attentions have been on fiscal resources, learning content, user attitudes, and financial sustainability; however, the biggest challenge to effective implementation of eLearning is poor practices and lack of good understanding to the overall end-to-end chain of eLearning projects. In many cases, there has been lack of proper and clear systems for harmonizing the projected education objectives and the ICT use strategic plan. Decision makers think that availing ICT hardware in schools solves everything, off-the-shelf practice can always work, e-content can be planned for later and get imported. In this study, we identified two constraints that prevent teaching and learning with ICT and manifestation of the impact of ICT because technology is being used with old ways instead of harmonized practices. The constraints are uncoordinated planning and implementation of integrated eLearning. A roadmap should be established for coordinating all key requirements and avoid wasting resources, time, and efforts of various ICT players and decision makers (Barakabitze, 2014). A harmonized framework, which sets priority to the availability of ICT in education implementation strategic planning is a must.

5.4 Methodology

In this study, our objective was to develop a framework that guides the planning, implementation and the monitoring and evaluation of integrated eLearning in Tanzania secondary education. To do so, we investigated the following key questions using a design research approach (Wang & Hannafin, 2005).

i. What is the typical eLearning implementation cycle in Tanzania?
ii. How are the key components of the cycle interrelated?
iii. What are the requirements for the eLearning implementation cycle in Tanzania?

iv. How are the activities constituted in the requirements' components analyzed and presented?

To answer the above questions, we comprehensively reviewed policies, strategic plans, frameworks, ICT initiatives scenarios and previous literatures that provided us with key information that we used to realize the requirements for eLearning planning and implementation in Tanzania secondary education. For example, this study have generally focused on what factors make ICT in education initiatives more successful; what are the obstacles these initiatives face; and how these obstacles can be weakened to enhance sustainability. The framework requirements were identified from the themes related to the purpose, ICT in education policies and practices in developed and less developed countries. Other themes include the developmental ICT projects and practices carried out in Tanzania and the challenges of eLearning Implementation. This study identified some of the potential existing documents that promoted ICT use in the Tanzania secondary education. However, documents that are important but do not exist were also identified and briefly described.

The ICT in education enhancement flow diagram and the available documents were identified. The "Online Resources and eLearning Implementation (OREI)" framework components and sub-components requirements were tabled and described. The framework conceptual block diagram narrated the interrelationships between major components to express the input, processing, and the output components. Using a Unified Modelling Language (UML) activity diagrams, the components and sub-components were presented to describe the OREI framework dimensions, measures, and interrelationships. Specifically the study used two procedures:

- Identified the framework components also regarded as requirements and aligned them to individual activities and actors.
- The study used Unified Modeling Language (UML) activity diagrams to describe the "Online Resources and e-Learning Implementation (OREI)" framework activities and actors. The descriptions dimensions, measures, and interrelationships enhanced the transparency of the framework activities.

The UML actvity diagrams were translated as a description of how the framework components are linked to one another. Based on the interractions of each component the importance of the designed framewrok can be realised as a harmonised framework which guides the ICT in education planning and implementaion feasibility.

5.4.1 Tanzania eLearning Implementation Cycle

The authoritative hierarchical document flow for the planning, design and implementation of eLearning in the Tanzania public secondary education should rise from the available policies, plans and guidelines. The UNESCO Institute for Statistics (UIS) define an education ICT policy as a government-issued document that set out the principles, guidelines, and strategy for ICT in education enhancement (UNESCO, 2015: p. 9). A plan is defined as an important instrument that documents these principles and how they are to be achieved within a specified timeframe and details each activity to be undertaken, the method employed for implementation, the timeframe, the resources required and the actors responsible for implementing each activity (UNESCO, 2015: p. 9). Some of the essential and existing documents (Figure 5.1 below) that have laid foundation to the ICT in education are the Tanzania vision 2025, The National Strategy for Growth and Reduction of Poverty (NSGRP-II), Education Sector Development Programme (ESDP-II), Tanzania national ICT policy, and the National ICT Policy for basic education.

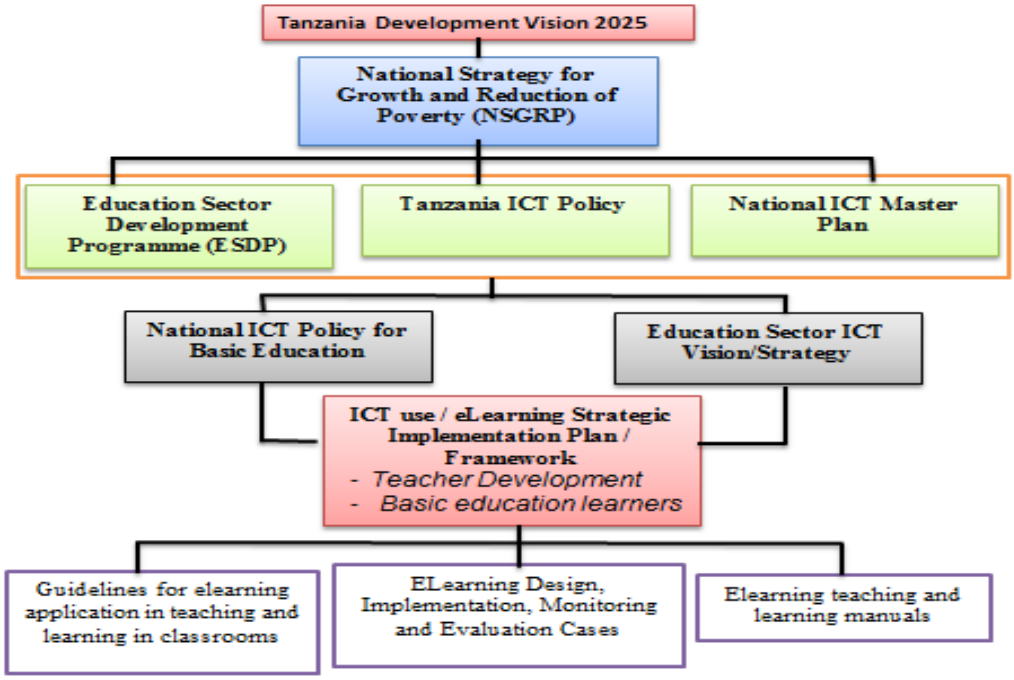

Figure 5.1: A Hierarchy of eLearning Planning and Influential Documents

However, there are non-exiting documents that have been obstacles to the ICT in education initiatives planning and implementation (marked with 'X' in Table 5.1).The documents that do not exist were identified based on the comparison between Tanzania initiatives and the eLearning initiatives in other developing countries.

Table 5.1: E-learning Planning and Implementation Potential Documents

Document/ Vision/ Policy/ Strategy/ Framework	Objective / Focus	Availability
Tanzania Development vision 2025 (TDV 2025) http://www.tzonline.org/pdf/theTanzaniadevelopmentvision.pdf	Long-term plan for national development (high quality livelihood, good governance, a well-educated and learning society, strong and competitive economy)	Available and clearly stated
National Strategy for Growth and Reduction of Poverty (NSGRP II) (United Republic of Tanzania, 2010a)	It is a vehicle for realizing Tanzania's Development Vision 2025.	Available and clearly stated
Education Sector Development Programme (ESDP II) (United Republic of Tanzania, 2008a)	ESDP vision is to promote effective and cost efficient provision of educational infrastructure and ICT.	Available and clearly stated
National ICT Policy (United Republic of Tanzania, 2003a)	Points on ICT Infrastructure and ICT solutions that could enhance sustainable socioeconomic development and accelerated poverty reduction both nationally and globally. The mission is to enhance and encouraging beneficial ICT activities in all sectors.	Available but outdated
National ICT Master Plan	Present detailed ICT application goals and milestones in all sectors by addressing the TDV 2025, NSGRP II, and ESDP II.	X
National ICT policy for basic education (United Republic of Tanzania, 2007)	The policy is categorized into six areas of Infrastructure and Technical Issues, Curriculum and Content, Training and Capacity Building, Planning, Procurement and Administration, Management, Support and Sustainability, Monitoring and Evaluation. It works as an education Sector ICT Vision/ Strategy.	Available and clearly stated
ICT in Education Implementation Strategic plan/Framework	Sets priorities, defines the solution that works, defines phases of implementation and the approaches for ICT in education implementation. Defines results in each phase.	X
Guidelines for classroom ICT use in teaching and learning	These are learner centered instructions that instruct on how to use tools that teachers should reference when leading students in classrooms.	X

ELearning Design and Implementation strategy cases	These are typical solutions defined to lead the use of eLearning approaches (e.g Content management system, Learning content Management systems, webpages, etc)	X
Elearning teaching and learning manuals	- Teachers and students guidance for using e-contents. - Computer applications users' manuals	Incompletely available

A comprehensive list of the general eLearning implementation requirements comprise of funding, government support, hardware and software availability, vision and measurable goals formulation, digital curriculum and resources, leadership at all levels, policies aligned with goals. Others include stakeholders support, infrastructures, professional development and ongoing training for users and administrators, opportunities for feedback, evaluation, and self-reflection. In addition, the use of locally developed e-contents libraries, internet connectivity, ICT experts, instructional resources, localized language of the Internet and contents, sustainable power supply, accountability, achievement Standards, curriculum relevance and guidelines that support the use of ICT in classrooms.

5.4.2 The Online Resources and eLearning Implementation (OREI) Framework

In most of public education system, the government acts as the main facilitator to maintain standards, control effectiveness, and sustainability. The requirement components for the design of the framework for online resources and eLearning implementation (OREI) focused on taking advantages of the strengths and opportunities available and resolving the weakness and challenges that inhibit the use of ICT in education. The OREI is a framework for online educational resources use and e-learning implementation in secondary schools. About the online resources and eLearning implementation in Tanzania, we summarized the requirements into seven components: (1) government support (political will and commitment), (2) potential users training and recruitment (teachers, students, technician, developers, and administration), (3) stakeholders' involvements (research institutions, communities, and development partners) and, (4) Policies and guidelines formulation and reviews. Others are: (5) technology (developing or outsourcing of technology and digital content library), (6) deployment of relevant supporting infrastructures (e.g. hardware, software, multimedia systems, and tools), and (7) monitoring and

evaluation practices. In this study, we categorized the factors into seven main components and several subcomponents (Table 5.2 below).

Table 5.2: The OREI Design Requirements

Main Component	**Sub-Components**
i. Government Support	a) Strategic Plans b) Budgeting and financing c) Digital Contents development plans
ii. Training and recruitment	a) Training potential users b) Recruitment of experts
iii. Technology enhancement	a) Digital contents development unit b) Digital contents libraries c) Enhance access to relevant Open educational resources
iv. Infrastructures	c) Hardware, Software d) Internet connectivity e) Sustainable power supply f) Establish regional /zonal digital contents centers
v. Guidelines/Policies	a) eLearning implementation policies and guidelines b) Quality control guidelines c) Review of existing curriculum and syllabuses
vi. Stakeholders involvements	a) Research institutions b) Training institutions c) Community awareness and support d) Educational materials publishers e) ICT in education front runners consultants
vii. Monitoring and Evaluation	a) Establish eLearning performance monitoring and evaluation criteria b) Establish quality control reporting mechanism c) Follow-up on achievements and Limitations

A framework conceptual block diagram that relates each of the main components was developed and presented (Figure 5.2 below). The OREI planning and implementation ecosphere indicates components interrelationships and the output for the systematic framework execution.

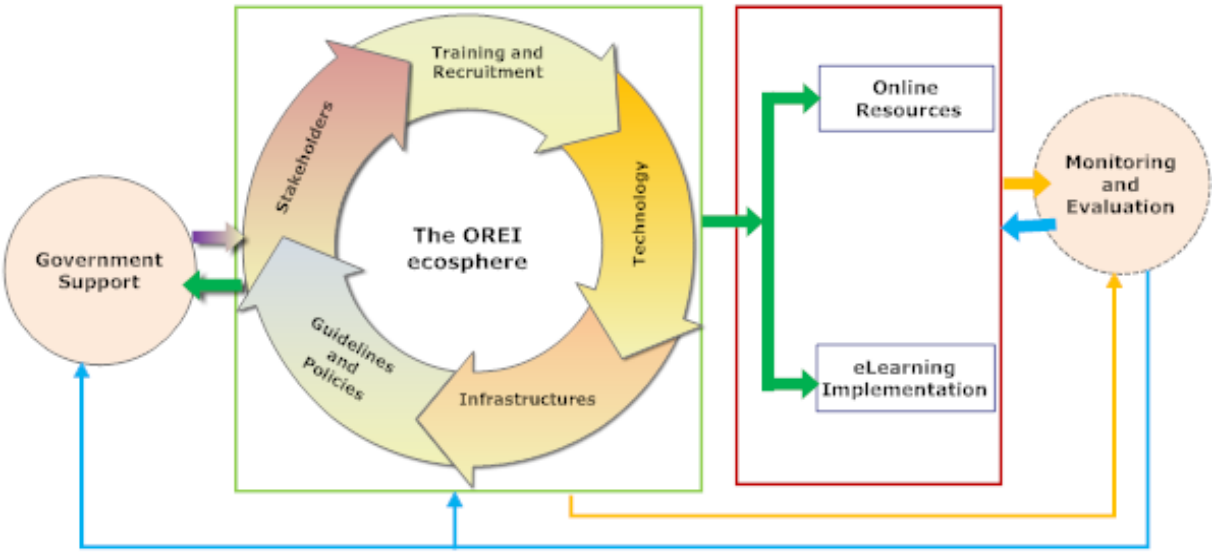

Figure 5.2: A Conceptual Presentation of the Online Resources and e-Learning Implementation (OREI) Framework

The framework planning and implementation ecosphere has five components that depend on the government support as potential input. The planning contains government support, policy and guidelines development and, the training and recruitment of potential online resources and eLearning users. The implementation involves the infrastructures deployment, stakeholder's involvements and, the technology availability (development or outsourcing and installation of the required technology).The online resources availability, and the eLearning implementations are the results of planning and implementation. The whole process should be assessed using monitoring and evaluation practices common to many projects of the kind.

5.5 Discussions and Illustrations

The UML activity diagrams were used to analyze and describe the dimensions, measures, and interrelationships for the framework main components. The OREI is a framework for online educational resources use and e-learning implementation in secondary schools. The OREI framework is practically divided into three major phases: (1) the planning, (2) the implementation, and (3) the monitoring and evaluation. The Planning phase involves the government support (political will), development of policies and guidelines, and the training and recruitment of experts and potential beneficiaries. The Implementation phase involves the choice of technology, deployment of infrastructures and stakeholders involvement. The last phase is the monitoring and evaluation that stands as a unique stage carried out continuously to measure

success and meeting of the planned objectives. This study did not deeply discuss the monitoring and evaluation phase, because this phase is common to almost all ICT projects that are carried out in different settings.

Each component of the OREI framework saves a purpose. A summarised influential practice for each component presented by the framework is in Figure 5.3 below:

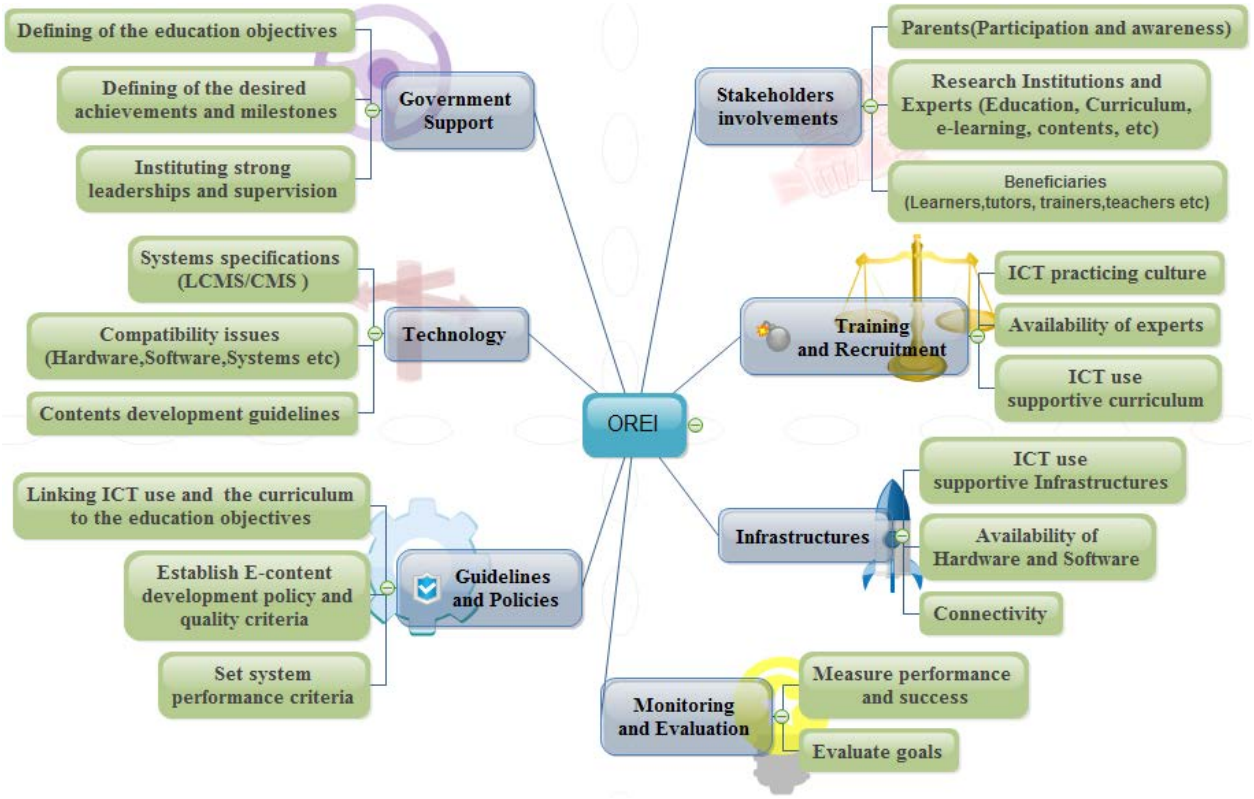

Figure 5.3: OREI Framework Componential Operations

- ***Planning phase***

In all public secondary education, the practical use of the OREI framework must start with government support. The government formulates policies and vision, sets goals, makes the implementation strategic plans available and achievable. The level of training and recruitment of potential ICT in education users have to be planned and decided by the government agencies. The budget for procurement of relevant infrastructures and deployment of working technology should pass the parliament votes making the government (political willingness) as important item above all. Any public education reform cannot succeed without the government support. Redecorating education systems using online resources and eLearning application is one kind of

reform, which should involve many factors that needs to be planned and integrated for realizing a common goal.

There are many eLearning settings and technologies available to use in schools, each with their own advantages and applications. In a study by Ottevanger et al.(2007, p. 18), reported planning for improving teaching and learning processes in schools using ICTs puts forward a foundation in policy specification and coherence, review of curriculum content and, a more comprehensive teacher training and supporting programs. In Tanzania, the use of ICT in secondary education have poorly progressed, because of low budget set by the government for purchasing most expensive ICT tools while other challenges like lack of enough textbooks, lack of sufficient classrooms and teachers shortages continued to stand as obstacles to the education sector performance. The use of e-Learning broadly comprises many teaching approaches, types of technologies and administrative practices that demands planning before being practically implemented. The government support on the eLearning planning phase has positive influence on the development of policies, guidelines, and the training and recruitment of potential users (see Table 3 below). The availability of a long-term strategy for sustaining and mounting key eLearning policy implementation elements, such as ICT infrastructure and teacher competencies leads to building on established foundations (Malaysian Government, 2012b, p. 168) The availability of the vision and implementation strategy for the ICT in education moves the desired goals closer to reality.

Table 5.3: Planning Phase Framework Components, Activities, and Actors

Components	**Activities**	**Actors**
1. Government Support/Political will	i. Understanding of the vision, goals and plans ii. Explore funding sources a) Internal funding sources-establish strategies for gathering funds b) External Funding sources-write proposals iii. Plan for change c) Conduct SWOC (Strength, Weakness, Opportunities and Challenges) analysis for the digital contents and blended learning implementation d) Change plans and Documentation e) Assess the quality of teaching and	a) Policy makers b) Digital contents experts c) Beneficiaries(Tutors, Teachers and students) d) E-learning experts e) Curriculum development experts f) Instructional designers g) Financial consultants

	learning approaches to be implemented f) Empower / negotiate with training institutions iv. Establishing Strategies and standards – Conduct a comprehensive SWOC analysis for digital contents application/Blended learning implementation v. Establishing of Implementation indicators – Set priorities – Set level of activities precedence	h) ICT experts i) Development partners
2. Develop Policies and Guidelines	i. Review teaching and learning frameworks to lead the use of digital content g) Develop instructional instruments h) Review classroom teaching manuals i) Establish students learning guidelines ii. Establish performance assessment policies j) Introduce Trainers performance assessment Policy k) Establish teachers training ICT policy l) Establish Students ICT use manuals and policy	a) Digital contents experts b) Instructional designers c) E-learning experts d) ICT experts e) Government Agencies f) Beneficiaries (Tutors, Teachers and Students g) Training institutions h) Researcher institutions
3.Training and Recruitment	i. Conducting training level needs assessment m) Assess training institutions abilities to carry out desired training n) Identify trainees' level of technology use competences o) Conducting ICT training needs assessment ii. Establish ICT training programmes to enforce sustainability of the desired skills p) Develop training manuals q) Develop digital contents for training r) Improve all the needed infrastructures for training purposes s) Establish mechanism for quality control and knowledge assessment for trainees iii. Recruit experts t) Conduct needs assessment for the categories of experts required u) Establish departmental units to deal with digital contents v) Promote committed schools management	a) Training institutions b) ICT experts c) Government agencies d) E-learning experts e) Development partners

The Use-Case diagram for the Planning of the online educational resources and eLearning implementation as in the OREI framework is presented in Figure 5.4 below. In this use case, there are three components and eleven actors referring to Table 5.3 above.

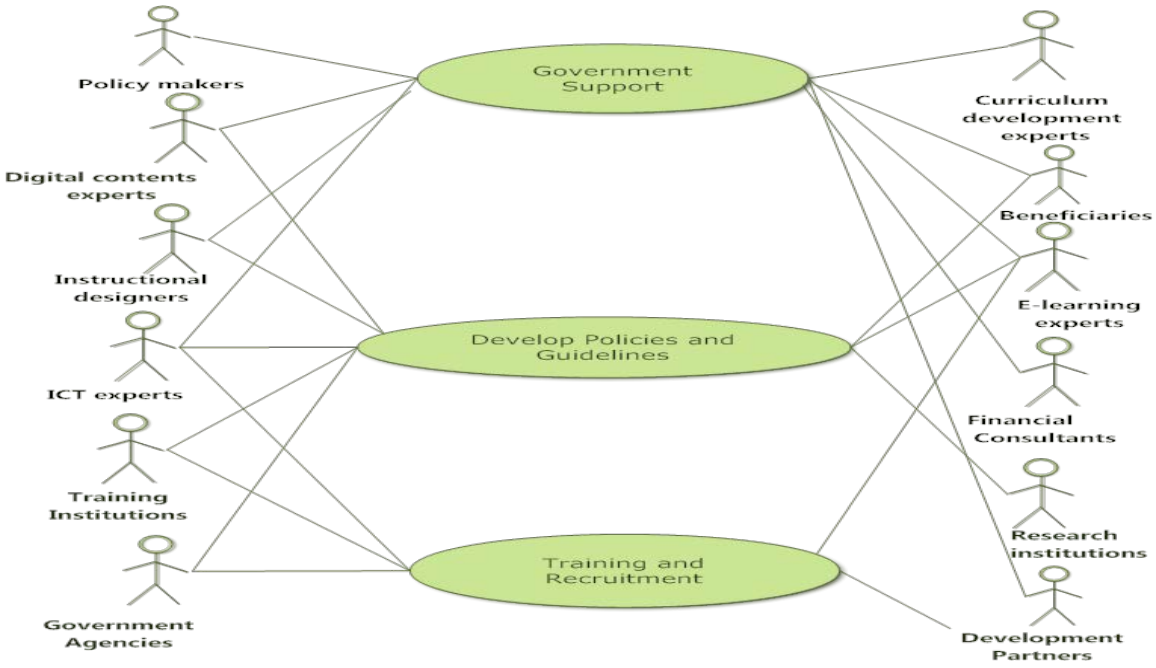

Figure 5.4: Planning Phase components and actors Use Case diagram

The Activity diagram (Figure 5.5 below) shows the flow of activities within a system of OREI framework individual components that should be implemented in the planning phase. In this case, the activity diagram summarizes the planning phase subcomponents.

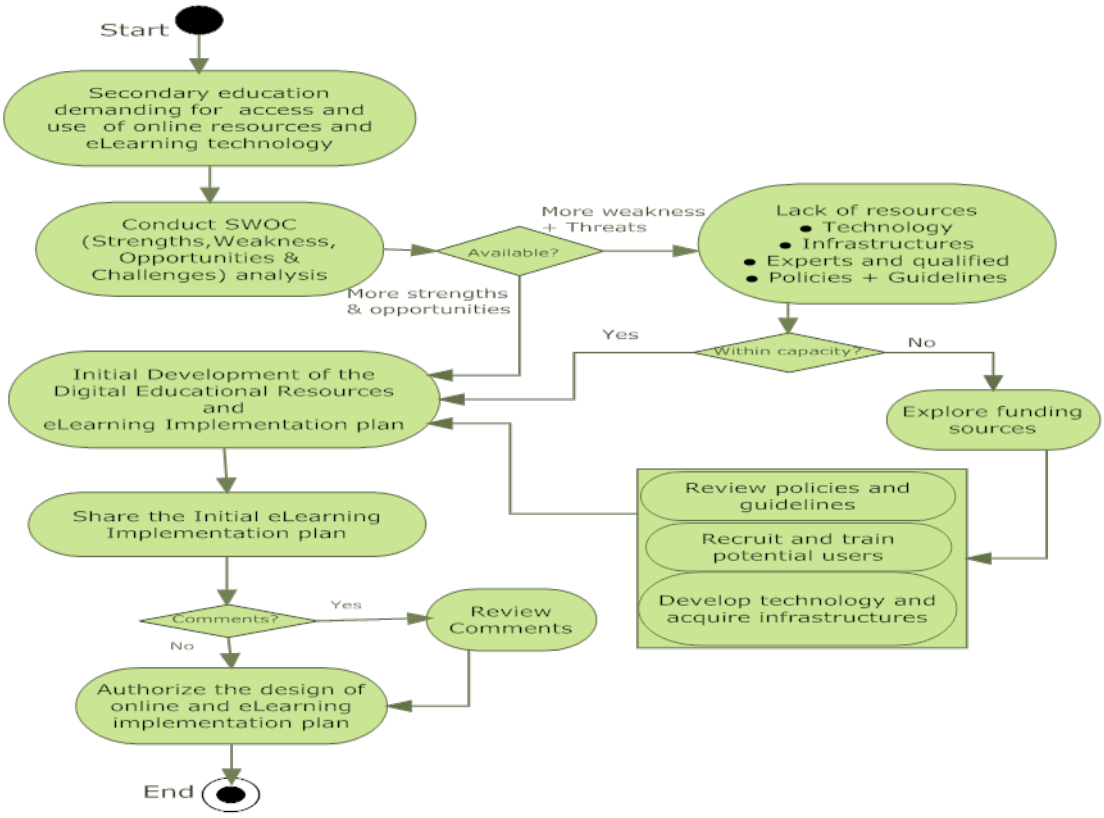

Figure 5.5: Planning Phase Activities diagram

- ***Implementation Phase***

The implementation phase involves technology planning (deciding between develop or outsource), infrastructure categorizations and deployment, and the stakeholders' involvement for better use of experts in relevant fields. During implementation, experts from different specialties like e-learning experts, instructional designers etc. must be involved. Effective ICT implementation does not occur simply when ICT is more available in the classrooms, but mainly occur because planning and implementation have delivered the requirements to achieve effective ICT use in the education process (Al-harbi, 2014). The choice and implementation of an e-learning strategy should involve input from relevant stakeholders and partners, including teachers, those involved in teacher education, universities and teacher colleges, curriculum developers, and solution providers (Baker et al., 2013: p. 21). This phase enhances the availability of all the necessary resources that should be acquired during the whole process of eLearning implementation and monitoring and evaluation process. The participants in a technology planning and deployment are the members of the education and technology ecosystem that require the inclusion of each of these members, from hardware and software,

supplemental learning content, curricula-providers, the governments to the students and teachers themselves.

Table 5.4: Implementation Phase Components, Activities, and Actors

Components	**Activities**	**Actors**
4. Develop/Outsource and install the required Technology	a) Decide on the level and type of technology b) Formulate a development / outsourcing team c) Develop / outsource the technology w) Configure the systems to meet user needs x) Upload and publish digital contents y) Establish access, publishing and downloading policies z) Ensure compatibility and accessibility aa) Establish digital contents quality assurances d) Ensure user centered systems development procedures bb) Apply user centered systems design procedures cc) Support the use of Swahili for easy interaction with the system e) Develop required digital contents – Establish and maintain digital contents libraries/repositories	a) ICT experts b) Instructional designers c) Digital content experts d) E-learning experts e) Government
5. Deployment of Infrastructures	i. Supply basic hardware and software dd) Install and configure relevant basic hardware and software ee) Establish a Computer library in each center ff) Install multimedia devices (Projectors, scanners, digital cameras, sound systems and recording devices) gg) Supply data storage devices (CDs, DVDs, Hard disks, flash disks, etc.) hh) Establish hardware and software maintenance procedures ii. Ensure connectivity ii) Linking schools to the fiber backbone /internet access jj) Assess minimum internet bandwidth requirements iii. Install power supply in each school / ICT centers – Ensure each school/center is connected to the grid/or has solar panels/generators	a) ICT experts b) Internet service providers c) E-learning experts d) Digital content experts e) Development partners f) community g) Government
6. Stakeholders involvement	i. External Institutions awareness and support kk) Research institutions involved in renovation	a) ICT experts b) E-learning experts

	and service improvements ll) Training institutions awareness and readiness to change ii. Community participation and awareness mm) Involve the community to ensure security of the devices nn) Encourage community contribution to give ownerships iii. Open access educational resources oo) Establish a mechanism to access relevant open educational resources pp) Establish a Link to relevant open educational resources to the local system	c) Instructional designers d) Digital content experts e) Beneficiaries (Tutors, Trainers, Teachers and students)

The Use-Case diagram for the OREI framework implementation phase comprised of nine key actors (Figure 5.6). The actors are ICT experts, Instructional designers, Digital content experts, E-learning experts, Government, Beneficiaries (tutors, teachers, and students), Internet service providers, community, and Development partners.

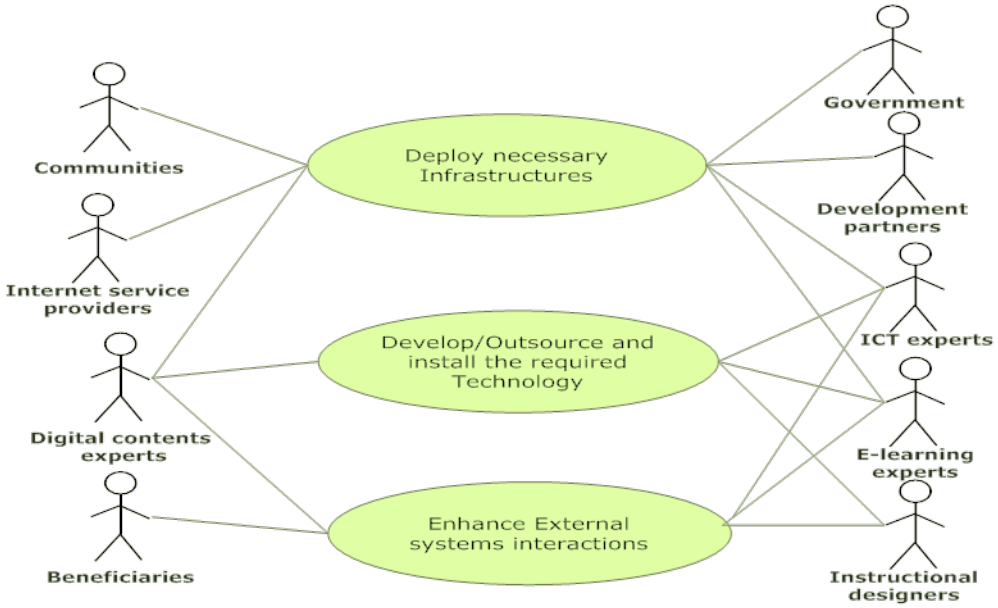

Figure 5.6: Implementation Phase components and actors Use Case diagram

The activity diagram (Figure 5.7) shows the flow of activities within the implementation phase and models the function of each actor and the flow of procedures and control among activities based on operations and workflow. In this case, the activity diagram summarizes the implementation phase of sub-activities.

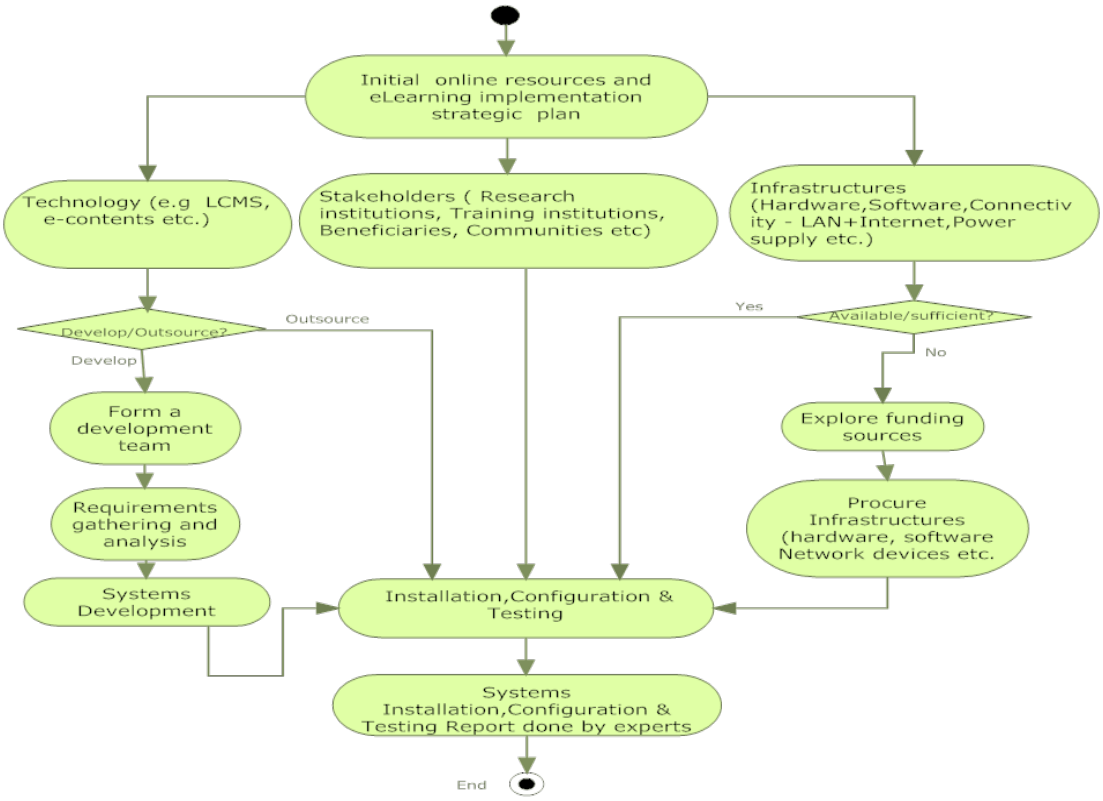

Figure 5.7: Implementation requirements Activities UML diagram

- ***Monitoring and evaluation phase***

The resources productivity, investments, and the expected achievements should be monitored to determine risks that must be managed and critical success factors. The monitoring and evaluation process focus on determining whether the initiative has served its purpose and how it might be improved, sustained and replicated (Rodríguez et al., 2010). In this phase, the most key actors are ICT experts, e-learning experts, government agencies that deal with education, instructional designers, digital content design experts, and potential initiative beneficiaries.

Table 5.5: Evaluation Phase Framework Component, Activities, and Actors

Component	Activities	Actors
7. Monitoring and Evaluation	i. Establish a system testing and performance evaluation criteria qq) Set system performance criteria's rr) Keep performance records for improvement ss) Set change over timeframe ii. Establish a fault reporting and service provider	a) ICT experts b) E-learning experts c) Systems developers d) Instructional designers e) Digital content experts f) Beneficiaries (Tutors,

	mechanisms tt) Recruit experts in each zone/regions uu) Prepare systems assessment policies and guidelines ii. Establish digital contents quality an assurance policies vv) Categories Content types and quality assessment v. Measure performance, success and achievement based on the pre-defined criteria.	Teachers and students)

The Use-Case diagram for the OREI framework evaluation phase actors are presented in Figure 5.8 . The actors are ICT experts, Instructional designers, Digital content experts, E-learning experts, Beneficiaries (tutors, teachers, and students) and the system developers.

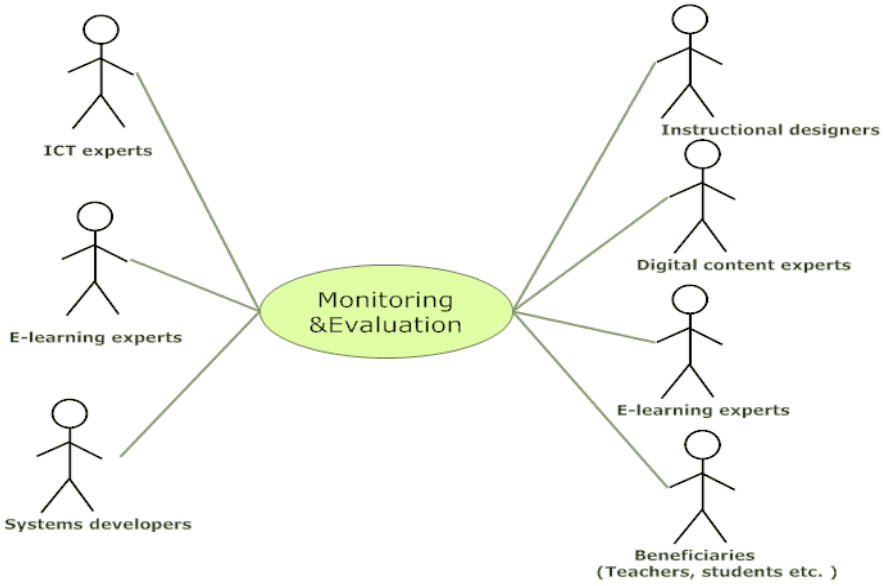

Figure 5.8: Monitoring and Evaluation Phase components and actors Use Case diagram

The activity diagram for the evaluation phase is presented in Figure 5.9. The Activity diagram summarizes the flow of activities from the implementation phase to the evaluation stage components, and models the function of each actor and the flow of procedures and control among activities based on operations and workflow. In this case, the activities diagram summarizes the evaluation phase sub-activities.

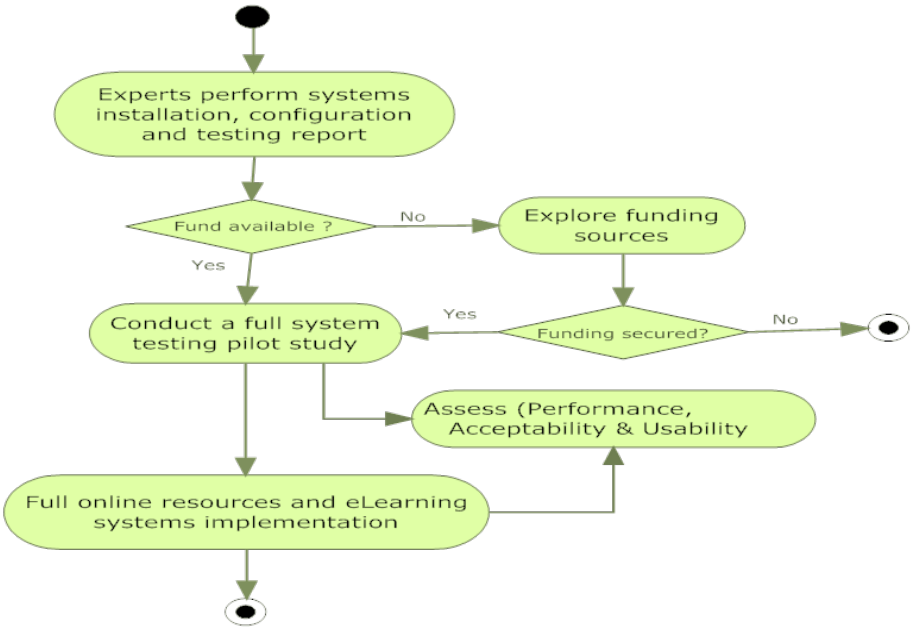

Figure 5.9: Monitoring and Evaluation Activities UML diagram

5.6 Limitations of the Study

This study focused on the formulation of the ICT Framework for fostering eLearning in the Tanzania public secondary education. The framework may not systematically apply when implementing the online and eLearning in private secondary education; because the hierarchy of decision making and the organization structure are different. However, any other institutions using the same public education curriculum may use the OREI framework. In addition, the framework does not define the flow of its implementation when looking at each of the seven individual components. This framework only works as a roadmap defining critical components for the successful planning and implementation of online education resources and eLearning in secondary education; the decision of which activity to start with in the planning phase and implementation phase needs to be decided by experts. However, the framework might be put into practice and the online education resources made available, e-learning cannot be expected and guaranteed to meet the needs of all learners.

5.7 Conclusion

This study designed and presented an “Online Resources and eLearning Implementation (OREI)” framework. We analysed the components that make up key requirements for a sustainable eLearning implementation in Tanzania secondary education. The framework is a roadmap to existing practices for the manifestation of the impact of ICT in teaching and learning.

Ideally, this study has developed a framework that underpins the critical activities related to the seven identified components. The framework will guide the planning process, implementation procedures, and the monitoring and evaluation practices for enhancing efficient online educational resources applications and the eLearning integration in the Tanzania secondary education. Without coherent policy implementation framework on eLearning, developing countries cannot benefit from the eLearning initiatives (Manji et al., 2015: p. 7). The OREI framework is more policy oriented that focus on harnessing local education environments, eLearning opportunities, challenges, and strengths for meeting education system goals. When implementing the OREI framework, the strategic ventures that focus on education innovation need to be identified by government policies as a means to increased access to education opportunities. The OREI framework we designed is a roadmap for ICT in education policy implementation and realization. Among the seven components, the government support (political willingness) should pioneer followed by either development of policies and guidelines, training and recruitment of experts and beneficiaries, technology (develop/outsource), infrastructures deployment and or Stakeholders involvement. Implementation of e-learning in Tanzania must be understood in terms of online educational resources accessibility and sharing with different starting points and approaches facilitated by government interventions.

This study recommends the need for interpretation of the overall national ICT policy and the ICT policy for basic education as the first step in creating a national ICT in education strategic implementation plan. This should take place parallel with the SWOC (strengths, weakness, opportunities, and challenges) analysis and at all public education sites (secondary schools, vocational training, and the teachers training colleges). There should be implementation strategic plans and frameworks for the ICT Policy for basic education vision and objectives.

CHAPTER SIX

A Design of a Business Model for Online Education Resources and eLearning Implementation in a Developing Country: Case of Tanzania [4]

[4]International Journal of e-Education, e-Business, e-Management and e-Learning,(March 2016, Vol .6, No1, 27-39), doi: 10.17706/ijeeee.2016.6.1.27-39

Abstract

This paper presents a business model for the ICT in education projects implementation. Using a design-research approach, we analyzed cases of the Online Resources and eLearning Implementation (OREI) framework that we developed. The OREI is a framework for online educational resources use and e-learning implementation in secondary schools. After the theoretical background, we discussed the proposed framework and a set of steps to guide the implementation. We formulated the framework practices and the levels of implementation precedencies using Matlab tools, and used Unified Modeling Language (UML) artifacts to present a business model for planning, implementation, and evaluation for the framework. A total of seven key components of (1) Government support, (2) infrastructures deployment, (3) technology enhancement, (4) training and recruitment of users and experts, (5) policies and guidelines, (6) stakeholders' participation, and (7) the monitoring and evaluation for acceptability, performance, and usability were discussed. Finally, we present a conceptual block diagram of the OREI framework business model to illustrate its validity on the enhancement of the ICT projects in education.

Key words: E-learning planning, online education resources, Business model, digital Contents, Tanzania

6.1 Introduction

In today's complex world of rapid technology change and information overflow, a solid approach for technology and infrastructure deployment in the education system is essential. Such an approach helps ensure that technology, infrastructures, manpower recruitment, policies and guidelines implementations are consistent with the education objectives, and can be effectively utilized once the technology has been deployed (Wims & Lawler, 2007). Many ICT in education projects in developing countries have not been performing constructively (Aduwa-Ogiegbaen, 2009; Andersson et al., 2014; Brunello, 2010; GESCI, 2011a). However, resources (e.g. hardware, software, connectivity) are provided and beneficiaries trained; evaluation stages reported narrow usage of ICTs in classrooms and lack of additional competencies among the

beneficiaries (Andersson et al., 2014; Hennessy, Onguko, et al., 2010; Kessy et al., 2006; Sánchez & Salinas, 2008; Sharma, 2003; Wims & Lawler, 2007). Most of ICTs projects carried out in Tanzania focused on improving teaching and learning practices and increased access to digital resources in secondary schools (Andersson et al., 2014; GESCI, 2011a; Hardman, Ackers, Abrishamian, & O'Sullivan, 2011; Swarts & Wachira, 2010). In relation to ICT equipment in secondary education, the issues of planning, implementation, and evaluation of the performance, usability, and standardization are important for provision of effective systems (Davis, 1993; Palmer, 2002; Tsakonas & Papatheodorou, 2006). The worst ICT in education practices in most of developing countries are dumping hardware in schools without prior planning, transferring ICT-related models and practices from developed countries to the less developed countries, deploying hardware without pedagogical contents being planned and the lack of monitoring and evaluation (Trucano, 2010; Trucano et al., 2011). The more diverse the ICT equipment schools' can have the more complex and expensive technical support is needed to manage them. In places where the specifications for ICT infrastructures and the level of technology have been planned, standardized, and comprehended by appropriate local experts', would lead to the best practices. There is a need to have a business model that guides existing policies and frameworks for the enhancement of ICT in education.

6.2 Background

6.2.1 Technology and Education Paradigm Shifts

Education paradigms are shifting to include online learning, hybrid learning, and collaborative models. The use of pedagogical ICT tools improves the effectiveness of teaching and learning both in the classroom and beyond the school walls (Wastiau et al., 2013). Mostly ICT makes easier to find, access, manipulate, remix and disseminate contents. The use of ICT across any curriculum can be regarded as supplementary, complementary, integrated and or infused across the curriculum (Kafitz & Cauthen, 2013; Keeler, 2008; Manitoba Education, 2006: p. 10; Pade-Khene, 2015) .

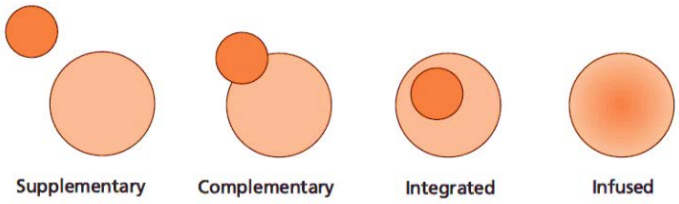

Figure 6.1: ICT and Curriculum Fusion Classifications (Manitoba Education, 2006: p. 10)

A supplementary relationship separates ICT and curriculum in space, time, and personnel-separate computer labs, computer classes, and computer teachers. A complementary relationship occurs when there are ICT connections with curriculum in various ways. An integrated relationship allows the classroom teacher to bring ICT into the classroom so it is available at teachable moments. An infused relationship allows the transparent application of ICT, wherever and whenever appropriate, to enhance critical and creative thinking.

There are trends of technology changes that have forced many education systems worldwide to embrace ICTs as basic classroom tools. Examples of important technological trends identified are:

a) Cloud computing-is a computing model for providing computing services that relies on a number of present technologies (e.g., the Internet, virtualization, grid computing and Web services) (Sultan, 2010). It has transformed education systems through computing and communication, data storage and access, and collaborative work (Johnson, Becker, Victoria, & Alex, 2014). The application and services of cloud computing to schools are such as remote access to learning tools in a cost effective manner to the school systems (Stein et al., 2013).
b) Mobile learning is becoming an integral part of secondary education practices, increasingly common for students to own and use portable devices in many countries where policies and teaching approaches support (Johnson et al., 2013; Lieberman, Bates, & So, 2009). Personal mobile technologies for learning are more widespread (Personal Digital Assistants, tablet or smartphone); with easy to use and touchscreen interfaces they are gateways to endless learning, collaboration, and productivity fostered by the Internet (Huizenga, Admiraal, Akkerman, & Dam, 2009; Roschelle, 2003).
c) Learning analytics are more associated with deciphering trends and patterns from educational big data, or huge sets of student-related data, to further the advancement of a personalized, supportive system of elementary education (Blikstein, 2011; Chatti, Dyckhoff, Schroeder, &

Thüs, 2012). They refer to the measurement, collection, analyzed and reported data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs (Johnson et al., 2013, 2014).

d) Open content focus on sharing of significant amounts of curricula resources and learning materials (Johnson et al., 2013). In many cases, open content represent shift in the way students study and learn by providing open data, and open resources, along with notions of transparency and easy access to data and information via the internet (Baraniuk, 2008; Caswell, Henson, Jensen, & Wiley, 2008; Fox, 2013).

e) Virtual and remote laboratories take advantages of the wireless networks, mobile devices, and cloud-based software to make scientific experiences more accessible for schools that lack fully equipped labs (Nedic, Machotka, & Nafalski, 2003). In in virtual and remote environments, an experiment can be conducted several times with greater efficiency and precision (Johnson et al., 2013).

f) Social media have changed the way people interact, present ideas, and information, and communicate. Educators, students, and even the public routinely use social media to share current events, opinions, and articles of interest (Ahn, Bivona, & DiScala, 2011; Halverson & Smith, 2009; Watson, Watson, & Reigeluth, 2015). The fact that all of these various groups are using social media speaks to its effectiveness in engaging people (Hew & Cheung, 2013).

6.2.2 Critical challenges leading to education reform

Mostly, challenges could hinder adoption of technology use in the secondary education system. They are obstacles to the success of ICT in education projects. Present and future challenges that hinder technology use in education are:

a) Lack of teachers' readiness to integrate ICT tools in classrooms and support the curriculum ICT implementation (Avidov-Ungar & Eshet-Alkalai, 2011; Bebell, Russell, & O'Dwyer, 2004).

b) Resistance to change. Old and traditional practices and approaches limit broader uptake of new technologies. In many cases, experimentation with, or piloting of innovative applications of technologies are often seen as outside the role of teachers, and thus discouraged (Hennessy, Onguko, et al., 2010; Niemi, Kynäslahti, & Vahtivuori-Hänninen, 2013; Topper & Lancaster, 2013). Students are different, but schools are still using materials developed decades ago, but today's students come to school with experiences of globalization and

access to information (Rideout et al., 2010; Rosen, 2011). Changing these processes will require major shifts in attitudes as much as the old policies.

c) Threats of new technologies. New models of education are bringing unprecedented competition to traditional models of schooling. This is a concern because schools' should plan for access to open education resources (e.g. multimedia, games, lectures, and tutorials) that provide an important part of the learning process (Gronn, Scott, Edwards, & Henderson, 2014; Plowman, McPake, & Stephen, 2008). Open educational resources (e.g. MOOCs) have opened the doorway to entirely new ways of thinking about online learning.

d) The increased demand of blending of formal and informal learning. Traditional approaches are running short when without technology mix; access to online resources is becoming more demanding than ever (Johnson et al., 2014). New concepts and materials are available to support traditional methods and increase efficiency thus preserving class time to refine mastery with discussions, collaborations with classmates, problem solving, and experimentation (Ash, 2012; Borgen, 2013; Datig & Ruswick, 2013; Tucker, 2012)

e) The demand for personalized learning and learner centered in the 21st century is high while the education system is not adequately supported by practices that use ICT effectively (Johnson et al., 2013). New learning models that are engaging younger generations are more challenging (Fryer, 2005). New technologies that provide more learner choices, control and differentiated instruction have enlarged the gap between the vision and the tools needed to achieve the personalized learning (Azer, 2005; McCombs, 2003; Scott et al., 2002).

6.3 Purpose of the Study

In developing countries, Information and communication Technologies (ICTs) are often seen as a promising solution to overcome educational systems deficiencies. However, ICTs solutions are normally expensive; it is a real challenge to use novel ICT based solutions in a meaningful way without prior strategic planning. For instance, in developing countries like Tanzania, deployment of ICTs in education has been spanned as shortcut; no ahead planning roadmap, frameworks and policies that leads the way. Expensive ICTs are being procured and some offered by development partners as donations without prior planning on how they are to benefit the education system. The aim of this study was to contribute to the development of a technology supported pedagogical reform that uses a framework for planning, implementation, and monitoring and evaluation, that we called OREI (Online Resources and eLearning

Implementation). The framework combined components of government support, training and recruitment, experts' involvement, technology deployment, infrastructures enhancement, policy makers, beneficiaries, and other stake holders to be used in as a roadmap for transforming education with new technologies. The study asserts to why it is important to have a roadmap framework that consider involvement of multi-stakeholders in each stage when the government wants to deploy pedagogical ICTs in the education systems.

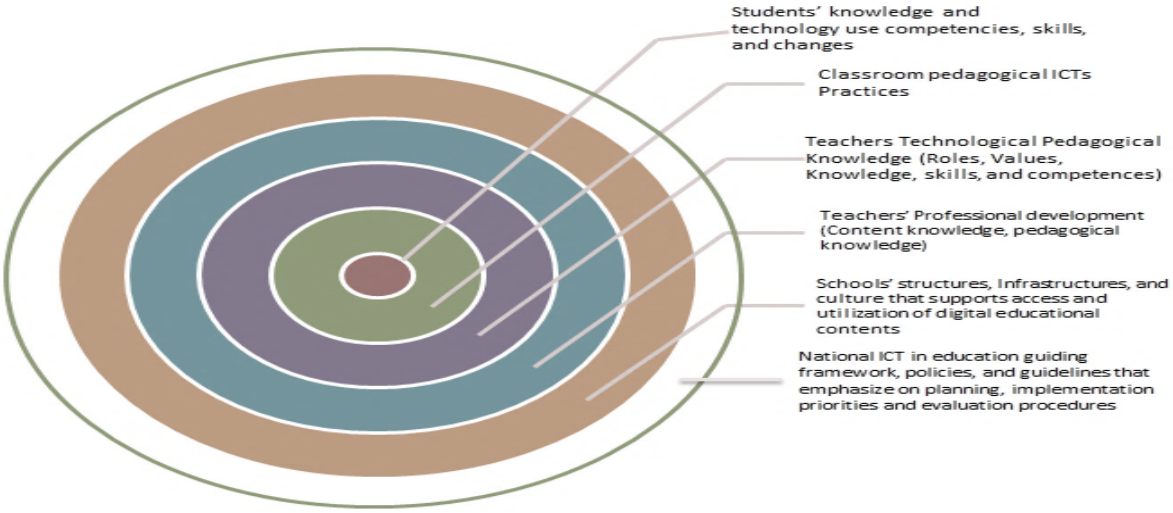

Figure 6.2: Linking Sustainable Technology use in schools' with other aspects

Figure 6.2 above show the dependencies and causality effects between components that have to be considered when planning for technology use in the education system. The objective of our study is to design a novel guiding principle for pedagogical ICTs solutions enhancement. To solve local educational problems, the Framework for Online Resources and eLearning Implementation that we developed, could be used to guide the future planning, investment and evaluation of ICTs in education projects in developing countries, taking Tanzania as a show case study.

6.4 Methodology

This was a design-based research for developing the OREI framework business model. The OREI is a framework for online educational resources use and e-learning implementation in secondary schools. Design based research is a methodology suitable to both research and design of technology-enhanced learning environments (TELEs) (Wang & Hannafin, 2005). The framework addressed the need for innovation in educational contexts (Anderson, 2005). The attention was on the challenges confronting technology use based on usable knowledge

implemented in schools' contexts with a framework guiding systemic technology Innovations as an end result also used in previous studies (Fishman, Marx, Blumenfeld, Krajcik, & Soloway, 2004). In this study, we followed the following steps:

a) We developed interactions of the OREI conceptual framework components.
b) We used Matlab tools to generate implementation alternatives based on interchanging the framework components.
c) The implementation alternatives were used to determine cases of the levels of precedencies when working towards an optimum goal of any ICT in education based project.
d) In the current work, we analyzed cases of the framework components based on the sampled levels of precedencies.
e) Finally, we designed a framework business model using Unified Modeling Languages (UML) artifacts as a result for this study.

6.5 The OREI Framework Cases of Practices

6.5.1 The OREI Framework Planning Requirements

The framework considered Government support as the highest priority and evaluation as the final stage when planning for online education resources and blended learning in secondary education. The interactions of components in Figure 6.3 below were based on the cause effects between requirements of the framework.

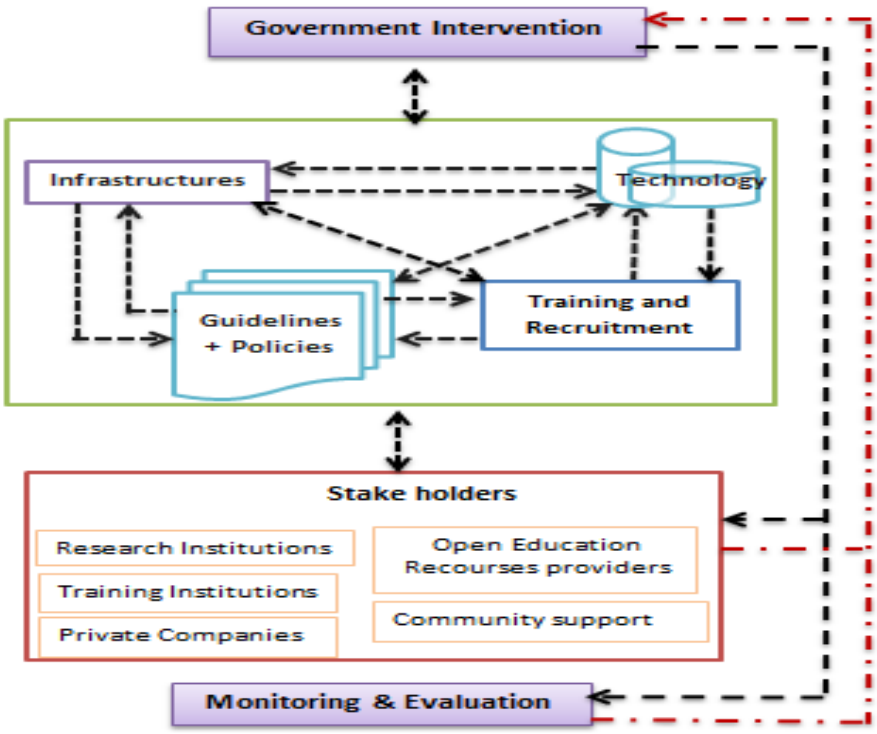

Figure 6.3: Conceptual Model of the OREI Framework Constructs Interactions

The presentation in Figure 6.3 above is the typical example of the framework interactions addressed with seven key components that are must in order to achieve sustainability in ICT use education projects. Others are infrastructures (e.g. hardware, software, projectors, multimedia devices, internet connections, wireless access devices etc.), technology (Learning Contents Management Systems that could work as communication and collaboration space), recruitment, and Training (training teachers and students to be confident with infrastructures and the technology, hiring experts). In addition, Guidelines and Policies (e.g. Ethics issues and ICT , curriculum and syllabuses reviews so they can match with technology integration, teaching and training manuals, performance indicators and assessment procedures etc.) and stake holders (e.g. research and training institutions, the communities, etc.). Students' abilities and eager to learn using ICT tools can be influenced positively by the availability of relevant infrastructures in schools and the teachers knowledge,skills,attitudes and ICT use competences. In addition, training institutions can influence teachers' knowledge and pedagogical ICT tools competences through readiness to ICT use programmes and practices tutors are familiar with.

6.5.2 Determining Framework Components Levels' of Precedencies

As a practical implementation of the framework components, seven components were modelled. The following assumptions were made as a foundation to simplify presentation of facts in the implementation of the framework levels of precedencies.

a) ***Assumption 1:*** In whatever case of the level of precedencies considered, the Government intervention must start, and the evaluation must determine which component is next till the finalization of the process.

b) ***Assumption 2:*** Depending on the support the Government needs to offer (e.g. financially, material, availability of expertise, review of Policies and Guidelines, deployment of Technology, Infrastructures and the stakeholders involvement coordination); decision should be carried out with care and the solution has to be because of SWOT analysis for each of the involved components. This should be determined by the SWOT analysis report.

c) ***Assumption 3***: The levels of precedencies of requirements used in the presentation of implementation facts was serially labeled as:

- A = Government support
- B = Infrastructures
- C = Technology
- D = Policies and Guidelines
- E = Training and Recruitment (experts, teachers, students)
- F = Stake Holders (External interactions)
- G = Evaluation

Using Matlab tools, we generated 120 numbers of possible levels of precedencies and implementation alternatives **(**see appendix A). Within each of the levels of precedencies produced can regenerate more alternatives based on the SWOT analysis report. Presented in this study are nineteen examples for illustrations and generated operations tree figures. To be more specific, components grouped together in circles in the figures below could be carried out concurrently while all other components that are not grouped in circles are to be carried individually and separately. The randomly cases of the possible alternatives of the levels of precedencies are presented below:

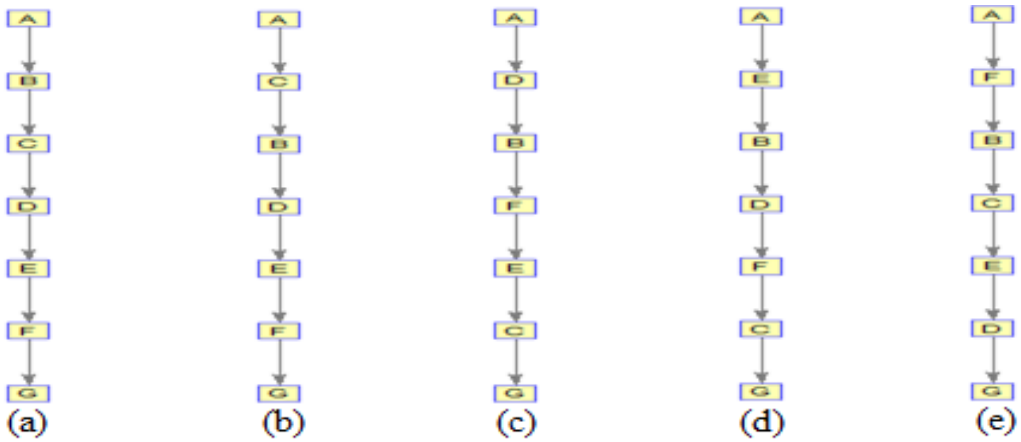

Figure 6.4: Levels of Precedencies and Implementation Alternatives Performed Serially

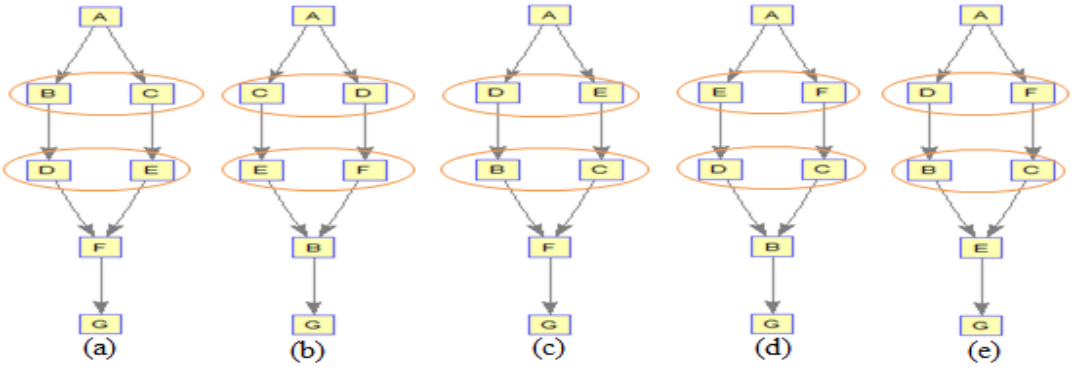

Figure 6.5: Levels of Precedencies and Implementation Alternatives with two activities and serially combined

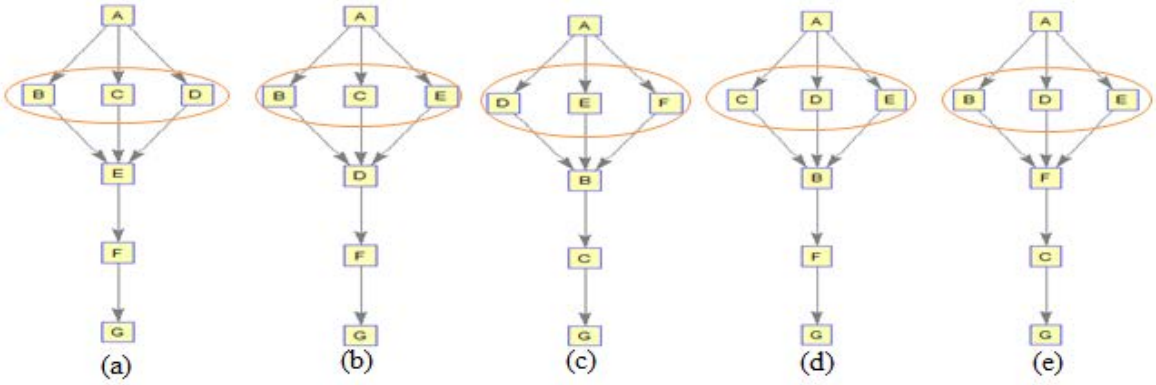

Figure 6.6: Levels of Precedencies and Implementation Alternatives with three activities and serially combined

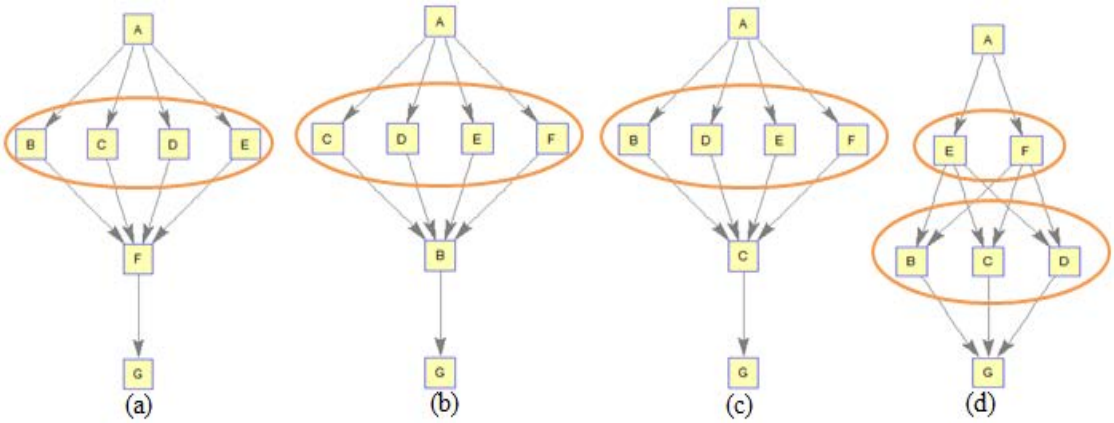

Figure 6.7: Levels of Precedencies and Implementation Alternatives with three activities and serially combined

Table 6.1: Descriptions of the levels of precedencies presented in Figures 6.4 -6.7 above

Figures	Descriptions
6. 4: (a, b, c, d, and e)	Considered carrying out each activity sequentially and separately. The levels of precedencies during implementation could only be determined using a SWOT analysis report.
6.5: (a, b, c, d, and e)	Considered combining some activities pairwise followed by indivual activities that could be performed sequentially and separately after getting inputs from previous activities. The levels of precedencies during implementation could be determined by Government budget and a SWOT analysis report.
6.6: (a, b, c, and d)	Considered combining three activities at once followed by indivual activities that could be performed concurrently. The levels of precedencies could only be determined by resources availability and a SWOT analysis report.
6.7: (a, b, c, d, and e)	Considered combining four activities followed by indivual activities carried out concurrently. The levels of precedencies could only be determined using a SWOT analysis report.

6.6 The OREI Framework Operational Model and its Constructs

It is self-evident that the establishment of pedagogical ICTs, broadband networks, centralized technology and supportive infrastructures (computer hardware and software) and other up-to-date teaching and learning technology is a priority area for secondary education investment. The ICT equipment currently available in few schools and teacher training colleges for use in the classroom is inadequate and much is outdated. It is not possible to create a blended e-learning culture and embed ICT in the curriculum without having appropriate and adequate information and communications technology tools available in the education systems. Within the rapidly

changing world of information technologies, evaluation, renewal, and replacement of computers and outdated technologies are on-going requirements. Carrying out any of these kinds of projects needs carefully planning, implementation, and evaluation to avoid committing huge investments on unpredictable achievements.

The predefined operational model can be realised based on the existing framework individual components. Few cases of the individual components of the OREI constructs and their entities are summarised in Figures 6.8 (a, b, c, d and e) followed by the comprehensive OREI operational model in Figure 6.9.

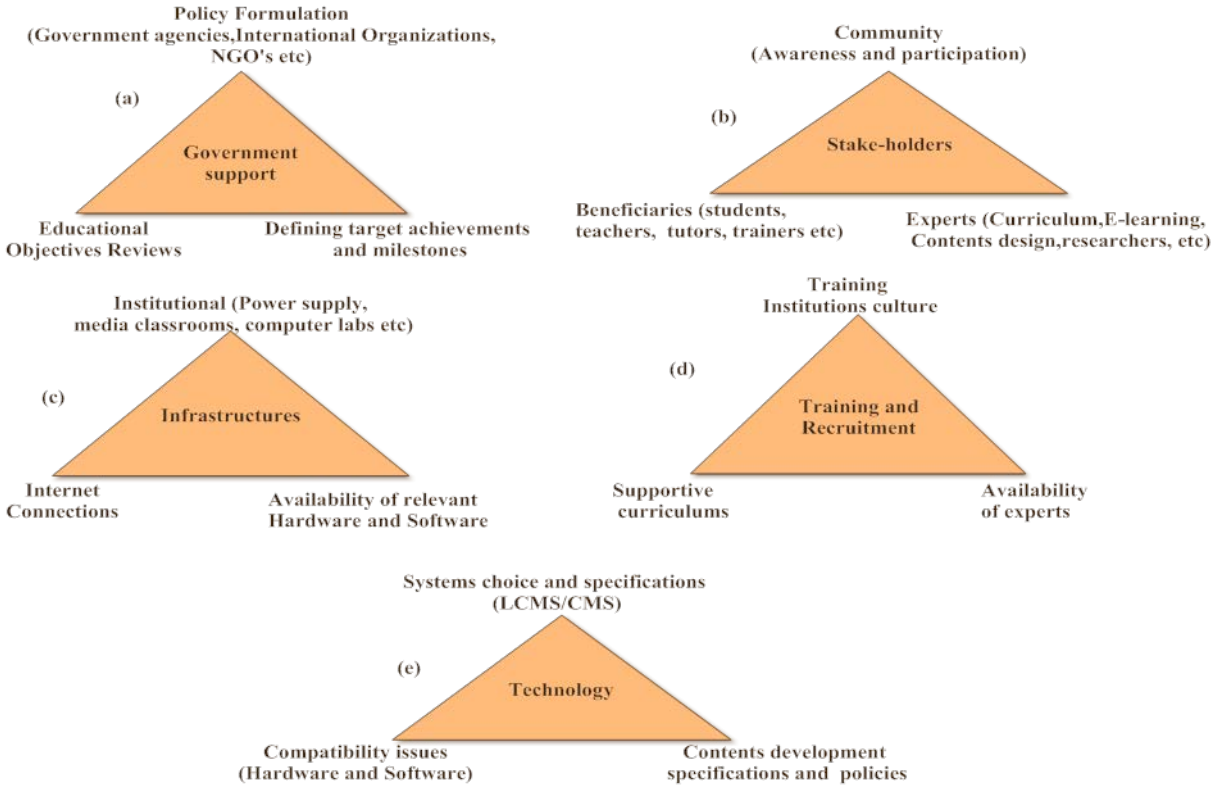

Figure 6.8: Cases of OREI Individual Constructs Accomplishments

The few illustration of the OREI components constituency of the individual operational cases can be summarised in a comprehensive OREI operational model in Figure 6.9 below.

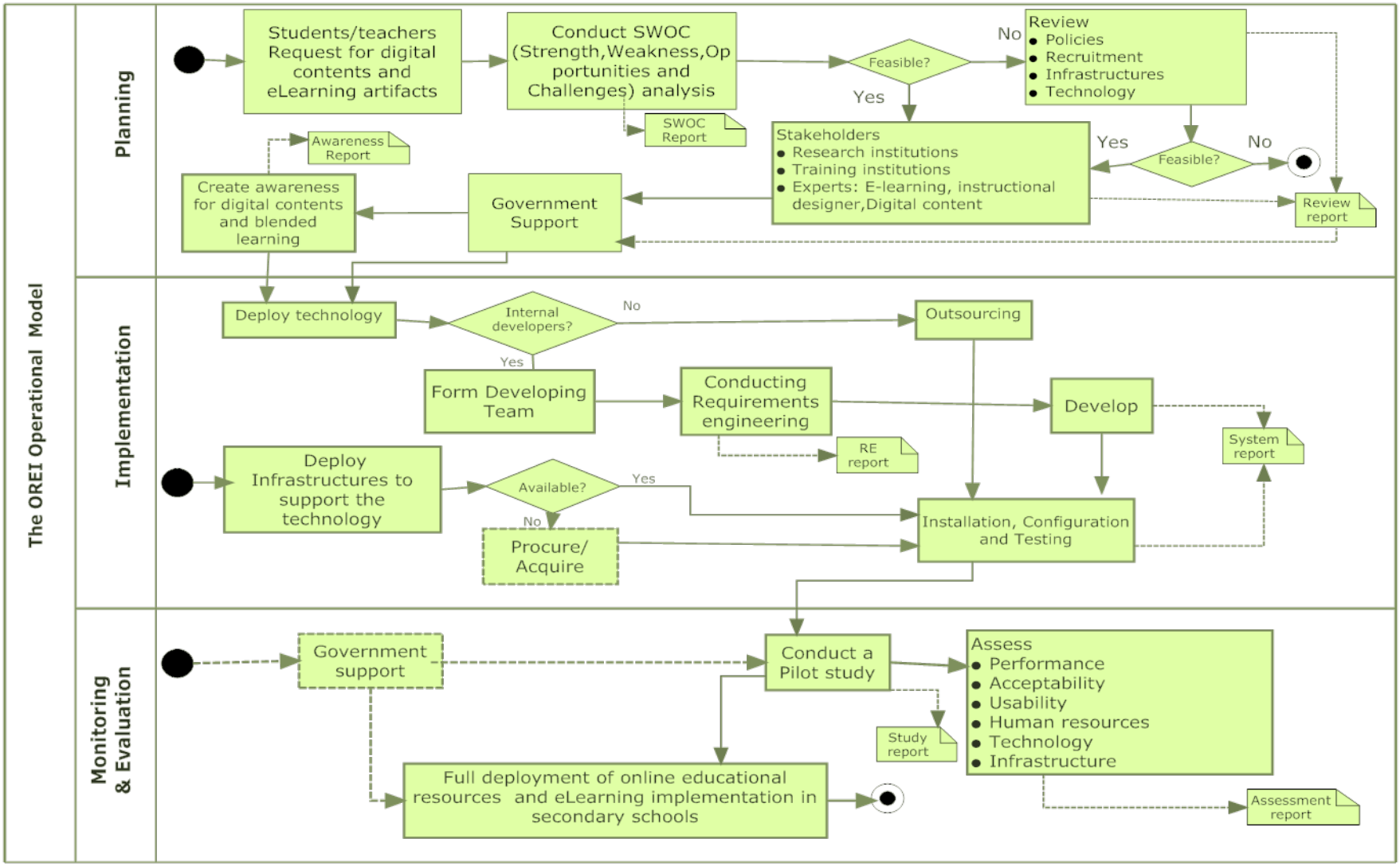

Figure 6.9: OREI Operational Model and its Constructs

Figure 6.9 above is a roadmap to ICT deployment in secondary schools, as far as any planning involving technology is concerned, the flexibility to change or reinterpret goals is vital. The OREI framework business model will assist developing countries, Tanzania as a case to plan for the effective use of digital technologies in schools to prepare students for the demands of an ever-changing world, to achieve powerful learning and teaching, and improve learning, teaching, avoid investing in outdated technologies and improve administration. When developing a plan based on this business model, there should be a vision to incorporate the direction that creates a picture of the future, how it looks, and how ICT could enable improvement. To achieve this, several resources must be identified in the SWOT (strength, weakness, opportunities and threats) analysis report, which comes at every stage of planning and implementation of this business model.

6.7 Conclusion

The successful integration of ICT in public schools depends on a planned and harmonized approaches, involving experts of different professionals, beneficiaries, stakeholders from various institutions that are spearheaded by strong leadership at all levels. However, a government centralized funding support works, there is a potential controversial between funding of school ICTs, experts consultation, planning and management of costly ICTs (Mee, 2007). Using a design-research approach, we analysed cases of the framework design requirements, formulated levels of precedencies using Matlab tools, and used Unified Modeling Language (UML) artefacts of the framework activities to design a framework business model for planning, implementation, and evaluation of ICT in education projects called OREI (Online Resources and eLearning Implementation). The OREI framework we designed, addressed the positions and involvement of the government, manpower recruitment, experts involvement, technology, infrastructures, policy makers, beneficiaries, and other stake holders. The designed model integrated leadership, time, investment, and policy imbued with vision to transform secondary education and building blended e-learning culture. Thus teacher professional development in the use of pedagogical ICTs should embody and model the forms of pedagogy that teacher can use themselves in their classrooms. A key lesson of previous initiatives (Andersson et al., 2014; Claussen & Assad, 2010; GESCI, 2011a, 2011b), demands governments in developing countries to have a predefined achievements before requesting for donor funding. In this study planning, committing

an investment, evaluations and monitoring the sustainability of the planned and implemented ICT project are potential to the deployment of technology in schools.

CHAPTER SEVEN

An Evaluation of OREI Framework Using SWOT Analysis: Case of Tanzania[5]

Abstract

In Tanzania, there is a research gap on the individual and organizational factors that enhance, and those hinder the sustainability of e-learning initiatives. The OREI is a framework for online educational resources use and e-learning implementation in secondary schools. In this study, online resources and e-learning implementation (OREI) framework which proposed planning, implementation, and monitoring and evaluation of ICT in education initiatives as potential attributes, was evaluated using SWOT(Strengths, Weaknesses, Opportunities, and Threats) analysis. The framework is assessed using data collected from policy makers, teachers, tutors, teacher trainees and school students, and the findings reported. Finally, implications for research and framework practice are presented. This study makes two contributions. First, prior research on e-contents and e-learning are synthesized by identifying related empirical literatures. In doing so, adoptability of the empirical findings of prior researches in e-learning practicality is given priority. Second, the study offers theoretical evidence that may account for the use of the designed OREI framework by specifying the simultaneous roles played by both internal and external factors. Results explored internal drivers and challenges towards e-learning that would in general lead to a sustainable planning for feasible e-learning model useful for secondary education.

Keywords: E-learning, SWOT analysis, E-learning implementation, e-content, Tanzania, Secondary education

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7.1 Introduction

In recent years, the moves towards ICT use in education in developing countries have increased adjacent to the dominantly traditional approaches. Current digital native learners' environment is expected to include technology because it is an essential part of life; the past never included laptops, projectors, interactive whiteboards, and mobile devices but had books, pencils, chalkboards, and erasers (Warger, Dobbin, Initiative, & others, 2009). Among the key trends reported by Johnson et al.(2013) and Nagel (2013) that have obstructed the education system are (1) increased shift toward blended learning (a model of e-learning), online-learning, and technology-driven collaborative learning, (2) the growth in the potential of social networks use in education, (3) the value of openness in educational resources and technology and, (4) the challenges educator face as resources become more accessible on the Internet. Various models of e-learning, from online content delivery models and asynchronous to synchronous instructor-led are becoming potential in education. The presence of globalization, technological advancement, and demographic forces that come from the nature of the students fuel the acceleration towards investing and developing e-learning strategies as key drivers (Zhang & Goel, 2011). The success of education system and students achievements principally are based on how students learn through interactions with people (teachers and peers) and instructional resources (textbooks, workbooks, instructional software, web-based content, homework, projects, quizzes, and tests) (Chingos & Whitehurst, 2012). The contexts within which these interactions occur are surely important. There exist technologies that shape how people learn, interact and access online sources of information over the Internet. Some of the current supportive and demanding technologies are familiarity to cloud computing services and social networks interactions, and ubiquitous computing such that individuals increasingly use mobile devices that allow infusion of virtual resources anywhere, anytime (Dede, 2005: p. 229). As technology connects more teachers and students, education changes for the better. The principle ICT use in education according to UNESCO (2009) demands the use of old and new technologies in a balanced way. With the appropriate use of technology, learning can be made more active, social, and learner centered, however the uses of ICTs are driven by pedagogy, not technology (Oblinger & Oblinger, 2005: p. 27). In classroom both on-the-air and off-the-air radio, television, online and offline video, are as important as more interactive computer/Internet-based virtual education or online distance learning (UNESCO, 2010). The Organisation for Economic Cooperation and

Development (OECD) acknowledged technology as potential tools that enable students to have greater access to a vast array of resources, classes, and experts (OECD, 2009). By bringing technology into the classroom allow teachers to refine teaching methodologies that students are familiar with, leading to more effective strategies and better results. E-Learning programs in Africa and in other developing countries are still often small, experiential pilot projects with little documented history of their successes and impacts (Olson et al., 2011: p. iii). The UNESCO ICT Competency Framework for Teachers (ICT-CFT) proposes a methodological approach for teachers in the field of ICTs for education that prioritize planning based on policies, standards and master plan (Midoro, 2013). In order to enhance classroom technology practices in schools, many aspects must overlap, among them being ICTs strategic plan, teaching and learning methods, flexible curriculum, and building human capacity and commitment (Baker et al., 2013; Niemi et al., 2013). The gap for technology use, the support framework and core technology relevance to curriculum for secondary education needs to be identified and harmonized (Hooker et al., 2011: p. 20).

A number of internal and external factors that drives this study have positive or negative effects on the ICT in education enhancement. The ability to identify strengths, weaknesses, opportunities, and challenges of ICT use in education brings forth the baseline for online resources and e-learning implementation framework examined by this study. In the Internal-External Model presented by Zhang & Goel (2011), internal factors are referred to as individual's knowledge and skills to use ICTs, general attitude towards information technology, personal innovativeness with information technology, and prior experience with using online resources for teaching and learning. External factors are ease of use of technology, organization support, and the government support. The use of ICT in education in most of developing countries have faced challenges such as: teachers lack of interest in implementing e-learning models, lack of access to technology and infrastructures, lack of funding and lack of governmental vision and leadership (Andersson, 2008; Barbour et al., 2011; L. Johnson et al., 2013; Kessy et al., 2006; Nagel, 2013). Others are lack of institutional support, subject culture, attitudes and beliefs, knowledge and skills, and lack of competence among teachers (Bingimlas, 2009; Hew & Brush, 2006). A study by Hennessy, Harrison, & Wamakote (2010) reported technological literacy and the pedagogical expertise related to technology among the challenges

of ICT use in the Sub-Saharan Africa. In many less developed countries, internet access and lack of sustainable power supply are among critical challenges that have hindered ICT use in education (Andersson et al., 2014; Oyelaran-Oyeyinka & Nyaki Adeya, 2004; Polikanov & Abramova, 2003; Richardson, 2011; United Republic of Tanzania, 2003b, 2007). In Tanzania, online learning objects have not being used efficiently due to existing limiting factors (Lujara, Kissaka, Bhalalusesa, & Trojer, 2007). Currently, the education sector face lack of power supply in schools, lack of resources (hardware, software, internet connections), teachers lack of technology classroom use competences and shortage of localized e-contents (Andersson et al., 2014; Farrell & Isaacs, 2007; Tanzania Institute of Education (TIE), 2009; United Republic of Tanzania, 2008b, 2013b). Preliminary Planning and deciding on the level and e-learning model should focus on taking advantage of existing opportunities while working on existing challenges (Cavus, 2013; Conde et al., 2014; Ismail, 2001; Varlamis & Apostolakis, 2006b). The current development of e-learning in Tanzania draws on the rapid procurement of ICT resources (hardware and software) in education heavily supported by the ICT policy in basic education as a leading policy and funded by the government through the Ministry of education and Vocational Training. This study intended to assess online resources and e-learning implementation framework using a SWOT (strengths, weaknesses, opportunities, and threats) analysis based on ICT use in secondary education in Tanzania. The SWOT analysis as an analytical method assisted to identify and categorize significant internal factors (i.e. Strengths and weaknesses) and external factors (i.e. opportunities and threats) that could permit the success of OREI framework in the ICT in education initiatives in Tanzania.

7.2 Background

7.2.1 Online Educational Resources

There are libraries of online educational resources that could be stored and shared as learning objects. A digital content repository is a space where digital content can be stored, accessed, and shared amongst a group of people (O'Carroll et al., 2013). On the Internet, for example, digital contents can be copied, edited, uploaded, published, downloaded, and transmitted in different formats. However, true digital content involves more than simply replicating the format of a print textbook online (Baker, 2011). Online resources are not a printout or an adhoc collection of links to Web pages, but they are true digital content restructures the text and images from print, and

then adds video, rich media and interactive activities in a way that is optimized for learning. They can be acquired as in-house built or designed, subscribed, mixed or modified and or accessed as open educational resources freely available online (Watson et al.,2013). The Project Tomorrow (2013) reported a list of online classroom educational resources that are mostly used by teachers as animations, games, e-books, real-time data, self-created videos, videos found online and virtual field trips.

7.2.2 E-Learning Implementation

E-learning (or eLearning, or elearning) is a learning approach in which the interactions between learners and teachers are online and depend of the internet connection. E-learning is an instruction delivered using a personal computer or mobile device, Internet, or intranet that use media elements such as words, pictures and videos for building knowledge and skills linked to individual learning goals or an education system (Clark & Mayer, 2011: p. 27). There are two time-based modes of e-learning: synchronous and asynchronous. In synchronous (participants interact in real time – e.g using as video conferencing) (Littlefield, 2014), while asynchronous (communication is separated by time such as email or online discussion forums) (Peterson, 2015). In asynchronous online Instructors provide materials, lectures, tests, and assignments that can be accessed at any time with students given a timeframe-during which they need to connect at least once or twice and they are free to contribute (Hrastinski, 2008). Some examples of supporting resources are web pages, files to be downloaded, e-mail, newsgroups and discussion forums, audios, and videos recordings (Esnault, 2008). Synchronous e-Learning is also referred to as virtual classrooms, Web conferences, Webinars, and online presentations; in common they all use of Web conferencing software to support live, interactive (more or less) learning events delivered on the World Wide Web (Hyder, Kwinn, Miazga, & Murray, 2007: p. 9). Synchronous requires students and instructors to be online at the same time where lectures, discussions, and presentations should occur at a specific hour with participating online at that specific hour (Beyth-Marom, Saporta, & Caspi, 2005).

Implementing e-learning should be approached as a strategic plan that involves developing projects, tasks, activities, dependencies, resources, and timelines for moving forward (Moore, 2007: p. 22). E-learning is free from limitations of space and time, while reaching learners in a

global context (Kidd, 2010: p. 5). According to Kaplan & Zhu (2011: p. 238), four major components enhance positive ICT use, the student, the instructor, the course content, and relevant technology tools. A visual spectrum for technology trajectory of teaching and learning show a progressive advancement of technology use in education which moved from traditional approaches, blended approaches to the purely online approaches (Figure 7.1) (Linder, 2013). Traditional learning (face-to face) has advanced from teacher led instruction that accommodates no classroom technology or digital contents to flipped or blended classroom settings where podcasts and other digital resources can be integrated (Abdous, 2012; Bart, 2014; Clarke, 2012). The concept of blended learning as an e-learning model is rooted in the idea that learning is not just a one-time event, but a continuous process that involves a hybrid of mixed tools beyond any single learning delivery medium; usually characterized by three key aspects of flexibility, effectiveness, and productivity improvements (Boyle, Bradley, Chalk, Jones, & Pickard, 2003; Butrime, Vitkute-Adzgauskiene, Mickus, & Vidziunas, 2010; Marsh, 2012: p. 11).

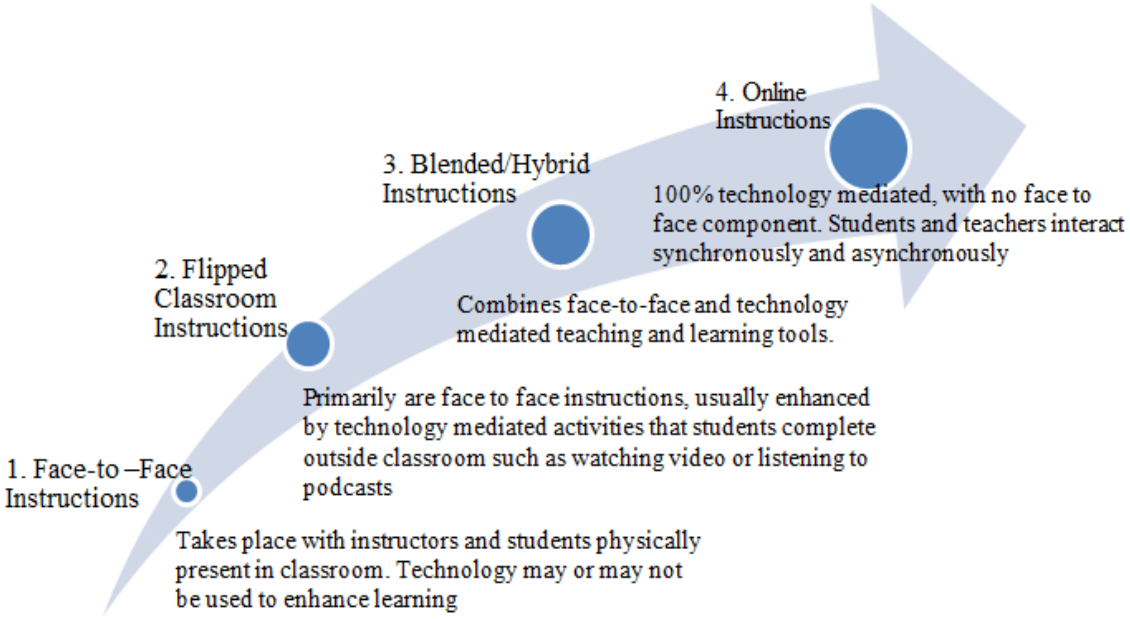

Figure 7.1: Spectrum Visual of Teaching and Learning with Technology Trajectory (Linder,2013)

In pure online instructions, teachers completely use technology like personal computers, mobile devices, interactive whiteboards, learning or content management systems while students benefit from access to devices, digital contents, and software with no physical face-to-face instruction at all (Edwards, Rule, & Boody, 2013). The Content Management Systems (CMS), Learning

Management Systems (LMS), and Learning Content Management Systems (LCMS) often compete for managing e-learning resources (Grant, 2010; Greenberg, 2002; Mijatovic et al., 2013). Institutions planning for e-learning implementation should carry out a SWOC (strengths, weakness, opportunities and challenges) analysis to specify business or service requirements before making decision on the relevant e-learning systems (Naik & Shivalingaiah, 2009; Ryan, Toye, Charron, & Park, 2012; Smart & Meyer, 2005). Each of the three applications have considerable and specific strengths and facilities that may complement each other, but no one often is the best fit for the particular organization (Ninoriya et al., 2011; Varlamis & Apostolakis, 2006b).

7.2.3 Blended Learning Context

Blended learning emerged as eLearning pedagogical concept that incorporates both traditional face-to-face instructions with web-based multimedia instruction. Blended learning according to (McElroy, 2012) can mean many different things to different educators; because it can take many different forms and have many different uses. It integrates the best aspects of face-to-face and online interactions for each discipline, using appropriate ICTs (Saliba et al., 2013). According to Pankin et al. (2012), they are structured opportunities to learn, which use more than one learning or training method, inside or outside the classroom. The Christensen Institute (Stack & Horn, 2012) defined it as a formal education program in which a student learns at least in part through online learning, with some element of student control over time, place, path, and /or pace.

Traditional instruction depends on teacher-led discussion, printed textbooks, teacher presence, physical lectures and individual written assignments submitted by hand and students matched by age (Johnson & Dasgupta, 2005;Johnson, Onwuegbuzie, & Turner, 2007). Technology-rich instruction shares the features of traditional instruction with digital enhancements such as electronic whiteboards, broad access to Internet devices, document cameras, e-books, videos, digital games, Internet tools, and online lesson plans (Cviko, McKenney, & Voogt, 2011; Keeler, 2008). Informal online learning and full-time online learning both differ from blended learning; they use the Internet to deliver content and instruction and allow students some element of control of time, place, path, and/or pace, but they substantially fall outside the scope of blended learning (Staker, 2011; Watson et al., 2011). Informal online learning allows students to use

technology any time to learn outside of a structured education program. For example, students could watch online video on their own outside of any recognized school program (Eduviews, 2009; Tsai, 2013). In a full-time online learning contents and instruction students use the Internet without attending a supervised brick-and-mortar location away from home, except on a limited cases, such as for supervised exams (Pankin et al., 2012).

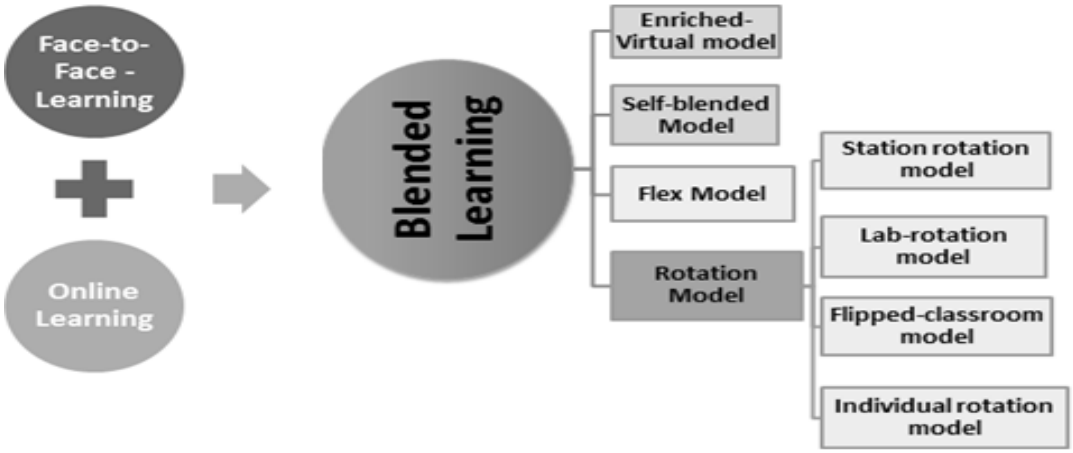

Figure 7.2: A Modified Blended learning taxonomy (Original from Staker & Horn, 2012)

Four blended learning models have been reported, (1) The rotation model in which students rotate through a fixed schedules, at least one of which is online-contains station and lab rotation, flipped classroom, and individual rotation (Horn & Staker, 2011) . (2) The flex model that allows internet as a primary delivery of contents and students move on an individually among learning modalities with face-to-face teaching still available (Bailey et al., 2013; *The Blended Learning Cycles*, 2012). (3) The self-blend model in which students take one or more classes entirely online and others in a traditional classroom (Bart, 2014; Christensen et al., 2013). (4) The enriched-virtual model in which students divide their time between attending a brick-and-mortar classes and learning remotely using online delivery of content and instruction (Horn & Staker, 2011; Page, 2002). Blended learning is supported by three primary components, traditional in-person classroom assisted by a qualified teacher, online digital educational resources often including pre-recorded tutorials given by a qualified teacher and structured independent learning engaged by the material in the lectures and knowledge established throughout the classroom involvement (Staker & Horn, 2012b).

7.2.4 Blended Learning Planning and Building Blocks

The most challenging demands of the 21st century learners are relational and quick access to new knowledge beyond the traditional reading, writing, and arithmetic for the purpose of visualizing critical thinking, creativity, communication, and collaboration skills (Blair, 2012; Starkey, 2011). Shortcomings in the planning of technology use rise when advocacy for manpower and technical support, facilities and maintenance, assessment and broad participation are not fully addressed (Gülbahar, 2007; Hoffman, 1996). Blended learning eliminates the shortcomings of eLearning design by bridging concepts between the two worlds of technology and pedagogical practices (Alonso et al., 2005; Kanuka, 2006). Khan (2005:27) reported blended learning framework with eight key dimensions (Figure 7.3); each saves a purpose as a guide to plan, develop, deliver, manage, and evaluate blended learning programs. He referred to the framework with different names such as e-learning, blended learning and web-based learning.

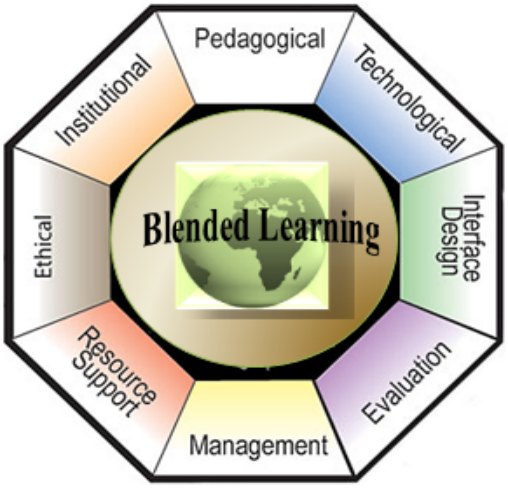

Figure 7.3: The Octagonal Blended learning Framework (Khan, 2005: 220)

Table 7.1: Descriptions of the Blended Learning Framework Dimensions (Khan, 2007:28)

Framework Dimensions	***Description***
1. Institutional	Is concerned with issues of administrative affairs, academic affairs, and student services related to blend learning.
2. Management	Refers to the maintenance of learning environment and distribution of information
3. Technological	Examines issues of technology infrastructure in e-learning environments. This includes infrastructure planning, hardware and software.
4. Pedagogical	Refers to teaching and learning, that addresses issues concerning content analysis, audience analysis, goal analysis, medium analysis, design approach,

	organization, and learning strategies.
5. Ethical	Relate to social and political influence, cultural diversity, bias, geographical diversity, learner diversity, digital divide, etiquette, and the legal issues.
6. Interface design	Encompasses page and site design, content design, navigation, accessibility and usability testing.
7. Resource support	examines the online support and resources required to foster meaningful learning
8. Evaluation	Includes both assessment of learners and evaluation of the instruction and learning environment.

The Hardware for blended eLearning may include personal computers, mobile devices like tablets and smart phones, servers, modems, networking devices, wireless devices, printers, scanners, cameras, microphone, storage devices (e.g., hard drives, hard disks, CD-ROM, DVD, etc.), and other equipments (Khan, 2005: p. 173). Software for blended eLearning may include (but not limited to) word processors, e-mail packages, presentation programs, graphic software, reader software, browsers and plug-ins, spreadsheets, databases, authoring tools and enterprise software (Khan, 2005: p. 173). In this study we considered learning management systems (LMS) and or learning content management systems (LCMS) as technology beyond software.

7.2.5 Redefining Blended Learning in a Tanzanian Context

According to Marsh (2012:11), the most important aim of a blended learning design is to find the most effective and efficient combination of learning modes for the individual learning subjects, contexts, and objectives. Important aspects of blended learning are traditional learning and online digital educational resources that supports learners control over time, place, path and /or pace (Staker & Horn, 2012b). There is no single best definition and approach of blended learning models; the one that works best for students and teachers in their localities and that discourses their needs at the time is mostly preferred (Dabbs, 2012b; Huang, Ma, & Zhang, 2008; Pankin et al., 2012; Saliba et al., 2013). In this study, the perspective of SWOT (Strength, Weakness, Opportunities and Threats) analysis for online digital education resources sharing and blended learning implementation in Tanzania guided us to redefine blended learning as instructional approaches and pedagogical practices.

We therefore, defined blended learning as the instructional design approaches and learner-centered pedagogical practices that permit creation, innovation/renovation, sharing of learning objects and a constructive mixture of online digital educational resources, computer-based learning, traditional learning, and /or inquiry based learning approaches; that enhance flexible self-paced learning and a continued preservation of learning artefacts' for future reuse.

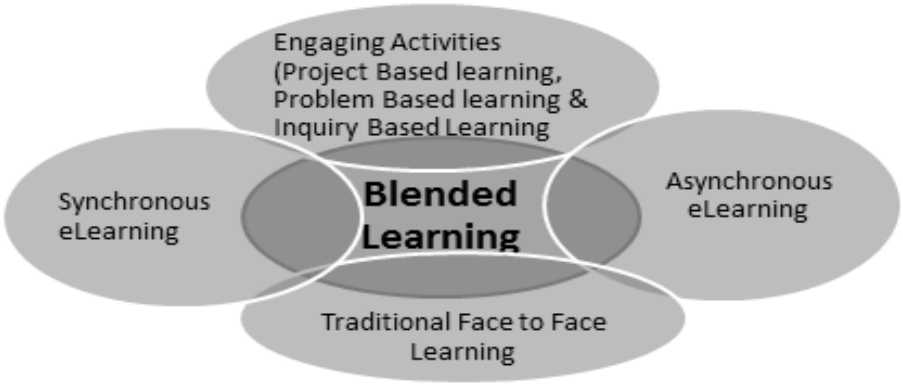

Figure 7.4: Blended Learning Visual definition

This definition includes network of collaborative variables that supports the use of localized real world tools, relevant experiences, and meaningful data to inject a sense of purpose to the teaching and learning processes and the classroom activities.

- Different learning or instructional methods (lecture, discussion, guided practices, reading, games, case study, simulation/animation)
- Inquiry-based learning approaches (e.g. project based learning, problem based learning, inquiry based learning)
- Different delivery methods and environments (live classroom, computer mediated and or activity based method),
- Different scheduling environments (synchronous or asynchronous)
- Different levels of guidance (individual, instructor or expert led, or group learning)
- Different external communities (experts in different fields, Society and Institutions).
- Different best practices (Flexible based on available supporting resources, Authentic, Interactive, active/engaging environment or activities)
- Different medium (face-to-face, televised, computer based learning, online videos, video conferences, web conferences, games, animations/simulations applications)

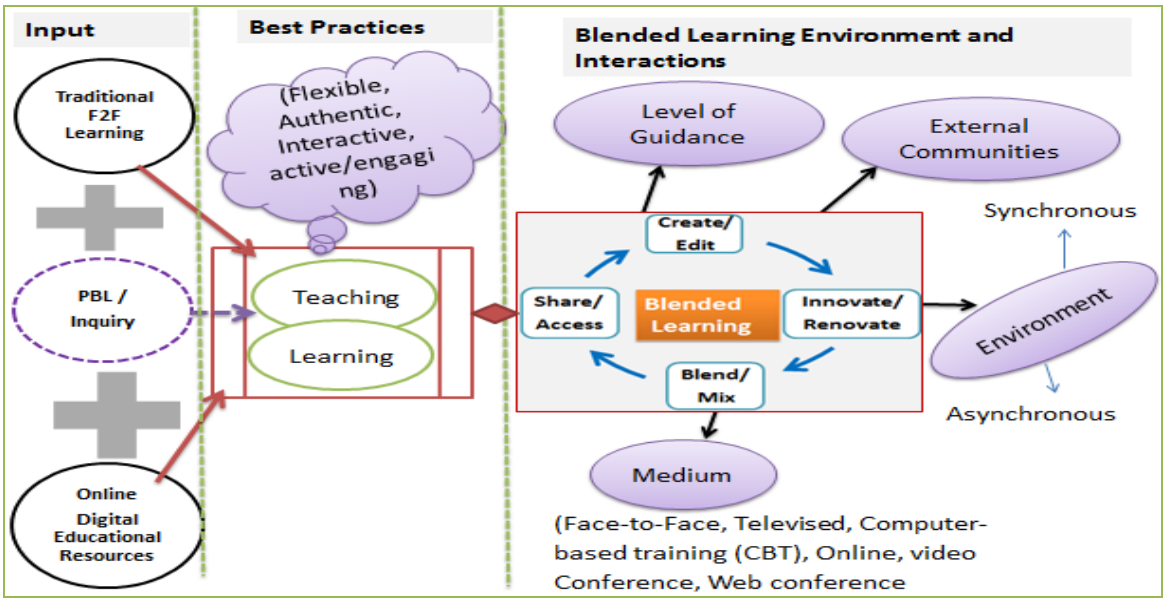

Figure 7.5: Blended learning and collaborating variables

7.2.3 Learning Objects

Learning objects (LOs) are digital learning resources that are shared through the Internet and could be reused in multiple learning contexts (Kay & Knaack, 2007; McGreal, 2004, pp. 7–9). They are small, reusable educational chunks of digital information that educators archive and use in teaching and can be shared online (Lehman, 2007). A learning object is a unit of digital resource that can be shared to support teaching and learning (Wang, 2008). The strategy for using learning objects should cover the design, implementation, delivery, costs, benefits, and pitfalls (Barritt & Alderman, 2004: p. 7). Usually, quality of learning objects is guaranteed when by the quality of instructional design approaches, methodologies, and the storage and retrieval of their elements from a database (Barritt & Alderman, 2004, p. 8; Grajek, 2013). Usually, they are accessible to teachers, students and other users through online portals, collections, or learning object repositories which store the objects themselves, or pointers or addresses to these resources (Barritt & Alderman, 2004; Caws, Friesen, & Beaudoin, 2006; Kay, Knaack, & Muirhead, 2009; Lehman, 2007).

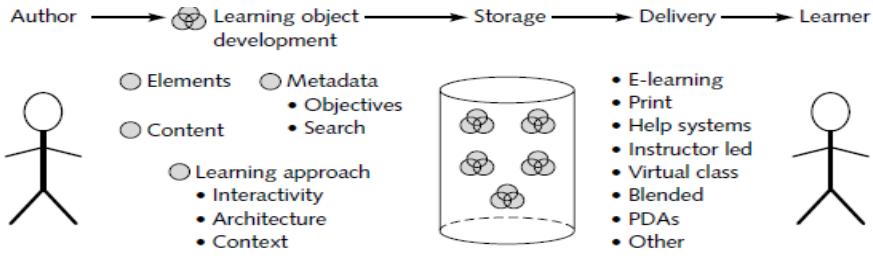

Figure 7.6: The Learning Object Designing Process (Barritt & Alderman, 2004, p. 8)

Metadata are structured information that describes, explains, traces, or otherwise makes it easier to retrieve, use, or manage an information resource (Barritt & Alderman, 2004: p. 9; Bourda, Hélier, Bourda, & Hélier, 2000; McClelland, 2003; Ogbuji, 2003). In a database, Metadata is called data about data or information about information.

7.2.4 SWOT Framework

The SWOT framework is a strategic analysis tool used to identify and evaluate the strengths, weaknesses, opportunities and threats of a project (Zhang & Goel, 2011). It is a business tool for planning purposes intended to yield strategic insights (Helms & Nixon, 2010; Valentin, 2001). A central idea in SWOT analysis is identifying a primary objective, or desired end state of the project widely used as a preliminary step in planning processes in many types of organisation (Miles, Keenan, & Kaivo-Oja, 2003: p. 75; Nisheva, Gourova, Ruskov, Todorova, & Antonova, 2008). For most institutions that undertake e-learning initiatives, the desired outcome for SWOT analysis would result into successful adoption of e-learning (Zhang & Goel, 2011). The SWOT analysis combines analysis of external drivers and of internal resources of organizations for determining to what extent the actual strategy is suitable and appropriate to meet the challenges and changes in the organizations' internal and external environment (Nisheva et al., 2008; Sambuu, 2005; Valentin, 2001). There are many ICT use in education framework, but not all can be accepted in all situations. Using SWOT analysis , can enhance the localisation of a framework with reasonable information for the existing strengths, opportunities, weaknesses and challenges (Robertson, Webb, & Fluck, 2007: p. 24). For any investment to be made in technology use in schools or teacher training institution, focus should not only be on materials and resources, but users' readiness and the teaching and learning environment should also be adjusted (Barton & Haydn, 2006).

7.2.5 Research Questions

Two research questions were used in this study:

RQ1: What are the indivual users' characteristics that are considered as inputs to the design of online resources and eLearning implementation framework?

RQ2: What are the strengths, weaknesses, opportunities, and threats (SWOT) Tanzania have regarding the use of ICT in secondary education?

7.3 Research Method

7.3.1 Research Design and Procedure

This study applied mixed-methods approach to make use of qualitative and quantitative data that have the advantages of complementing each other and providing deeper understanding of the issues under the study. This research was carried in the secondary education domain as a case study. The study collected data from four secondary schools, teachers' training college (TTC), one University, Ministry of Education and vocational Training and the Tanzania Institute of education. The study targeted to identify participants' perceptions about ICT use in teaching and learning, the use of online resources and e-learning, challenges faced, opportunities etc. During the study, teachers first completed a short survey about the status of classroom ICT use, e-contents accessibility and availability, perceived readiness, and their own knowledge, skills and experience in ICT use for teaching. After completing the questionnaire, teachers and tutors focused group discussions took place (separately). The participants were asked to discuss how they perceive the SWOT of integrating and implementing online educational resources in classrooms, their perceived benefits and limitations and the skills. To solicit the attitudes of teachers, tutors, curriculum development experts and MoEVT officers; they filled out a questionnaire and later participated in a focus group interviews of roughly 15 minutes on the factors that influence ICT use in secondary education. The research team recorded and took notes during the focus group interviews. We analyzed data from the survey (including the open questions) and the questionnaires. The case study was carried out on individuals with influence on the government's decision to use ICT in education and those considered as principle beneficiaries supposed to have relevant competences, knowledge, skills, and readiness to support e-learning implementation in schools. The practices and actions of participated individuals could

lead to factors affecting the present and future state of online educational resources and eLearning implementation in public schools. The study evaluated participants' abilities, knowledge, skills, attitudes, and digital contents practices in the OREI framework dimensions based on SWOT analysis.

7.3.2 Participants

Data for the present study came from 542 participants.The study collected data from four secondary schools (from both teachers and students in year two and three of study), teachers' training college (TTC) (tutors and teacher trainees in Science and Mathematics), University students (specialized in education), Ministry of Education and vocational Training officers (secondary education unit, teacher training unit, commissioner's office and inspection unit) and the Tanzania Institute of education (curriculum developer experts). To avoid any personal conversations or topics outside the study at hand, researchers tried to stick to issues related to teaching practices with pedagogical ICTs and e-contents knowledge that could enhance e-learning implementation. The research used questionnaires and interviews as the primary instruments for data collection. Students' participation was organized with approximately 35 students from each year of study selected randomly. All Science and Mathematics teachers who were available participated. In addition, approximately 50 Science and Mathematics teacher trainees from each year of study participated. All tutors in science and mathematics who were available were freely allowed to participate in the study.

Students participated were second year 160 (54.2%) and third year 135 (45.2%) with age range of 12-17 years. Schools were presented by 69 (23.4%) from Mongola, 70 (23.7%) from Kipera, 73 (24.7%) from Kilakala and 83 (28.1%) from Lupanga. Teachers participated constituted 6 (25.0%) from Mongola, 5 (20.8%) Kipera, 9 (37.5%) Kilakala and 4 (16.7%) Lupanga. The questionnaires to the Tanzania Institute of Education were distributed by the director of human resources and collected after two weeks to allow them fill out the questionnaire without pressure because of their tight work schedules, the MoEVT officials participated were from secondary department, commissioner's office and teacher education department. Tutors and teacher trainees were given freedom to participate, except that must come from science and mathematics

specializations. School heads invited teachers who participated and the teachers on duty invited students.

7.3.3 Instrument

The survey comprised questions for teachers, tutors, students, schools' inspectors and Tanzania Institute of Education officers on own experiences with online resources, their attitudes, self-perceived ICT use knowledge, skills, and the availability of ICT infrastructures that could enhance blended learning as a preferred model of e-learning. For the structured questions, a Likert scale of 1–5 was used. The demographic information of the participants (age, gender, year of study, subject of teaching, and years in the field of teaching) was solicited. The focus group interviews and guiding questions prompted the group to remain focused.

7.3.4 Data analysis

The survey data were analyzed using SPSS ver.21 and the focus group interview results reported qualitatively. The data collected through the survey were presented in stacked bar charts, radar with markers and pie charts showing percentages of respondents on each matter presented. The reliability analysis of scales was conducted and was confirmed with Cronbach's alpha higher than 0.70. The open questions in the questionnaires were analyzed qualitatively.

7.4 The OREI Framework Core Domains and their Influences

The OREI framework provides a roadmap for planning, implementation and Monitoring and evaluation of ICT in education projects in developing countries taking Tanzania as a case. Understanding of key participants in the success of the OREI framework mainly focused on examining contribution requirements into successful interactions of activities and the dependencies that define a framework dimensions. The OREI framework focused on inventing a shared vision and technology integration plan that stands on the knowledge, attitudes, beliefs, and positive ICT use practices for all responsible parties. As part of an on-going study, this paper evaluated desired principle beneficiaries (teachers and students) and government agencies (MoEVT and TIE) required for supporting the enhancement of the ICT in secondary education. For the success of project, consideration of the users' characteristics in the early stages is necessary to determine training and recruitment needs and avoid wastage of limited resources

such as time and money. The government support should ensure the availability of funding, plan for the technology level and the training and recruitment. As a result for OREI enhancement teachers and students should have basic ICT knowledge to enable them to organize and store, distribute or share, innovate or create, evaluate or review the digital contents that are relevant to their teaching and learning environment (see Figure 7.3 below). The technology should link users to the contents developed locally (curriculum based e-contents) and the online open systems contents. Users' should be familiar with new ideas and new technologies that are applicable to teaching and learning process directly. Teachers and learners can only achieve the goals when they have access to new and emerging technologies and have the opportunity, knowledge, and skills to explore knowledge using technology.

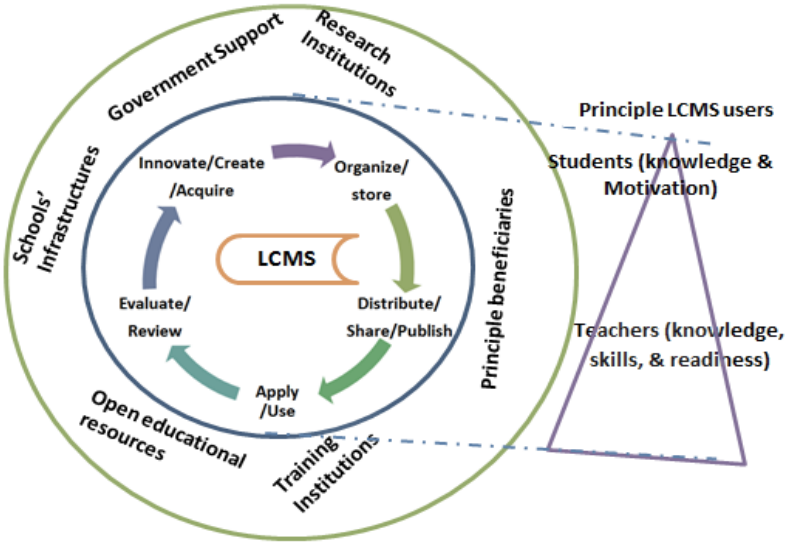

Figure 7.7: The OREI Framework Influences on ICT in Education Users

Whatever education system wants to achieve must first consider potential beneficiaries (teachers and students). A best use of technology allow teachers and students, in a user friendly manner to interact online using a well-designed and localised technology and have constant access to the most curriculum relevant digital contents. When potential users have knowledge and become owners of their learning environment rather than consumers, that's when the use of technology becomes dominant and sustainable (only when other factors are controlled). Digital educational contents can either be in-house build, off-shelf, or mixtures, though teaching approaches and the contents must balance to achieve the desired goal (Figure 7.4 below).

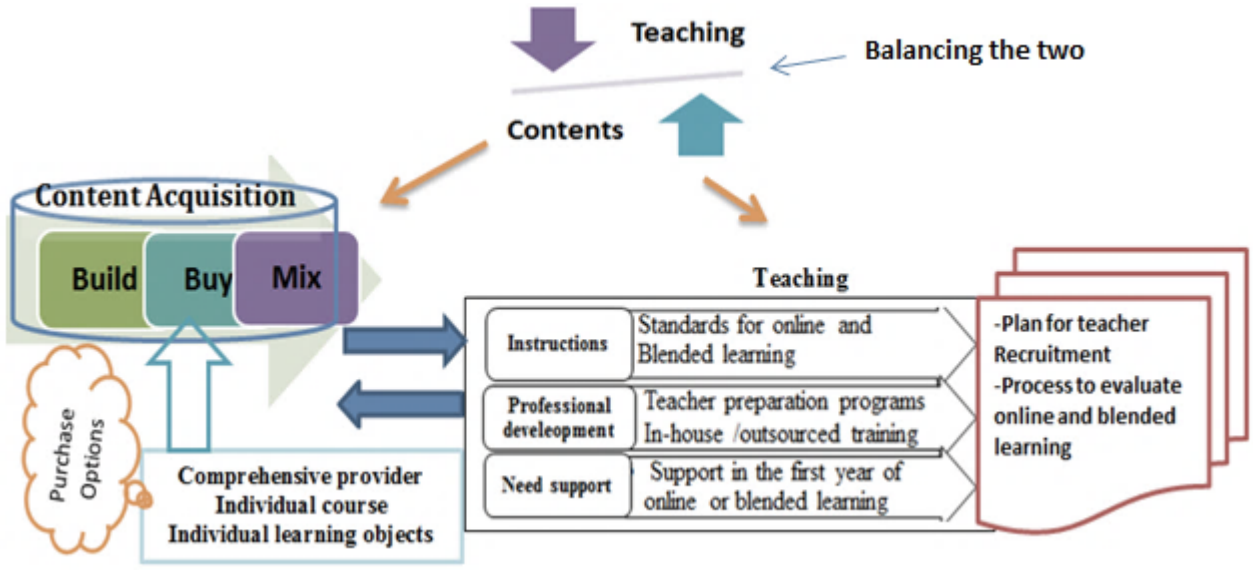

Figure 7.8: Planning for Contents Acquisition and the Teaching Environment

The contribution of research and training institutions should be valued and considered as a continuous partnership that tend to meet a common goal of having efficient technology for teachers and students. Teachers should become creators of learning artifacts and interact with the technology effectively. Training institutions should support teacher training programmes that emphasize on the use of pedagogical ICT resources. Research institutions should support improve the technology through research, development of new tools and positive suggestions for things that needs change-over. Schools infrastructures (Hardware and software) should support teachers and students sustainable access to the relevant ICT resources. The contribution of contents and teaching should balance to make use of all possible resources and contents available. The measure of SWOT analysis on the OREI framework should sick to meet what the framework intents to achieve.

7.5 Results and Discussion

7.5.1 Experts Perceived Factors Leading to ICT use in Education

It was vital for this study to solicit information from curriculum developers and experts on the reasons for ICT use in education. The knowledge and readiness of curriculum development experts on ICT use in education have influence on the government's decision to invest in ICTs in

education. The question asked was "Why would you recommend ICTs to be used for teaching/learning in Tanzania secondary education?"). Results are presented in Figure 7.5 below.

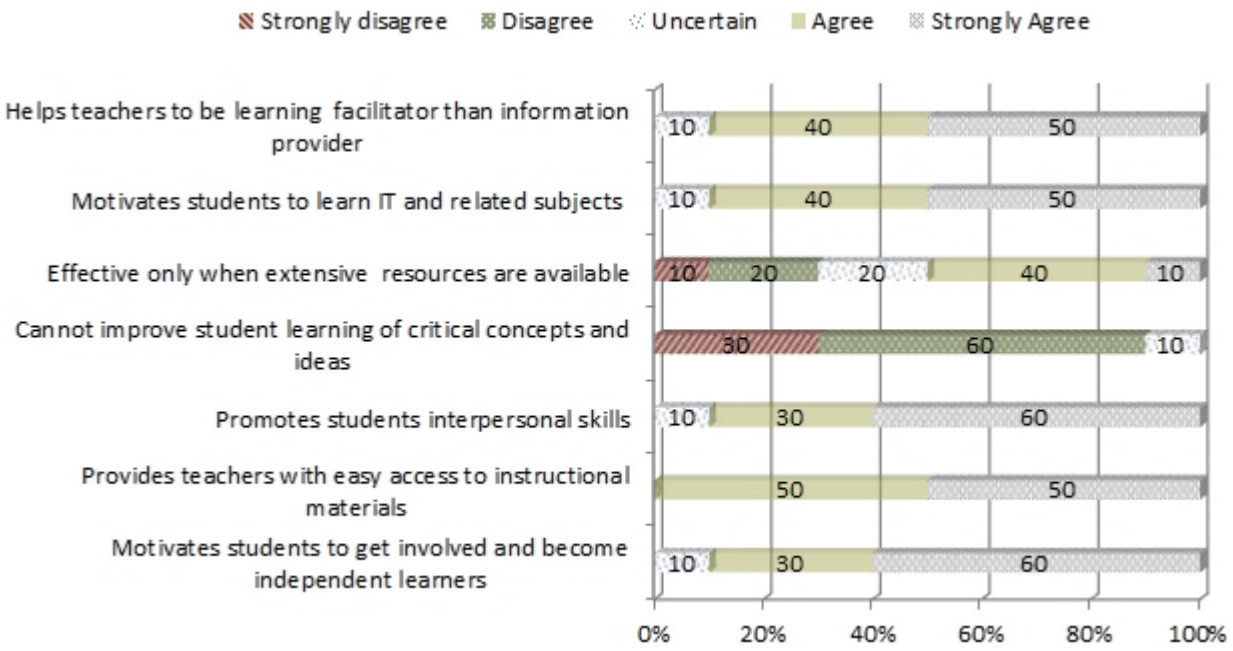

Figure 7.9: Perception of Curriculum Developer Experts on the use ICTs in Education

Results in Figure 7.5 above show that, majority (60%) agree on the ability of ICT use to motivate students become independent learners, (50%) agree that ICT provides teachers with easy access to instructional materials, (60%) agree that ICT promotes learners interpersonal skills, (50%) agree that the use of ICT motivates students to learn IT and other related subjects and (50%) agree that ICT helps teachers to become learning facilitator than being information providers only. However, it was recently reported that investing heavily in computers and classroom technology in schools does not improve performance; the use of technology increases teachers efficiency and learners collaboration and access to more diverse learning materials in a timely and flexible schedule (OECD, 2015).

7.2.5 Teacher Trainees Knowledge, Skills and Classroom ICTs practices

The study examined the abilities, belief, and skills of teacher trainees by focusing on their pedagogical ICT knowledge and skills. Their responses were assessed using Very Strong (VS),

Strong (S), Adequate (AD), Weak (W), and Very Weak (VW). Results are present in Figure 7.6 below using radar.

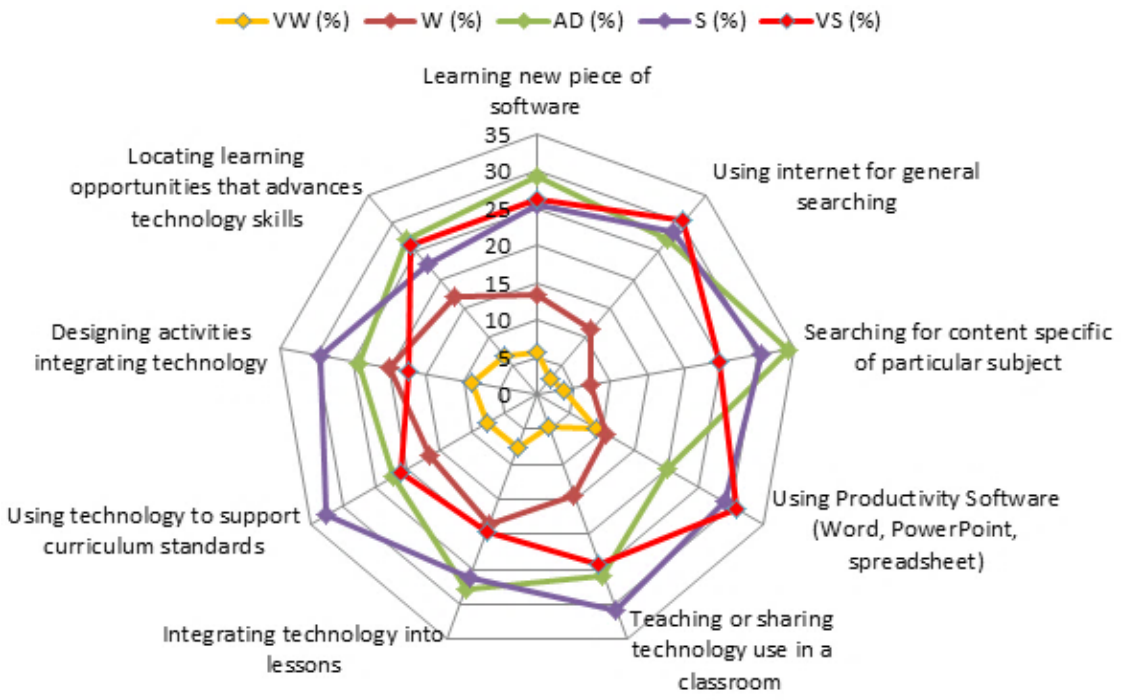

Figure 7.10: Teacher Trainees Knowledge, Skills and Pedagogical ICTs practices

Results in Figure 7.6 above show that, most of respondents reported Very Strong (VS), Strong (S), and Adequate (AD). Between 25% and 30% reported Very Strong (VS) on using productivity software (Word, Power point and Spreadsheet), Using Internet for general searching, learning new piece of software, and locating learning opportunities that advances technology skills. Between 25 % and 35 % of respondents reported, Strong (S) on using technology to support curriculum standards, teaching, or sharing technology use in a classroom, designing activities that use technology and searching for online content related to a particular subject. Majority who reported Adequate (AD) at 35% nominated searching for content specific of particular subject and at 25% integrating technology into lessons. This means that teacher trainees perceived themselves as having good pedagogical ICTs knowledge. Teachers' ICT knowledge and skills are important attributes that could have positive influence on technology use in education (Ertmer & Ottenbreit-Leftwich, 2010). Majority of teacher trainees (20%) reported as Weak (W) on the ability to design classroom activities that involve technology. Teachers general ICT use knowledge do not always mean effective skills and ability to design classroom activities that use technology (So, Choi, Lim, & Xiong, 2012). Enhancing teacher

trainees on basic ICT skills and knowledge helps them to become innovative for the improvement of the educational environment, development of technological literacy, and creation of deeper knowledge (Midoro, 2013).

7.5.3 School Teachers' Classroom ICTs Practices

School Teachers were assessed to find out how often have they practically considered the use of pedagogical ICT tools as teaching and learning resources/ aid. Results are in Figure7.7 below in form of a pie chart.

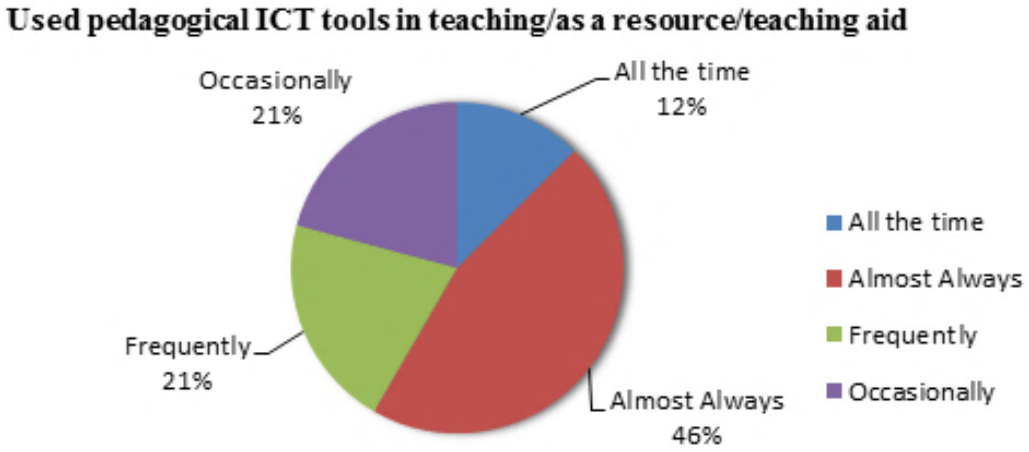

Figure 7.11: Teachers Frequencies of Pedagogical ICT tools they have used

As in Figure 7.7 above, the number of teachers who have considered using pedagogical ICT tools all the time, frequently and almost always combined is high (79.0%), with only 21.0% admitted to have used occasionally. No one reported "Not at all". This means teacher's readiness to use pedagogical ICT is high, even when they still face a lot of challenges. The success of ICT integration into real educational classes will depend on the ability of teachers to restructure the educational environment with the purpose of combining of new technologies and new pedagogics (Midoro, 2013).

7.5.4 Perception of Students on Experiences with the Use of ICTs

In this study, we examined students' experiences with pedagogical ICT that could have resulted from teachers' abilities to use and present ICT tools in the classrooms. All tools assessed were not based on the experience to use but knowledge of the tools. The knowledge students have, is

potential attribute in the SWOT analysis as an internal personal factors. Statistical results are in Figure 7.8 below.

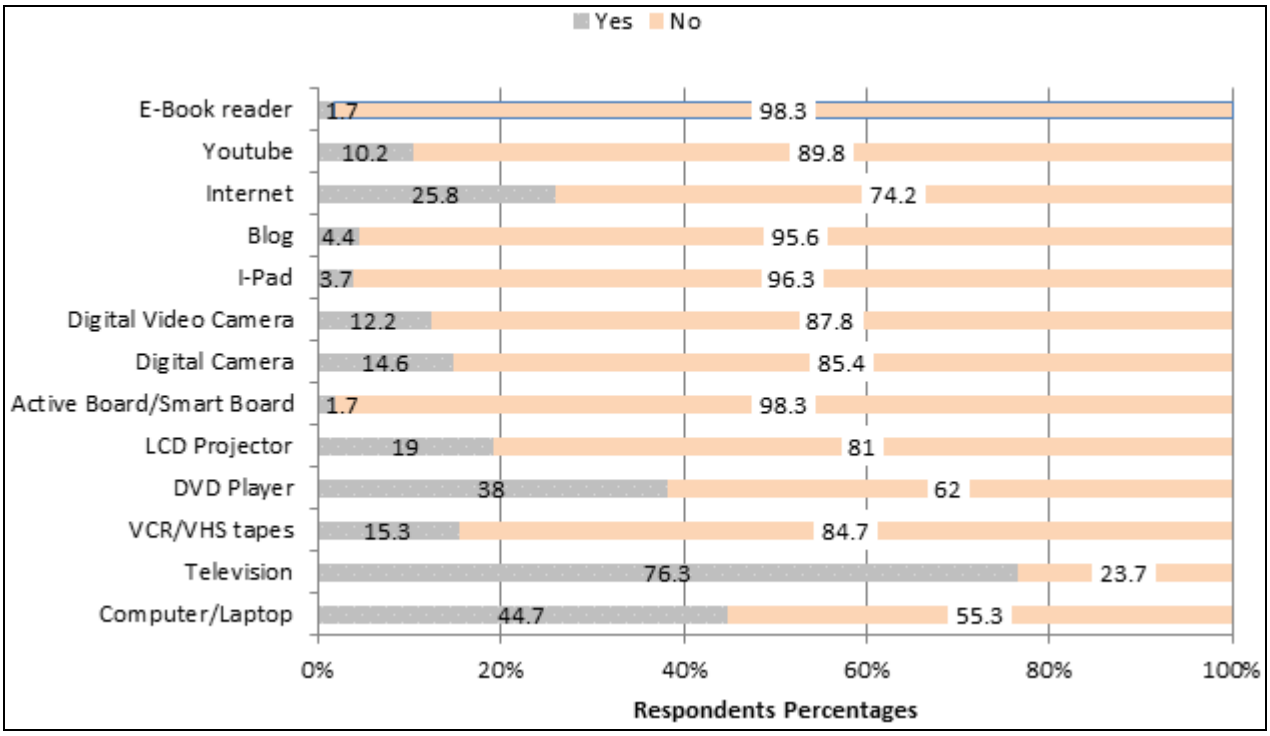

Figure 7.12: Pedagogical ICT Tools Students have practiced

Results in Figure 7.8 above show that, majority of students have not been exposed to the relevant pedagogical ICTs, they lack knowledge, skills and competence in the use of digital contents. The most tools that are knowledgeable to students are television (76.3 %) , computer/laptops (44.7%) and DvD player (38.0%) and the internet (25.8%).The rest reported 'yes' by less than 20%. This means most school students perceived themselves to have low knowledge on basic ICT tools that support e-learning models. A successful use of pedagogical ICTs in secondary education must affect both teachers and students through purposive use and access to relevant technologies. A stud by Norris, Sullivan, Poirot, & Soloway (2003) reported that, technology cannot have impact on learners when they have no opportunity to access and use the technology. Having minimum number of ICT tools in schools can lead to significant students' knowledge, skills and awareness that are import for OREI efficient practices. The development of competencies among students follows into three stages of technology literacy (promoting opportunities to use ICTs for more effective knowledge acquisition within the learning process),

knowledge deepening (application of technology for concepts deepening using real-world tasks) and knowledge creation (create new knowledge based on the available technology) (Midoro, 2013).

7.5.5 Tutors' (TTC) Knowledge and ICT Tools Practices

In this study, we assessed tutors readiness to use pedagogical ICTs to measure the level of teacher trainees' exposure to relevant ICTs. The tools assessed are important for determining the level of technology, user knowledge and the need for training when OREI framework is enhanced. The knowledge of tutors' on ICT tools, positively or negatively affects teacher trainees knowledge and abilities to adopt ICT use in education. Results are in Figure 7.9 below.

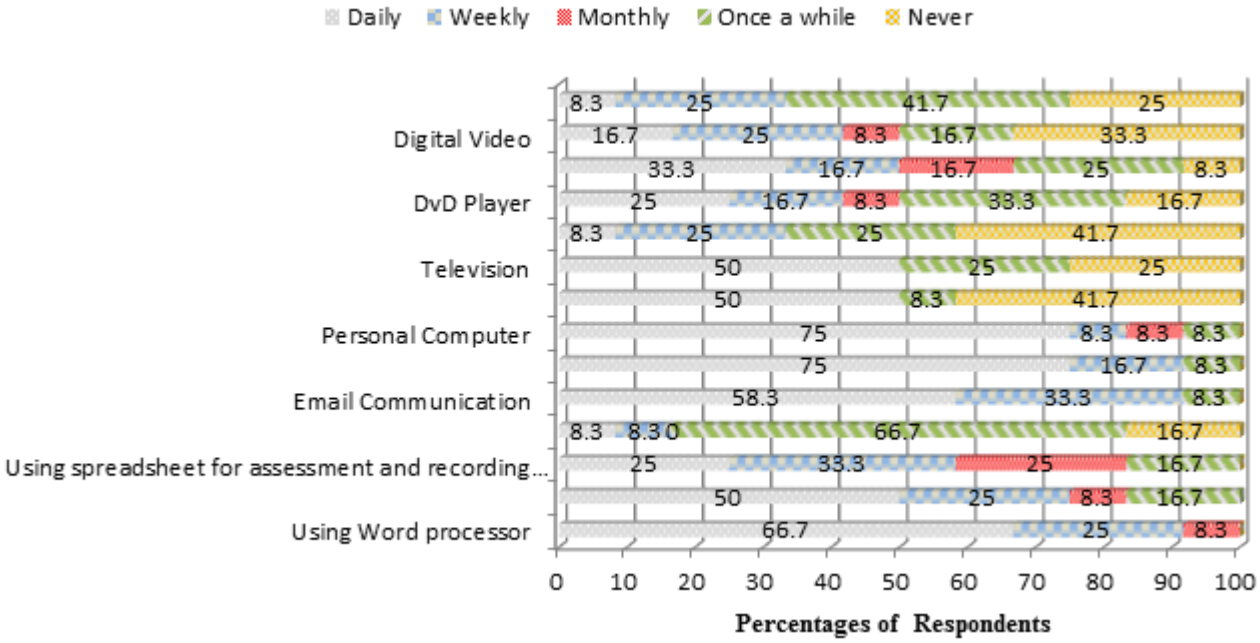

Figure 7.13: Respondents Frequencies of Pedagogical ICT tools Practices

Results in Figure 7.9 , revealed that majority of tutors have daily used word processor (66.7%), Power point presentation (50%), email communication (58.3%), internet search engine (75%), Ipad/android Phone/A tablet (50%), Television (50%), personal computer (75%) and projector (33.3%). In addition, tutors reported to have on a weekly basis used Spreadsheet application (33.3%), digital video (25%) and digital camera (25%). Those who nominated once a while majority reported using the DVD Player (33.3%), College Website (66.7%) and the VCR/VHS tapes was reported never being used by 41.7%. They are able to search and access online educational resources that are more relevant to what e-learning needs. The more knowledge,

belief and skills tutors have on ICTs use in classrooms; the more motivation and experiences teacher trainees gain. In particular, study by Barton & Haydn (2006) found that teacher trainees ICT use is portrayed by the experiences, knowledge and skills of their tutors. Application of new technologies in education assumes a new role of the teacher, new pedagogical techniques, and new approaches to teacher education (Midoro, 2013).

7.5.6 Government Readiness to Support ICT use in Secondary Education

Based on the conducted interviews, officials from the Ministry of Education and Vocational Training (MoEVT) had varied positive responses. The interview focused on existence of policies and guidelines, present and past ICT use in secondary education enhancement projects and personal knowledge and readiness to advice the govern on investing in ICT use in secondary education. It was found that the ICT policy for basic education exist, however no implementation guidelines such as strategic plan and investment framework. One officer stated: "*We have an ICT policy for basic education, however it lacks harmonized implementation plan"*. An officer from the Tanzania Institute of education when asked about the curriculum and directly support on ICT tools application, stated: "M*ajority of schools have no ICT infrastructures like computers, internet access, and electricity, therefore it is not realistic to implement ICT in secondary education*". The MoEVT officers when asked on present and previous ICT related projects, they listed three major recently carried out projects. Results are summarized in Table 7.2 .

Table 7.2: Government Readiness for Educational ICT Usage

Project Name	*Project Sponsor/Coordinator*	*Project Objectives*
(a) National Programme for ICT for Secondary school Teachers, 2005 to 2008	MoEVT-Secondary Education Unit, World bank	-Targeted to eradicate ICT illiteracy among teachers and enhance its use in teaching. -To its completion, the project supported 50 secondary schools and all 34 government teachers' colleges with ICT infrastructures and e-contents
(b) SME (Science, Mathematics, and English) ICT project-2011-2013.	MoEVT-Teacher education Department and Global E-Schools and Communities	-Baseline study on e- resources gaps in secondary education and teacher training colleges. -Install computer systems, internet, and equipments in 35 schools.

	Initiative (GESCI).	-Train Science, Mathematics, and English teachers in in ICT basic skills.
(c) Strengthening Innovation and Practice in Secondary Education (SIPSE) Project - June 2013 - May 2015	MoEVT-Teacher education Department and funded by Master Card Foundation.	-Equipping teachers to provide a student-centered, participative and ICT- based approach to curriculum delivery in Science Technology, English, and Mathematics (STEM).

Government readiness should be known as the most important factors for public education system that have influence on many other factors. Among the factors that depends on government influence and have not sufficiently supported technology use in schools are ICT focused teacher preparation, insufficient number of computers and unreliable internet connections that stand as obstacles for the preparation of student-teachers to teach ICT and use ICT in their teaching (Andersson et al., 2014: p. 88). Investment in e-learning is not an alternative to investment in education generally; the two are seen as being complementary entities for promoting and transforming education for a better (Olson et al., 2011).

7.5.7 School Inspectors Pedagogical ICT Tools Knowledge and Support

The knowledge and support school inspectors have on the benefits of pedagogical ICT tools have influence on teachers' technology adoption. It should be noted that, all school inspectors are teachers by professional; they are part of the MoEVT advising body on issues related to education improvement. When asked to mention any pedagogical ICT tools that could be recommended as teaching/learning resources, they listed numerous tools. Results are in Table 7.3 below.

Table 7.3: School Inspectors pedagogical ICT tools knowledge and Support

Question: List some few examples of the pedagogical ICT tools that you could suggest to be included in the curriculum as teaching/learning resources/aid.		
School Inspector (SPn)	**School Inspector (Spn) Response**	**Significance**
- Sp1	Multimedia (scanners, digital cameras and video cameras), Electronic mail and the internet, Presentation software, Expansive software	Yes to all

- Sp2	Communicative application, interactive whiteboard software, simulation/animations applications, spreadsheets.	Yes to all
- Sp3	DvD player, Video, TV, Radio, Radio tapes, Content specific applications, presentation software e.g. power point, internet resources	Yes to all
- Sp4	Analytical/programing tools, content specific applications, presentation software.	Yes to all

Results in Table 7.3 above show that, inspection officers are knowledgeable about pedagogical ICT tools, but these results could not suggest if inspectors are good technology users or not. Their knowledge and skills about pedagogical ICTs have influence on what teachers practice in classroom. Schools' inspectors have influence in the current and future use of ICTs in education (Robertson, 2003). Inspectors are part of policy makers, their knowledge and beliefs about technology have great influences on government's decision to invest in ICT in secondary education.

7.5.8 Tanzania ICT Use in Education SWOT analysis

E-learning is built on the availability of ICT resources ranging from hardware, software and relevant educational materials that are well planned and accessible to learners and teachers. The SWOT analysis is viewed from two perspectives of external factors and internal factors as in Figure 7.10 below.

Figure 7.14: ICT Use in Education SWOT Analysis Process

The SWOT analysis helps to focus on strengths, minimize threats, and take the greatest possible advantage of opportunities available when taking any strategic action. The presentation of SWOT analysis on the ICT use in Tanzania secondary education are presented as internal and external factors in the Tables 7.4 and 7.5 below.

Table 7.4: SWOT analysis - ICT Use in Education Strengths and Weaknesses

Internal Factors	
Strengths	***Weaknesses***
– Government readiness as indicated by the past and ongoing ICT in education projects. – Availability of ICT policy for basic education used as base for ICT use and planning. – Presence of key decision makers who see ICT use in education as important. – Recognition and readiness of principle users on the importance and needs of ICT education – Training institution are increasing ICT teacher supply – Existence of private organizations ready to support and fund the ICT use in education projects. – Existence of the fiber backbone as an ongoing effort to link all education institutions and public secondary schools to the fiber optic for enhancing connectivity – Internet connectivity and Access growth and awareness among many citizens. – Growing and penetration of mobile devices country wide. – Low connectivity charges per bandwidth and flexibility – Possibilities of having local in-house content developers with ability to localise contents relevant to curriculum and guidelines – Availability of experienced staffs in delivering e-learning in the field of secondary education.	– Lack of ICT policy for basic education strategic implementation plan and the framework. – Lack of technical infrastructure issues i.e. IT equipment not fit for education purpose – Physiological barrier of teachers and schools management – Principle users have weak English language that do support most of technology use terminologies – No universal standard of computer software and hardware specifications for secondary education – Lack of sustainable funding – Earlier, emphasis was given to information technology as a subject rather than pedagogical ICTs applications. – Due to lack of computers and professional teachers the skills and knowledge transferred to learners do not meet the minimum standards of ICT use in education – Lack of supportive infrastructures (inadequate computers, internet access, like internet , hardware and software, e-contents, unreliable internet connection and insufficient bandwidth) – Too many disadvantaged families (many families cannot afford to invest in technologies for their children) – Limited number of supporting experts (ICT users lack support). – Resistance to change (teachers unwillingness to adopt new technology use) – Lack of motivations and incentives to use e-contents in education (Teacher who use ICT are not recognized). – Tutors and Teachers have limited technology usage capabilities (pedagogical technology use, inability to search, design, edit and construct e-contents) – Lack of standardized and quality e-learning training materials. – Learners' lack knowledge, skills and readiness to use ICT tools for learning.

Table 7.5: SWOT analysis - ICT Use in Education Opportunities and Threats

External Factors	
Opportunities	***Threats***
– Possibility of enhancing availability of online collaboration tools. – Existence of unexplored external funding sources. – Opportunities for blending of existing traditional teaching methods with technology – New advancement in technology for our generation (Surrounded by graphical web browsers, laptops, cell phones, instant messenger services, broadband, wireless, video games, video conferencing, and crowd/cloud computing) – Could enhance development of ICT curriculum on international level. – Foster active cooperation of government, public and private sectors and international and donor organizations in ICT use in education. – Can motivate creativity and contribution in advancement of educational technology	– Financial constraints (limited external funding sources) – Lack of sustainable power supply for running technological devices – Technology changes (new technologies can discourage users who are not eager to learning) – Lack of secondary school curriculum related e-books and e-contents. – Bandwidth and connectivity issues – E-learning being seen as not cost effective. – Lacking allocation of specific amount of fund in the government budget for the ICT in secondary education initiatives – There is misunderstanding that ICT education is just a computer literacy or knowledge of widely used applications – Consequences of inadequate computer hardware and software supply – If the government does not resolve issues related to preparation and education of teacher trainees in ICT use, few years later the nation will face lack of ICT qualified teaching staff.

Tanzania faces many challenges that range from financial, social to infrastructural support. Recent increase in the number of students enrolment which is opposed to the available resources (Classrooms, teachers and textbooks), can its rampage effects be minimised using technology. However, there exists the planning of technology shortcoming, which range from poor planning leading to an availability of relevant educational e-contents, lack of technical support, facilities and qualified teachers who can teaching using ICTs. Addressing these problems saves a purpose for sustainability in technology use (Gülbahar, 2007). The use of blended learning model, eliminates the shortcomings of e-learning where the use of traditional approaches can also be integrated into the technology enhanced teaching and learning practices; an assertion also supported for bridging concepts between the two worlds of technology and pedagogical practices (Alonso et al., 2005). The use eight of eight dimensions by Khan (2005:27) for

planning and design blended learning application, needs readjustments into a particular education context. It cannot be generalised into all situations.

7.6 Conclusion

Frameworks that help us organize learning with, though, or about ICT are useful, as are frameworks that guide us to a new level of technology use. The OREI framework and SWOT analysis prompted identification of favourable factors (strengths and opportunities) and the unfavourable factors (weakness and threats) intended to yield strategic insights for the OREI framework practices. Without these information, framework implementation misses feasible inputs (Valentin, 2001). However, there is also the warning that a framework that is reasonable and coherent in its own right may not be reasonable and coherent in certain situations (Robertson et al., 2007: p. 23). Hence, Tanzania education system needs a stable localized framework to be used a roadmap for ICT use in education planning and implementation. The successful use of online educational resources and e-learning implementation (OREI) framework as a roadmap for the ICT in education planning in Tanzania secondary education depends much on several critical factors. The planning and deciding on the levels of ICT integration in secondary education settings should be interpreted in ways that are realistic and sustainable for improving educational outcomes. The favourable factors (strengths and opportunities) and the unfavourable factors (weakness and threats) presented in this study are grounded in practical solutions to problems and issues identified in the planning process, schools' environments, principle users characteristics and the levels of stakeholders involvement in the process of designing a working solution.

This study promotes a roadmap for sustainable ICT use planning steps that enables education policy makers, research institutions, instructional designers, and teachers training institutions to construct and reconstruct their own understandings of their lived experience in relation to the use of ICT, its possibilities for continuation, the opportunities for improvement and change and the constraints currently limiting initiatives. The OREI framework will improve access, equity, and quality in the delivery of e-contents through integration and harmonization of curriculum relevant e-contents that can be used in teaching and learning. There have been an uncovered gap for identifying relevant and core technology for secondary education ICT use enhancement

(Hooker et al., 2011, p. 20). Specifically, the OREI creates a cohesive ICT framework that enhance the planning and implementation of suitable ICTs in secondary education, provide and improve investment of ICT infrastructure that directly support teaching and learning. In addition, provide guidance for capacity building, transform basic education curriculum for e-delivery modes, develop guidelines for online resources design and access, integrate ICT in educational management functions, and enhance the contribution of stakeholders in ICT research and development. Redefining the Tanzania education in terms of e-learning models and implementation is an important step to be made in the 21st century (Baker et al., 2013, p. 8).

7.7 Recommendations and Further studies

This study recommends for the government to invest in the availability of a centralized learning content management system that would lead, motivate and allow the creation, storage, sharing, and collaboration between users. To overcome barriers of ICT use in education we recommend for a shared vision and technology integration plan and changing attitudes and beliefs for all users. The basic question that needs to be addressed by proceeding studies is how integrated the e-learning models and approaches that cope with the societal and technological changes should be designed to lead the direction of seizing the available complex learning resources, enhance multilevel students' flexibility, and empower teachers to work effectively in the school environments with high growing number of students. The proposed e-learning approach should first, take pedagogical, technical, and organizational aspects into account; second, take a systems design approach that might be necessary to mix online educational resources with face-to-face instruction and other media in order to maximize the effectiveness and efficiency of the e-learning model of choice. And third, it should be student centred to conspire the education policy and implementation plans that address collaboration of diverse, widely distributed set of learners who need to learn and transfer skills to an increasingly varied set of real-world contexts and settings.

CHAPTER EIGHT

General Discussions, Conclusion and Recommendations

Summary

This chapter summarises the discussion of major findings in response to the research questions and the contributions to the field of e-learning, reflects the study objectives in relationship to existing education system and concludes the research. Future research directions and prospective improvements are presented in the concluding section. The contribution of this dissertation has been established and presented on the scope to which it delivers adequate answers to the problem acknowledged. A summary of answers have been provided relating to understanding the e-learning models, practical planning and implementation of sustainable ICT use in education, theoretical groundwork for e-learning, and requirements for online resources and e-learning implementation in public secondary education.

8.1 General Discussions

In recent years, demands for application of ICTs in education have worldwide increased. Despite of strengths and opportunities that influence deployment of pedagogical ICTs in education, there are numbers of challenges such as lack of funding, lack of concrete baseline planning framework, lack of local experts' involvement and lack of strategic principles when deciding on the relevant ICT infrastructures and level of technologies to use. The Tanzania Education Sector Development Programme (ESDP) 2008-2017 comprehended substantial improvements that have been attained in secondary school infrastructure, students' enrolment, teacher supply, and provision of teaching and learning materials (United Republic of Tanzania, 2008b: p. 3). However, in order to improve learning outputs and outcomes, teacher capability and promoting a better teaching and learning environment the ESDP 2008-2017 and the Tanzania ICT Policy for basic education have admitted the need to strengthening ICT in education institutions for open learning (United Republic of Tanzania, 2007, 2008a: p. viii). The use of online resources and e-learning models in secondary schools however can be delayed but cannot be avoided. In Tanzania, existence of the ICT policy for basic education is one of the mile stone towards ICT use in education but failed to excel ICT use in education because of lacking a strong strategic implementation plan and a harmonised

framework (Olson et al., 2011; United Republic of Tanzania, 2007). The actual impacts of e-learning on students, schools and the education systems in developing countries are difficult to measure. The newness and diversity of the e-learning models and the complexity of factors affecting outcome, makes measuring e-learning to be considered as an emerging science (Olson et al., 2011, p. 8). When ICT is effectively used in education, it lives a life at the crossroads between evidence based policymaking, learning, and the fast-changing world of new technologies (Johannessen, 2009: p. 15). The OREI Framework presented in this dissertation provides high level strategic components for the effective planning, deployment and management that could ensure planning for the relevant ICT systems, desirable level of technology, instituting control and maintain standards for achieving educational objectives and emerging trends. The OREI is a framework for online educational resources use and e-learning implementation in secondary schools. In this part, the main findings of the study are summarized and discussed.

When technology advances, new tools and strategies for learning and potential stakeholders' involvement demand proof of the impact of ICT in education. The level of teachers exposure to formal information technologies, availability of relevant hardware and software, contents availability and supporting curriculum contents have influences on the readiness to use ICTs as pedagogical tools (what students learn as well as how they learn) (UNESCO, 2014: p. 48). We found, the mismatch between the governments' level of readiness, teachers' lack of readiness, and the schools infrastructures that failed to support efficient and sustainable technology use in education as the most serious drawbacks for the ICT use in education. Teachers training have concentrated much on pedagogy and contents knowledge. The right starting point for deployment of technology is the people for whom the technology is needed (Horton & Horton, 2003: p. 3). Key areas for users are training and recruitment. However, there were no noticeable differences in the ICT knowledge levels, awareness, and readiness for teachers with diploma and bachelor's degrees in the teaching professional. This means teacher training colleges and Universities nurturing teachers, have failed to create a harmonized skills and competencies for professional teachers to be able to execute teaching using pedagogical ICTs. Digital educational resources should be designed and associated with the pedagogical goals of the local curriculum, which could only be realized using a harmonized framework as a guiding principle (Olson et al.,

2011). The availability of strong policies and implementation strategic plans that address the use technology are necessary.

The UNESCO ICT competency framework for professional teachers (UNESCO, 2011, p. 17), recommended the taxonomy of ICT competencies with three components, (1) technology literacy (ability to integrate technology as pedagogy and use ICT basic tools in teaching). (2) Knowledge deepening (ability to solve complex problem with ICT pedagogy and apply complex ICT tools), and (3) knowledge creation (pedagogy self-management and ability to use pervasive ICT tools). The curriculum contents, online educational resources, Internet connection, ICT infrastructures and other instructional materials should be enriched to support teachers readiness to use ICT in classrooms (Chingos & Whitehurst, 2012: p. 11). In Tanzania, the challenges led to the low usage of ICTs in education are associated with the lack of infrastructures (hardware and software), teachers' lack of ICT use competencies and unreliable Internet connection. However, in most developing countries blended learning have been ascribed as a best e-learning model (Pankin et al., 2012; Sife, Lwoga, Sanga, & others, 2007). The desired level of ICT use teachers needed to exhibit on the curriculum lacked guidelines that emphasize on ICT use as among teaching and learning resources in the existing syllabuses. The uses of blended learning focus on the most effective and efficient combination of learning models for the individual learning subjects, contexts, and objectives. When education sector reform have focused on enhancing e-learning models for teaching and learning emphasis should be made on content relevance to the context, course description, the educational value that contents /Software provides to learners, materials flexibility (it can be used anytime, anywhere), the use of contents mix (i.e. animation, video, graphics, text), organization of materials, the basis of research contribution when designing materials, contents relevance to different learning styles, the enhancement of collaboration and interaction among users, copyright and license issues on contents (free) in order to use the content or operate the software (Andersson et al., 2014: p. 34).

The education sectors in developing countries demand the use of contemporary technologies based approaches and traditional approaches to be able to succeed in the 21st century. The viability of basic technologies and the pedagogical principles that enhance practices of e-learning models run short of the best possible e-learning solution for the many different needs and

situations (Jochems et al., 2004: p. 64). Today's learning environment whenever possible should support the use of all medias such as television, personal computers, mobile devices, radio, films, magazines, newspapers, textbooks, DVDs, e-books, e-readers, internet and the World Wide Web as additive to the traditional approaches (Berk, 2010). This study found knowledge transfer gap that led to an existence of double standards in the use of digital educational resources between students from schools with computer laboratories and those without computers at all. Students' attitudes and decision to use ICTs could be influenced by the people around them while accessibility to relevant blended learning contents plays a role in shaping the students intention to use e-contents use (Al-Harbi, 2011). The basic ICT use knowledge and competencies that most of tutors and teacher trainees' exhibit in the teaching and learning process are characterized as the TPACK or SAMR models constructs. However, tutors exhibited good knowledge level in all TPACK and SAMR constructs, teacher trainees have revealed poor and inefficient competencies on the use of basic ICT hardware, software, and associated peripherals. The weakness teachers have revealed originates from the way they have been trained which paid much emphasis on pedagogical knowledge and the content knowledge but lacked technological knowledge as an important TPACK component. Any paradigm shift in the classroom pedagogical ICTs application should be realized as practices from teaching and learning about ICT to teaching and learning with and through ICT (Majumdar, 2009). The abilities and skills teachers have for linking ICT resources, teaching methodologies and apply pedagogical principles are the results of formal knowledge to implement techniques relevant to any teaching environment. At a time when demands on education improvements are growing and resources are decreasing, information technologies should be used to mobilize teaching and learning resources and alleviate the personal learning differences for learners with diverse background and understanding capacities (Hudson, 2014: p. 2).

This study identified seven requirements for online resources and e-learning implementation (OREI) framework resulted from the opportunities, strengths, the available limiting factors, literature reviewed, and the raw data analysed. The seven framework components identified were: (1) government support (political will) revealed by government commitment, readiness and support, (2) recruitment and training (teachers, students, technician, developers and administration), (3) Infrastructure deployment and improvements (hardware, software,

multimedia systems, computer laboratories, connectivity, classrooms etc.). Others are, (4) the level and type of technology (digital library resources or content management systems (CMS), (5) formulation of guidelines/policies (curriculum /syllabuses relevance and support, Quality control guidelines), (6) stakeholders Involvement (research Institutions, training institutions, community awareness and support and other open access educational systems) and (7) Monitoring and evaluation mechanisms (procedures and guidelines). These components are regarded as tools for harmonising all effort negotiating for planning, implementing and management of ICT use in education. Currently in Tanzania, there is no harmonised ICT in education implementation strategic plan, however its importance could take the education system and information technology usage to the most desired level (Baker et al., 2013: p. 8). Lack of framework, is a challenge for policymakers who are supposed to plan and budget for technology, infrastructure and the training and recruitment. The use of framework which clarifies key requirements, achievement indicators could impart better insights into the use of ICT in teaching and learning (OECD, 2015). The availability of framework which determines strategic implementation of ICT projects in education could free the government from controversial linked to funding of school ICTs, experts opinions, planning and decision-making (Mee, 2007). However, Government support is presented as a superior component; the OREI framework addressed the positions and involvement of manpower training and recruitment, experts, technology, infrastructures, policy makers, beneficiaries, and other stake holders.

This study has presented a conceptual OREI framework business model. The OREI framework business model dimensions, boundaries, and interrelationships were described to represent the OREI framework best practices. Any successful ICT integration into national education systems can be effective when only supported by adequate mix of the policy and operational measures (UNESCO-UIS, 2009: p. 23). An effective online educational resources and e-learning implementation requires a strong, national education system vision enhanced by the working strategic plan and belief that can enhance ICTs to accelerate, enable, improve, and transform students learning opportunities. As opposed to the framework document by the Global E-Schools and Communities Initiative (GESCI) (GESCI, 2009: p. 5) which puts more emphasis on the technical tools and possible ICT solutions for the developing countries, the OREI framework is both a management, a strategic and a planning roadmap for supporting sustainable ICT

deployment in schools. The GESCI framework inclined more on technical specifications of hardware, software and networking devices without indicating how a developing country like Tanzania could realise sustainability when using technology (GESCI, 2009: p. 4). The OREI framework could enable developing countries like Tanzania to avoid stepping into the worst practices of dumping hardware in schools without relevant pedagogical ICTs (Trucano, 2010). The level of failure or stagnant in the ICT use in secondary schools is influenced by the government readiness and local ICT experts' intervention. When the government investment in ICT has focused, on the old bureaucratic with heavily segmented style of government, failure happens (Mulder & Kontakos, 2015). The OREI framework business model presented by this study integrated leadership, time, investment, and policy imbued with vision to transform secondary education and building blended eLearning culture. Because of lacking a harmonized framework for ICT in education in Tanzania, reports from two major previous ICT in education projects indicated unsuccessful achievements (Andersson et al., 2014; United Republic of Tanzania, 2011). We generated a case block diagrams that illustrated the validity of OREI framework and extracted performance alternatives based on the potential benefits and limitations. The OREI framework and its pertinent business model can easily be understood by non-technical personnel.

There are many frameworks for the ICT use in education, but not all can be accepted in all situations. The measure of framework effectiveness should not only be focused on materials and resources, but users' readiness and the teaching and learning environment that needs to be adjusted (Roy Barton & Haydn, 2006). The strengths, weaknesses, opportunities and threats (SWOT) analysis was used to determine the characteristics of potential ICT in education users and key shareholders as components for the OREI framework evaluation. The UNESCO operational and conceptual framework for meeting policy goals of ICT integration in education recognizes political commitment, provision of ICT facilities (Infrastructure), training and deployment of teachers to use ICT-enabled pedagogy, extent of integration of ICT into the curriculum , access to ICT in schools (as proxy measure for usage) and the learners performance evaluation and monitoring (UNESCO-UIS, 2009: p. 23). The SWOT analysis focused on six key areas such as (1) government readiness, (2) public and private partnerships in ICT in education enhancement, (3) acquisition of standardized digital educational contents and software, (4)

teachers and learners training programmes, (5) access to ICT resources and (6) availability of monitoring and evaluation systems for alleviating potential shortcomings. The design and planning for ICT based instructional design could fail if the design ignores the significance, knowledge, skills, and competencies of potential users (Avgerou, 2008; Gulliksen et al., 2003). The SWOT framework as a most used strategic analysis tool, have asserted the need, benefits, and insight presented in the OREI framework as useful, new and clearly a roadmap that could enhance the governments in developing countries to plan for ICT resources in schools.

8.2 The Scientific Gap between this Study and the Previous Studies

8.2.1 Previous studies gap

- Most of the previous studies focused on the design of elearning tools such as contents and mobile apps (hard science)- but most of them proved unsustainable. They lacked coordination between general practices, education objectives and the curriculum in practice.
- Eliminated key players who could provide potential contributions in the working solution. Focused on tools design (software, mobile apps, interactive systems) using few experts and relaying on available documents- but forgot majority of key players in the filed who can make great contribution-again this proved unsuccessful
- None has aver focused on the designing of a framework that could integrate efforts all key players for sustainable ICT use in secondary education-in most cases community, researchers and teachers contributions are ignored.
- Considered teachers, trainers, and learners as users only and not owners of the learning environments. Designed things and pushed teachers to use them without being involved in the design process.
- Users' readiness, skills, and competences were not considered as pre-conditions for ICT deployment in the education system. They believed ICT tools may get dumped in schools where users have no interest, have no skills-their readiness could arise as they use the tools.

8.3 Conclusion

In this sub-section, we present conclusive remarks with regard to the study objective. Several literatures were reviewed and empirical data analysed to build a solid basis for the generalization of the findings and usefulness of the OREI framework proposed by this dissertation. This sub-

section reflects and concludes the research, summarizes the major findings in response to the research questions, and highlights the contributions of this study to the field of educational technology, particularly blended learning-a model of e-learning.

The government readiness to enhance ICT use in secondary education has been addressed in various forms as important an education tool. Examples of the documents (projects, policies, and programmes) that addressed ICT use in education that were initiated by the government are: the Education sector development Programme (2000), the Secondary Education Development Programme (SEDP I-2004-2009 and SEDP II-2008-2017), the National ICT policy (2003), the ICT policy for basic education (2006), and the National Strategy for Growth and Reduction of Poverty (NSGRP) implemented between (2005/6-2009/10). However, they refer to the ICT use in different focus; they have preceded facilitation of the projects for the ICT use in education. Some of the ICT projects implemented were National Programme for ICT for Secondary school Teachers (2005 to 2008), SME (Science, Mathematics, and English) ICT project-2011-2013, and the Strengthening Innovation and Practice in Secondary Education (SIPSE) Project - June 2013 - May 2015. These projects had mainly diverse objectives ranging from infrastructure deployment, training of users to the ICT pedagogical knowledge enhancements. However, they ended up unsustainable due to the lack of harmonized framework and a consolidated implementation strategic plan. They are many factors that should be integrated to avoid investing on non-useful tools and solving a wrong solution; referred to by Trucano et al. (2011) as worst projects of ICT in education practices. Today's world is connected and students in the 21st century are part of a digital generation that expects schools to provide them with ICT tools that could enhance their learning experiences. The impact of ICT in education, which brings positive change, can be achieved with a harmonized ICT framework and partnerships between teachers, learners, and peers (Karsenti, Collin, & Harper-Merrett, 2012: p. 7).

This study stressed on a condensed number of components that addressed players in the ICT in education projects namely: government support, policies and guidelines, training and recruitment (experts and potential beneficiaries), technology (a centralized system for e-contents creations, sharing, use and management), infrastructures (Hardware and software for supporting pedagogical ICTs practices) and the monitoring and evaluation for sustainability and effectiveness of continued technology use. The study provided a direct account of the

experiences and factors leading to the realisation of the value of online educational resources and blended learning implementation in secondary education. As an optimum objective, this study has resulted in a design of "Online Resources and E-Learning Implementation (OREI)" framework supposed to work as a roadmap for the ICT policy in education strategic planning and implementation. The OREI framework presented by this dissertation sets forth key components that need to be upfront deliberated when planning, designing, deploying, and managing ICTs and the information resources for reinventing the education system. It represents the key elements, and their relationships, that are expected in an ideal environment. The roadmap brings a comprehensive tool for sustainable deployment of major components that make up eLearning such as the digital pedagogy, digital contents (including eCurriculum), and eLearning spaces. In this sub-section, we briefly presented how the research questions were answered based on reviewed literatures and the analysed empirical data.

RQ1: Are the resources in secondary schools (human and ICT infrastructures) supportive for the online educational resources and e-learning implementation?

The principal attributes when designing and deploying online educational resources and e-learning in secondary education are technology, users (teachers and learners), and the ICT infrastructural support. Having teachers with knowledge, skills, abilities, attitudes and competences to help choose or use e-contents have influences of the level of technology use readiness and acceptance. However, teachers are nurtured in teacher training colleges for diplomas and Universities which offer bachelor degrees in education; there is no harmonised level of pedagogical ICT competences teachers needs to acquire. Neither teacher training colleges offering diplomas in education nor Universities offering bachelor degrees in education have prepared teacher trainees with skills and knowledge to use ICTs competently. This study found that, the training teachers trainees have received while in training colleges do not guarantee their pedagogical ICTs practices and readiness. However, the government readiness is revealed by a number of ICT in education projects, the level of ICTs in education deployment are limited by the lack of sustainable funding. Most of the previous ICT initiatives were donor funded projects and they focused on teachers training, ICT infrastructure deployment and installation (hardware, software, and connectivity).

RQ2: What are the opportunities and challenges for ICT integration in the secondary education?

The ability of teachers to practice pedagogical ICTs is highly influenced by the knowledge, competences, and skills they received during college years. The benefits of technology use in teaching and learning as a pedagogical tool or a resource can be assessed and realised in the context of Technological Pedagogical and Content Knowledge (TPACK) and the SAMR (Substitute, Augmentation, Modification, and Redefinition) models' chacteristics. The TPACK framework addresses the essential abilities mandatory for teachers' technology integration in classrooms while shiny the complex and multidimensional pedagogical and contents knowledge (Hewitt, 2008; Voogt et al. 2013). The SAMR is a model which illuminates teachers, students, learning environments and the changes influenced by technology practices in classroom settings (Lund, 2015; Myers, 2014). Tutors in teacher training colleges shape the destinies of teacher trainees who must build their knowledge on pedagogy, content, and technology. The knowledge, skills, readiness and competences tutors have, are the advantages for their pear learners who will be influenced to adopt technology use. Today, educational information technology and pedagogical practices are inseparable fields. Unlocking the opportunities and challenges could enhance the design of practical roadmap for efficient and sustainable technology use in secondary education. This study found that both internal (related to personal attitudes and perceptions about a technology) and external (related to availability and accessibility to the relevant hardware and software, lack of harmonised strategic ICT in education planning and implementation framework, institutional support, staff development program and training) challenges existed. Tutors were more prepared compared to teacher trainees; however ICT knowledge characteristics of tutors and teacher trainees could not sufficiently support the ability to enhance classroom technology integration. In addition, this study found that, there were more opportunities that could work as a motivation for ambitious ICT in education users such as the government determination to improve ICT infrastructures in teacher training colleges and secondary schools, the existence of private-public and donors' partnerships, the availability of pear telecommunication projects that have enhanced glowing of mobile devices users and internet connectivity.

RQ3: What are the significant requirements for online educational resources and e-learning implementation in Tanzania secondary schools?

The planning and implementation of an effective e-learning requires a strong, whole-education system vision built on the belief that ICT can accelerate, enable, improve and transform student learning opportunities in all key learning areas and phases of learning. The OREI framework requirements and components comprehensively focused on government support (leadership, planning, and decision making), the provision and use of ICT infrastructure, e-learning spaces, guidelines and curriculum support, resources (online and offline e-contents), development of workforce capacity. The OREI framework requirements was recovered as a means to identify operational challenges that educators creating and supporting e-learning face (California County Superintendents Educational Services Association (CCSESA), 2011: p. iii) such as content acquisition, teaching and professional development for teachers, technology, student support, funding and staffing and the evaluation. This study used seven components to design and present a conceptual Online Resources and E-learning Implementation (OREI) framework. The requirements presented were political will indicated by government commitment and support, training and recruitment (Human resources-teachers, students, technician, developers and administration), ICT Infrastructure deployment and improvement (hardware, software, multimedia systems and tools), the technology (e.g. digital library resource, content management systems), guidelines and policies review or formulation, Shareholders involvements (research Institutions, training institutions, community, development partners) and the Monitoring and Evaluation mechanisms. The framework interactions and interrelationships between components were presented using UML Use case and activities diagrams. Using a design-research approach, we analysed cases of the framework design requirements, formulated levels of precedencies using Matlab tools, used Unified Modeling Language (UML) artefacts of the framework activities to design a framework business model for planning, implementation, and monitoring evaluation processes for any ICT in education project.

RQ 4: What are the Strengths, Weaknesses, Opportunities, and Challenges that determine the validity of the online resources and e-learning implementation framework?

In developing countries, Information and communication Technologies (ICTs) are often seen as a promising solution to overcome educational systems deficiencies. However, ICTs solutions are normally expensive; it is a real challenge to use novel ICT based solutions in a meaningful way without prior strategic planning. The OREI framework evaluation focused on answering question on how successful the objectives of the designed framework could be realized. This study found that, at large users lack the availability of relevant classroom application ICT tools and supporting infrastructures. The level of digital contents access and application in education will only increase when teachers, students, tutors and teacher trainees have technology (e-spaces such as Learning (Content) Management Systems (LCMS/CMS) that achieves the most relevant digital contents they can directly access and use in the classroom or learning process. This study found that there are no enough relevant supportive infrastructures in most public secondary schools. The study asserts to why it is important to have a roadmap framework that consider involvement of multi-stakeholders in each stage when the government wants to deploy pedagogical ICTs in the education systems. For learners, the ability to think and solve problems requires that knowledge of a subject area be accessible and linked to current understanding.

Specifically, the OREI framework enhances the planning and implementation of suitable ICTs in secondary education by providing a cohesive guidance on the investment decision for technology deployment and ICT infrastructure. The framework will harmonize efforts and ICT deployment targeted in different national documents. In addition, provide guidance for capacity building, transform basic education curriculum for e-delivery models, develop guidelines for online resources design and access, integrate ICT in educational management functions, and enhance the contribution of stakeholders in ICT research and development.

8.4 The Study Contributions

a) Societal contributions

The framework acknowledges the society as the owner of the facts for developing learning artifacts. It is a place where contents with local contextual originate. Their involvement will give new hope to the education support from the society

b) Educational contribution

The availability of sustainable re-use of e-contents (e-books, videos, webpages, audios etc) recorded using ICT tools will motivate hard working teachers and bring competion, which uplifts the education system across the country. This could also motivate teachers to store materials online where globally leads to the sharing of information and knowledge as well.

c) The Field of Educational technology

When experts in the fields of educational technology are enhanced to work in a team towards one goal, may lead to the ideas generation that gives birth to new tools. This may cause new research areas to emerge.

d) *Computer science as a field contribution*

When teachers, tutors and other key players in the field of education are motivated, the use of ICT will result into more students with interests in ICT tools design. This can raise more future computer scientists. The design of innovative working ICT tools will uplift software development industry.

e) General scientific contribution

The use of ICT is at the heart of scientific proof and simulations. When young generations are enhanced to share, test, simulate, use, and creatively design learning facts will motivate them to like science.

f) Economical contribution

It can be used as a reference for benchmarking and formulation of frameworks for e-contents application and policies that emphasize on the use of online education resources and e-learning models. This could lead to the use of more softcopies and reduce the need for much hardcopies. This saves as an opportunity cost to the funding agencies when both hardcopies and softcopies are to be used as working solutions.

8.5 Recommendations and Future Research

In the system of education with ICTs integrated into the curriculum and being used innovatively, there exists learning experiences that are more enriching, collaborative and objectively sound. The use of ICTs permits teachers to bring teachings to life in new ways, which motivates learners. This study highlights the need for an integrated framework approach addressing

government involvement and support, ICT infrastructure, technology deployment, teacher professional training and recruitment, research and training institution involvements, experts' technical support and designing of localized digital contents. The use of ICT in this study refers to the blended learning-an e-learning model, which takes advantages of technology and traditional approaches and mixes the two. Characteristics of an effective blended learning schools and teacher were of key priority for identifying the requirements for the OREI framework designed by this study. Examples of the characteristics of an effective blended learning school are:

- availability of a vision and supportive policy
- human resources capability (digital pedagogy, digital literacy
- learning spaces (physical spaces, virtual spaces, and enabling infrastructure)
- learning not restricted by barriers of time or place
- communities of practice (including local community supportive of students use of technology for learning)
- Accessible digital content developed/created by teachers and students for learning and sharing.)
- The assessment, reporting and evaluation mechanism for components of curriculum.

The ability to think and solve problems requires that knowledge of a subject area be accessible and linked to current understanding. Designs for subject area study should help students learn with understanding instead of promoting the acquisition of disconnected sets of facts and skills.
In addition, examples of the characteristics of effective blended learning teachers are ability to demonstrate TPACK (professional practice, relationships and values), employ a variety of methodologies (current learning theories and practices), constantly collaborate with colleagues, make conscious decisions about student learning based on an understanding of digital learners
Blended learning, which combines face to face classroom instruction with online learning, has the potential to improve education while helping schools meet the challenge of ensuring high achievement for all students. Given the powerful interactions that digital technologies can facilitate for students, educators should focus on digital curricula that supply new and transformative learning tasks for students. Once educators have selected digital curricula, the adoption and inclusion of these resources will be more successful when the implementation is strong and educators understand how the technology that matches their needs and aligns with

expectations for engaging student thinking and improving student learning. To realize efficient and sustainable ICT use in education this study made number of recommendations:

(a) Teaching and learning occurs primarily through interactions with people (teachers and learners) and instructional materials (offline, online content, textbooks, e-books, instructional software, homework, projects, quizzes, and tests). The contexts within which these interactions occur are surely important and they should be well planned. In most of developing countries the use of web based contents are not possible due to the existence of prevailing challenges, allowing traditional approaches to persist. Students learn by engaging in cognitive processes that are shaped by interactions with people and instructional materials. However, there is strong evidence that the choice of instructional materials has large effects on student learning-effects that conflict in scope those that are associated with differences in teacher effectiveness. Nevertheless, improving ICT use teacher quality through in-service training and professional development is challenging, expensive, and time-consuming, making better choices among the available mixture of instructional materials should be relatively easy, inexpensive, and quick. The government should clearly define the model of technology use in secondary education. In addition, the availability of numerous forms of instructional materials and the participation of local institutions in the planning, design and content development process should be harnessed.

(b) The ICT policy for basic education demands for a determined effort to provide adequate ICT infrastructure throughout the education sector. Given the current lack of ICT infrastructure, lack of ICT use competent teachers and the limits of power supply in many schools, the roll-out of ICT was projected to be carried out in phases, with the overall aim of nationwide coverage by 2025. Based on the OREI framework, this study recommends for the documented policy implementation strategic plan, which should define the level of technology secondary schools' require, the types of ICT infrastructures and the purpose they should serve and all other supporting infrastructures that needs to be planned and prepared. The strategic plan should state measurable achievements to avoid entering the worst ICT investment practices. It also should be shared to the public and other development partners to welcome any voluntary contribution.

(c) The models that describe potential successive phases through which education sector steadily adopt and use ICT are confusing and mostly not understood by policy makers. For example, the use of ICT across any curriculum can be regarded as supplementary, complementary, integrated and or infused across the curriculum. For the context of school education, the levels of technology integration progresses through four distinct successive phases: (a) emerging, (b) applying, (c) integrating and (d) transforming. Implementing e-learning based on rich digital content can take many forms. It can be provided in standards-based packages that build upon textbooks, with teacher's guides, assessments and multimedia content all included and aligned to standards. It can be created collaboratively, in open source format, by a variety of experts. Or it can be drawn from multiple sources -subscriptions, free online resources and other digitized material - customized locally to meet the needs of a particular classroom or level of study. A move away from a reliance on print textbooks to the use of multimedia or online content offers many advantages, including cost savings, increased efficiency, timeliness, improved accessibility, and enhanced learning opportunities in a format that engages today's tech-savvy students. Rich digital content, delivered on flexible mobile computers, can revolutionize the ways in which secondary school students learn and grow. There are significant differences between serving students in a full-time online environment, supplemental environment or a blended environment. The most effective digital learning environments bring together the three C's of consumption, collaboration, and creation. There is a need for authoritative approach to the study of the degree of ICT in education integration that makes use of such indicators within developmental models of integration of ICT in education with considerations of local circumstances. Tanzania as a nation should define levels of ICT integration and break them into goal oriented phases.

(d) Tanzania faces many limitations to the implementation of e-learning models in secondary schools. First many of the available e-contents instructional materials have not been evaluated against the local curriculum context; considerable studies provide information of use to policymakers and practitioners. Second, limitation is that most of existing studies of the effectiveness of e-contents instructional materials are carried out in schools

located in urban centres, provided with electricity and computers carrying small samples of convenience and ill-defined comparison conditions that compromise the usefulness of the results for individuals charged with choosing e-contents instructional materials. For example, a pilot study demonstrating that Science, Mathematics and English (SME) curriculums are more effective when taught using ICTs using was carried in training schools overseen by teacher training colleges, there was no sample participated from rural areas facing different challenges. Ensuring student success in online and blended learning extends beyond the instructional environment into the support structures established to help students succeed. An educational epidemiology of instructional materials and student achievement requires having information on teachers, schools, students, and instructional materials at the level of individual students, teachers, and schools. For the government to know whether one model of instructional materials is a better choice than another, it must know which students are being exposed to which instructional materials.

(e) The Tanzania National ICT policy recognizes that, applying ICT in education has many opportunities, including curriculum development, teaching methodologies, simulation laboratories, life-long learning, and distance education. The policy calls for the teaching of ICT at all levels of education and training, and the use of ICT to improve the quality of delivery of education. However, teaching ICT to a teacher trainee should differ from teaching ICT to normal school student. Reforms in the area of teacher effectiveness have to date focused on identifying persistently effective and ineffective teachers based on classroom performance on ICT as a subject and instituting pedagogical and content knowledge policies that are designed to reward persistently effective teachers, deselect persistently ineffective teachers, and target professional development to teachers. Teachers remain a key part of instruction in e-learning, as successful student outcomes derive from a successful classroom experience - regardless of whether that classroom is in a brick-and-mortar or e-learning environment. These initiatives are based on the assumption that the overall bell-shaped distribution of teacher effectiveness is more swollen on pedagogy and content knowledge and less on technological pedagogical knowledge. It should be noted that technologies are not available to replace teachers but

to efficient their practices. In the 21st century, Tanzania as a nation should focus on the whole TPACK characteristics of individual teacher performance that contribute to students learning mostly based on the application of contemporary technologies as pertinent components to pedagogical and content knowledge.

(f) Major education reforms that have taken place through Primary Education Development Programme (PEDP) and Secondary Education Development Programme (SEDP) documented shift from the heavy dependency on text materials for teaching and learning to one of wider access based on ICT. However, teacher training colleges run short of ICT resources and infrastructures, only few secondary schools have ICTs and majority of teachers' ICT use competences ranked as beginners; students who are ambitious to know and learn using ICTs deserve the rights of digital generation. Teacher education programmes are striving to accommodate the rising demand for teachers that are more qualified as well as the changing role of teachers into facilitators of learning and problem solving. The use of ICT-mediated training and distance education has been identified as one of the strategies for access and quality improvement. Therefore, efforts should be made to allow teachers have access to ICT facilities either in schools, public ICT centers or empower them with personal mobile devices or laptops that could allow them to have access to technology anywhere sustainably. For example, to start with the government could provide personal computers to every college leaving teacher trainee, install a computer, a projector, and multimedia devices in every science laboratory. Teacher training will need to employ a variety of tools, among them education of and with Information and Communications Technologies (ICTs).

(g) The ICT solution used in one country's education system can hardly be transferred in another countries' education system. The successful integration of ICT in education requires continuous reviews of the curriculum, to accommodate training in ICT as well as ICT-enabled teaching and learning. In Tanzania, current curriculum still embrace much on traditional approaches and practices where ICT is being mainly taught as a subject, and have not being integrated as a pedagogical tool for teaching and learning in other subject areas. It is a high time for the government to formulate a team of local and

international e-learning and instructional designer experts who should carry out an integrated study for harmonizing technology, teacher training, learners' localities, contents, and pedagogy. The curricular reviews should be accompanied by designing e-spaces, e-curriculum, and content development (i.e. instructional content or learning experiences that are delivered or enabled by ICT) and the contents should be well-aligned with curricular goals and objectives, while addressing how the ICT should solve the problems of the teachers' shortage as well as teaching and learning materials. In this study although ICT use had regularly being used as a general term, blended learning–an e-learning model should be acknowledged as of high priority for the success of the OREI framework developed. This comes, as there have been few signs of radical alteration to existing structure of teaching practices or even evidence of particularly innovative application of ICT to enhance and extend learning opportunities using CD ROMS, recorded videos and animations.

(h) It was found that ICT was being used as a tool for learning with little recognition of its potential roles as a catalyst for materials accessibility, social and educational change. What is unclear is whether the use of ICT found in this study is simply a necessary stage in a more visionary and socially challenging use of technology. Throughout the research, the notion of education system change as a staged process was reported. In the perspective of ICT in education planning, designing and deployment it is necessary to bring ICT into a familiar educational framework as a tool equally to textbooks and in time allow and pro-actively encourage the government to intentionally budget for them equally.

(i) Most of the ICT use in education challenges (internal and external) Tanzania face as a nation, are to ensure that the emphasis on ICT in schools shifts, in the immediate future, from technology provision to a focus on its deliberate learner centred practices enhancement. Fostering personal competences and creativity has always been a desirable educational value. The use of online learning environments, Virtual Learning Environments, and secondary education centralized website provide opportunities to build and share content. The pursuit of creativity and innovativeness are now

fundamental skills in a knowledge economy and the embedding of ICT in learning can greatly facilitate their development. More research should focus on the e-learning model that includes Web 2.0 characteristics in order to facilitate greater interactivity and enable greater levels of user-generated content. It is crucial that young people acquire the ICT and related skills to support these new opportunities. It is clear that a balance is required between providing offline digital content resources, online content and online content creation tools that allow teachers and students to create and share their own teaching and learning content.

(j) However, online and blended teaching requires additional skill sets that must be developed through pre-service training or ICT pedagogy professional development. Using real time online educational resources requires that teachers go beyond subject area proficiency and understand how to teach effectively online. Online Resources and E-learning Implementation framework provides the roadmap for the planning of the e-learning environment. The Learning Management System/ Learning Content Management System, Student Information System, and content must work together seamlessly; as technology provides more student data allowing and supporting highly customized learning for students, the interoperability of systems becomes increasingly important. It almost certainly means however, that piecemeal approaches, which address discrete elements, which are perceived to have impact on increasing ICT use, will at best have limited outcomes. More research should be carried out to find out how the key components should work together and empower the education system in an environment that has numerous limited resources.

8.6 List of Publications and Manuscripts

a) Published Articles

- ***Chapter Three:*** An Assessment of Teachers' Abilities to Support Blended Learning Implementation in Tanzania Secondary Schools. *Contemporary Educational Technology*, January 2016, Issue 7, Vol 1, 60-84, URL: http://www.cedtech.net/
- ***Chapter Four:*** Classroom ICT Integration in Tanzania: Opportunities and Challenges from the Perspectives of TPACK and SAMR Models. *The International Journal of*

Education and Development using Information and Communication Technology (IJEDICT), April 2016, Vol.12, Issue 1(*Accepted , will appear online soon*); URL: http://ijedict.dec.uwi.edu/

- **Chapter Six:** A Design of Business Model for Online Education Resources and eLearning Implementation in a Developing Country: Case of Tanzania. *International Journal of e-Education, e-Business, e-Management, and e-Learning;* March 2016, Vol.6, No1, 27-39. URL: http://www.ijeeee.org/

- **Chapter Seven:** An Evaluation of Online Resources and E-learning Implementation (OREI) Framework Using SWOT Analysis: Case of Tanzania. *International Journal of Instructional Technology and Distance Learning*; November 2015, Vol .12, No.11, 41-58; ISSN 1550-6908, http://www.itdl.org/

b) Manuscripts Submitted

- **Chapter Five:** An ICT Framework for fostering eLearning in the Tanzania Secondary Education. Journal of Information Technology Education: Innovations in Practice (JITE: IIP). URL:http://www.informingscience.org/Journals/JITEIIP/Overview, (***Resubmitted for Review***)

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APPENDICES

Appendix A: Levels of Precedencies that Determines the Framework Implementation Alternatives

Note: Below is the table showing 120 numbers of the levels of precedencies, however they are not necessarily to be undertaken serially. For example, for a set with " ABCDFEG ", after " A " has completed, " BC " can follow, then " DF " can be combined, " E " can be undertaken separately and finalize with " G "alone.

A = Government support
B = Infrastructures
C = Technology
D = Policies and Guidelines
E = Training and Recruitment (experts, teachers, students)
F = Stake Holders (External interactions)
G = Monitoring and Evaluation

ABCDEFG	ACBDEFG	ADBFECG	AEBDFCG	AFBCEDG
ABCDFEG	ACBDFEG	ADBFCEG	AEBDCFG	AFBCDEG
ABCEDFG	ACBEDFG	ADBCEFG	AEBFDCG	AFBDECG
ABCEFDG	ACBEFDG	ADBCFEG	AEBFCDG	AFBDCEG
ABCFDEG	ACBFDEG	ADBECFG	AEBCDFG	AFBEDCG
ABCFEDG	ACBFEDG	ADBEFCG	AEBCFDG	AFBECDG
ABDCEFG	ACDBEFG	ADCFBEG	AECDBFG	AFCBDEG
ABDCFEG	ACDBFEG	ADCFEBG	AECDFBG	AFCBEDG
ABDECFG	ACDEBFG	ADCBEFG	AECFBDG	AFCDBEG
ABDEFCG	ACDEFBG	ADCBFEG	AECFDBG	AFCDEBG
ABDFCEG	ACDFBEG	ADCEBFG	AECBDFG	AFCEBDG
ABDFECG	ACDFEBG	ADCEFBG	AECBFDG	AFCEDBG
ABECFDG	ACEBFDG	ADEFBCG	AEDCBFG	AFDBCEG
ABECDFG	ACEBDFG	ADEFCBG	AEDCFBG	AFDBECG
ABEDFCG	ACEDFBG	ADEBFCG	AEDFBCG	AFDCBEG
ABEDCFG	ACEDBFG	ADEBCFG	AEDFCBG	AFDCEBG
ABEFDCG	ACEFDBG	ADECFBG	AEDBFCG	AFDEBCG
ABEFCDG	ACEFBDG	ADECBFG	AEDBCFG	AFDECBG
ABFCDEG	ACFBDEG	ADFECBG	AEFCDBG	AFEBDCG
ABFCEDG	ACFBEDG	ADFEBCG	AEFCBDG	AFEBCDG
ABFDCEG	ACFDBEG	ADFBCEG	AEFDCBG	AFECDBG
ABFDECG	ACFDEBG	ADFBECG	AEFDBCG	AFECBDG
ABFECDG	ACFEBDG	ADFCBEG	AEFBCDG	AFEDCBG
ABFEDCG	ACFEDBG	ADFCEBG	AEFBDCG	AFEDBCG

Appendix B1: Questionnaire for the Ministry of Education and Vocational Training (MoEVT)

A: Demography

1. Your full Name (optional):_____
2. Age (Tick only one that apply)

Below 25		**25-30**		**31-36**		**37-42**		**43-48**		**49 and Above**	

3. Please state your gender (tick that apply):

Male		**Female**	

4. Your level of education (Tick only one that apply)

PhD		Master's degree/Postgraduate	
Bachelor's Degree/Adv. Diploma		Diploma/ adv. Professional training Certificate	
Professional level Certificate		Other (Specify)	

5. Specify area(s) of your Career specialization_____
6. Department:_____ Section/Unit_____
7. How long have you worked in this Institution /Ministry (Tick that apply)

Less than 5 years		5 to 10 years		10 to 15 years	
15 to 20 Years		20 to 25 years		26 years and above	

8. In terms of your current occupation, how would you characterize your role? (Tick only one that apply)

Administrator		Administrative Assistant		HoD	
Education Planning Officer		Technical Expert Advisor		Researcher	
Office Assistant					
Other (Specify)					

B. ICT in Education Past and Present Initiatives

9. What are the strategies/Frameworks/ plans that support ICT use and skills enhancement for teachers at Teachers Training Colleges? If any (list/mention them)
   ……
   ……
10. Are there any ICT related present or previous projects at the Ministry level that intends / intended to foster ICT use in teaching and learning in Tanzania secondary schools? **YES** ☐ **NO** ☐

    If **YES** name them and indicate where all the information related could be found:

Project Name	Information Source
i.	
ii.	
iii.	
v.	
v.	

Interview Guide Questions

1. What have been the major challenges for the use of online educational resources and blended learning in public schools and public teachers colleges?
2. Do you see any future or advantages in the use of e-contents (ICT tools /software/digital media/ online resources) in teaching and learning in secondary education?
3. What are the long term /short term goals that focus on linking and using the fiber optic, to increase the bandwidth and lower the cost of communications, considering that a country like Rwanda is already benefiting much in the use of ICT resources in primary and secondary education?

Appendix B2: Questionnaire for Schools and TTC Zonal Inspection officers

Section A: Demography

1. Full Name (optional):_____
2. Gender (tick only that apply):

Male		Female	

3. Age *(Tick only that apply)*

Below 25		25-30		31-36		37-42		43-48		49 and Above	

4. Your level of education (*Tick only one that apply)*

PhD		Master's /Postgraduate degree	
Bachelor's Degree/Adv. Diploma		Diploma/ adv. Professional training Certificate	
Professional level Certificate		Other (Specify)	

5. Specify area(s) of your Career specialization-
   _____

6. How long have you worked in this Institution /Ministry *(Tick one that apply)*

Less than 5 years		5 to 10 years		10 to 15 years	
15 to 20 Years		20 to 25 years		26 years and above	

7. In terms of your current occupation, how would you characterize your role? *(Tick only one that apply)*

Administrator		Administrative Assistant		HoD	
Education Planning/Officer		Technical Expert Advisor		Inspector	
Office Assistant					
Other (Specify)					

8. Department/ Inspectorate:_____ Section/Unit_____

Section B: Technology Awareness and Usage

9. What is your information technology proficiency level *(Tick only one that apply)*

Beginner (I am able to perform basic functions in a limited number of computer applications)	
Average (I demonstrate a general competency in a number of computer applications).	
Advanced (I have acquired the ability to competently use a broad devices and tools	

10. How often do you consider application of computer/information technologies when you evaluate teachers' competences and practices? *(Tick only one that Apply)*

Not at all		Rarely		Occasionally	
Frequently		Almost Always		All the Time	

11. What general evaluation can you give when considering teachers knowledge and competences in the following areas of ICT application in the process of teaching and learning in secondary schools? (*For each statement, Write only one that apply)*

Well Prepared	Somewhat Prepared	Poorly Prepared	Not Prepared	Not Sure
1	2	3	4	5

	Technology	Rating
i.	Ability to create multimedia presentations using scanners, digital cameras and video cameras	
ii.	Ability to use computers for office applications programs (e. g : word processing and creating spreadsheets)	
iii.	Ability to use computers for accessing online resources and communicating (e.g electronic mail, accessing the internet)	
iv.	Ability to use computers and LCD Projector for making presentations.	
v.	Ability to enhance professional productivity through the use of interactive media	
vi.	Ability to balance the use of technological and none technology resources in teaching	
vii.	Ability to apply research-based instructional practices (project/problem based learning / inquiry based learning).	
viii.	Ability to use technological resources to support learning activities for individuals, small groups and large groups.	
ix.	Ability to use technology in varied ways to assess student learning.	
x.	Ability to use a wide range of teaching approaches in a classroom setting (collaborative learning, group discussion and inquiry/problem/project based learning etc.)	
xi.	Ability to search and access online information technologies resources used for teaching and learning mathematics independently.	
xii.	Ability to search and access online information technology resources used for teaching and learning science subjects independently.	
xiii.	Ability to choose information technologies that enhance the teaching approaches for a lesson.	
xiv.	Ability to choose information technologies that enhance students' learning for a lesson.	
xv.	Ability to choose technologies that enhance the content for a lesson through animations/ simulations.	

12. Please indicate how frequently the following computer technologies have been / can be integrated into teaching and learning processes. *(For each statement, Write only one number that apply)*

Often	Sometimes	Rarely	Never
1	2	3	4

	Computer Technologies /Applications	Frequency
i	Communicative applications (e.g., e-mail, computer conferencing, LCD projector)	
ii	Organizational software (e.g., data base, spreadsheets, record keeping, lesson plan tools).	
iii	Analytical/Programming tools (e.g., statistics, charting, graphing, drafting)	
iv	Creative (e.g., desktop publishing, digital video, digital camera, scanners)	
v	Informative (e.g., internet, CD-ROM, forums)	
vi	Content specific applications (e.g math, science, social studies, music, etc.)	

vii	Audio/Video production/editing (e.g Audacity, GarageBand, iMovie, MovieMaker, etc.)	
viii	Interactive whiteboard software (e.g Promethean, ActivInspire, SMART Notebook, etc.)	
ix	Internet resources (e.g web posts, chart rooms, discussion forums, web 2.0 tools, Social network media, etc)	
x	Presentation software (e.g.Power point)	
xi	Simulations /Animations for demo	
xii	Spreadsheets programs, Microsoft Mathematics, Database Management Systems	
xiii	Videoconferencing	
xiv	Video streaming (e.g Learn360, YouTube, etc.)	
xv	Web portals and forums	
xvi	Blogs related to key subject areas	
xvii	DVD player, Video, TV, Radio, e-Posters, radio tapes etc	

13. List some few examples of the pedagogical ICT tools that you could suggest to be included in the curriculum as teaching/learning resources/aid

……
…….

Appendix B3: Questionnaire for Secondary School Students

Section A: Demographic

1. Your full Name (optional):_____School Name_____
2. Region_____District:_____Village/Location_____

3. Gender *(Tick that apply):*

Male		**Female**	

4. Age *(Tick that apply)*

Between 12 - 17		**18-23**		**24-29**		**Above 29**	

5. Level of Study

Form I		**Form II**		**Form III**		**Form IV**	

Section B: Technology Awareness, Knowledge and Usage

6. Which information technology device (s) is available at home and that you have access to: *(Tick all that apply)*

Device	**Tick**	**Device**	**Tick**
Desktop Computer		Television (TV)	
Laptop		DVD Player	
Ipad /Tablet		Radio	
Android Phone		Video Player (VCR)	
Other (Please specify)			

7. Which technological devices are available at your school , that teachers have used at least once to teach / demonstrate something?: *(Tick all that apply)*

Device	**Tick**	**Device**	**Tick**
Desktop Computer		Television (TV)	
Laptop		DVD Player	
Ipad /Tablet		Radio	
E-book reader		LCD projector	
Android Phone		Video Player (VCR)	
Other (Please specify)			

8. How often do you watch video /Movies in the community video centers?*(Tick only that apply)*

How often	**Tick**	**How Often**	**Tick**
Almost Never		Once in every few months	
Once or Twice a week		Every weekend	
Daily		Weekly or More	

9. What technology /device /tool that you have used previously/recently from the following list? ***(Tick all that apply)***

Technology media/device	Tick
Computer/laptop	
Television	
VCR/VHS tapes	
DVD Player	
Projector	
ActivBoard /smart board	
Digital cameras (still)	
Digital video cameras	
i-pad	
Blogs	
Internet	
Youtube	
E-book reader	
Facebook	

10. If you have used the **Internet**, please indicate all activities you have done ***(tick all that apply)***

	Activity	Tick
i.	Communicate / chat with family	
ii.	Communicate /chat with other students on School related matters	
iii.	Search for information on topics of personal interest (e.g. Hobbies, news, music, e-books etc.)	
iv.	Download music, videos, software etc.	
v.	Search for information for class assignments, etc.	
vi.	Other (Please specify)	

Appendix B4: Questionnaire for Teacher Trainees and Tutors

Section A: Demography

1. Full Name (optional):_____Institution_____Region_____

2. Please, specify your gender (tick that apply):

Male		**Female**	

3. Age (Tick that apply)

Below 25		**25-30**		**31-36**		**37-42**		**43-48**		**49 and Above**	

4. Year of Study **First year** ☐ **Second Year** ☐ **Third Year** ☐

5. What is the area (s) of your specialization: (Please tick as many that apply):

Subject	**Tick**	**Subject**	**Tick**
Mathematics		Information Technology	
English Language		Foundations of Education	
Biology		Physical Education and Sports	
Physics		Audiology	
Chemistry		Agricultural Science /Teaching Methods	
Geography		Development Studies	
French		Civics/Civics Pedagogy	
Music		Economics	
Methodology		Kiswahili	
ICT		Home Economics	
Visual Arts		Education Res. Meas. & Evaluation	
History		Curriculum and Teaching	
Other (Please specify)			

Section B: General ICT use and Awareness

6. Your level of information technology proficiency (**tick only one that apply**)

Beginner (I am able to perform basic functions in a limited number of computer applications)	
Average (I demonstrate a general competency in a number of computer applications).	
Advanced (I have acquired the ability to competently use a broad devices and tools	

7. Please indicate how do you rate your **Internet** use: (Write a number that apply for each item)

Do Not use	**Occasional** (1 hour per week or less)	**Moderate** (2-5 hours per week)	**Extensive** (More than 5 hours per week)
1	**2**	**3**	**4**

	Internet usage:	**Rating**
i.	I use the Internet at Home with a Dial-up Connection or modem	

ii.	I use the Internet at School/college/University Computer library	
iii.	I use the Internet at other locations (e.g. Internet café, friend's home) - not home or school)	
iv.	I use internet on my tablet/my android mobile phone	
v.	I do not use the Internet	

8. If you use the **Internet**, please indicate the frequency and type of use: (Write a number that apply for each item)

Do Not use	**Occasional** (1 hour per week or less)	**Moderate** (2-5 hours per week)	**Extensive** (More than 5 hours per week)
1	**2**	**3**	**4**

	Purpose	Frequency of use
i.	Communicate/chat with family/friends	
ii.	Communicate /chat with other students on School related matters	
iii.	Search for information on topics of personal interest (e.g. Hobbies, news, class notes, e-books etc.)	
iv.	Download music, videos, software etc.	
v.	Search for information for class assignments, projects, etc.	

9. From your knowledge / experience, please indicate the usefulness/state of value of the computer, computer applications and information resources: **(**Write that apply for each item**)**

Essential	**Valuable**	**Of Limited Value**	**Not needed**
1	**2**	**3**	**4**

	Usefulness/Value	**Usefulness/State of value**
i.	Information accessed on CD/DVD	
ii.	Information created by you from research or other available data	
iii.	Online Communication with other students on homework/Assignments	
iv.	Classroom presentations by teachers (PowerPoint/CDs/DVDs)	
v.	Spreadsheets programs	
vi.	Word Processing programs	
vii.	Desktop Publishing programs	
viii.	Social media networks (Facebook, LinkedIn, whatsup, Wikipedia etc)	

10. What are the examples of the ICT tools (Open Source Software, Free Software, Open courseware, Proprietary Software, or online resources (Urls)) in your opinion that are most useful and should be included into the curriculum as teaching /learning resources? (List them)

a. _____
b. _____
c. _____
d. _____

11. How do you perceive the integration of computer technologies in teaching and learning based on the following statements? (Write that apply against each statement)

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

	Perception	Choice
i.	Can increase students' academic achievement (e.g. grades).	
ii.	Gives teachers the opportunity to be learning facilitators instead of information providers.	
iii.	Cannot accommodate students' personal learning styles.	
iv.	Motivates students to get more involved in learning activities.	
v.	Can provide teachers with easy access to instructional materials (eg. E-books, free lecture videos etc)	
vi.	Promotes the development of students' interpersonal skills (e.g., ability to relate or work with others)	
vii.	Is effective only when extensive computer resources are available	
viii.	Makes classroom management more difficult.	
ix.	Can increase students desire to learn information technology and related subjects	

12. Please indicate how frequently the following computer technologies can be integrated into teaching and learning activities. (Write that apply)

Often	Sometimes	Rarely	Never
1	2	3	4

	Computer Technologies /Applications	Integration
i.	Communicative applications (e.g., e-mail, computer conferencing, LCD projector)	
ii.	Organizational software (e.g., data base, spreadsheets, record keeping, lesson plan tools).	
iii.	Analytical/Programming tools (e.g., statistics, charting, graphing, drafting)	
iv.	Creative (e.g., desktop publishing, digital video, digital camera, scanners)	
v.	Informative (e.g., internet, CD-ROM, forums)	
vi.	Content specific applications (math, science, social studies, music, etc.)	
vii.	Audio/Video production/editing (e.g Audacity, GarageBand, iMovie, MovieMaker, etc.)	
viii.	Interactive whiteboard software (Promethean ActivInspire, SMART Notebook, etc.)	
ix.	Internet resources (e.g web posts, chart rooms, discussion forums, web 2.0 tools, Social media, etc)	
x.	Presentation software	
xi.	Simulations and animations application software	
xii.	Spreadsheets programs, Microsoft Mathematics, Database Management Systems	
xiii.	Videoconferencing	
xiv.	Video streaming (e.g Learn360, YouTube, etc.)	
xv.	Web portals	
xvi.	Blogs	
xvii.	DVD player, Video, TV, Radio, e-Posters, radio tapes etc	

13. Please use the following scale to rate how well you feel prepared to integrate various technologies in your teaching processes: (Write a number that apply)

Well Prepared	Moderately Prepared	Poorly Prepared	Not Prepared at all
1	2	3	4

	Personal Opinion	Rating
i.	Ability to create multimedia presentations using scanners, digital cameras and video cameras	
ii.	Ability to use computers for office applications programs (e. g : word processing and creating spreadsheets)	
iii.	Ability to use computers for accessing online resources and communicating (e.g electronic mail, accessing the internet)	
iv.	Ability to use computers and LCD Projector for making presentations.	
v.	Ability to enhance professional productivity through the use of computers/ interactive media	
vi.	Ability to enhance professional productivity through the use of audio/video conferencing.	
vii.	Ability to enhance instruction through the use of computers, interactive media, audio/video conferencing.	
viii.	Ability to apply research-based instructional practices (project or problem based learning and inquiry based learning) through the use of computers and other related technological resources.	
ix.	Ability to use technological resources to support learning activities for individuals, small groups and large groups.	
x.	Ability to use technology in varied ways to assess student learning.	
xi.	I can use a wide range of teaching approaches in a classroom setting (collaborative learning, direct instruction, inquiry learning, problem/project based learning etc.).	
xii.	I can choose information technologies that enhance the teaching approaches for a lesson.	
xiii.	I can teach lessons that appropriately combine mathematics, technologies, and teaching approaches.	
xiv.	I can teach lessons that appropriately combine science, technologies and teaching approaches.	
xv.	I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn	
xvi.	I can choose information technology tools that enhance the content for a lesson.	

Appendix B5: Questionnaire for the Tanzania Institute of Education (TIE)

Section A: Demography

1. Your full Name (optional):_____
2. Age (Tick only that apply)

Below 25		**25-30**		**31-36**		**37-42**		**43-48**		**49 and Above**	

3. Please state your gender (tick that apply):

Male		**Female**	

4. Your highest level of education (Tick only one that apply)

PhD		Master's degree/Postgraduate	
Bachelor's Degree/Adv. Diploma		Diploma/ adv. Professional training Certificate	
Professional level Certificate		Other (Specify)	

5. Specify area(s) of your Career specialization_____

6. In terms of your current occupation, how would you characterize your organizational role? (Tick only one that apply)

Administrator		Administrative Assistant		HoD	
Education Planning Officer		Curriculum Technical Advisor		Researcher	
Other (Specify)					

7. Department:_____Section/Unit_____

8. How long have you worked in this Institution /Organisation (Tick only one that apply)

Less than 5 years		5 to 10 years		10 to 15 years	
15 to 20 Years		20 to 25 years		26 years and above	

9. Your level of information technology proficiency (Tick only one that apply)

Beginner (I am able to perform basic functions in a limited number of computer applications)	
Average (I demonstrate a general competency in a number of computer applications).	
Advanced (I have acquired the ability to competently use a broad devices and tools	

Section B: Technology Awareness and Use

10. Please rate how you can recommend integration of the following computer technologies/applications into the process of teaching and learning when reflecting the current mathematics and Science syllabuses. **(Write one number that apply against each statement given below)**

Often	Sometimes	Rarely	Never
1	**2**	**3**	**4**

	Computer Technologies /Applications	Rating
i.	Communicative applications (e.g. e-mail, computer conferencing, LCD projector)	
ii.	Organizational software (e.g. data base, spreadsheets, record keeping, lesson plan tools).	
iii.	Analytical/Programming tools (e.g. statistics, charting, graphing, drafting)	
iv.	Expansive software (e.g. simulations, experiments, brainstorming)	
v.	Creative (e.g. desktop publishing, digital video, digital camera, scanners)	
vi.	Informative (e.g. internet, CD-ROM, forums)	
vii.	Content specific applications (math, science, social studies, music, etc.)	
viii.	Audio/Video production/editing (Audacity, GarageBand, iMovie, MovieMaker, etc.)	
ix.	Interactive whiteboard software (Promethean ActivInspire, SMART Notebook, etc.)	
x.	Internet resources (web posts, chart rooms, discussion forums, web 2.0 tools, Social media, etc)	
xi.	Presentation software (e.g power point)	
xii.	Simulations/Animations applications	
xiii.	Spreadsheets programs, Microsoft Mathematics	
xiv.	Online Free Tutorials	
xv.	Videoconferencing	
xvi.	Video streaming (Discovery, Learn360, YouTube, etc.)	
xvii.	Web Portals	
xviii.	Blogs	
xix.	DVD player, Video, TV, Radio, e-Posters, radio tapes etc.	

11. Rate the extent to which you disagree or agree with the following statements related to the state of using the information technology in the Tanzania secondary education systems **(Write one number that apply against each statement given below)**

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
1	2	3	4	5

	Statement	Rating
i.	Insufficient number of computers in schools	
ii.	Lack of curriculum focus on the application of ICT	
iii.	Unrealistic syllabuses on the uses of ICT tools as teaching /Learning Resources	
iv.	Teacher's lack of computer skills	
v.	Teacher's lack of interest in computers or using technology in teaching and learning	
vi.	Teacher's lack of experience with technology	
vii.	Internet connection unreliable	
viii.	Lack of framework on how to integrate ICT tools in Teaching and learning	
ix.	Teachers' lack of time for their computer supported teaching	

12. What are the examples of the ICT tools (Open Source Software, Free Software, Open courseware, Proprietary Software, or online resources (Urls)) that are more useful and that should be included into the curriculum as teaching /learning resources? (mention them)

Appendix C: OREI Framework Evaluation Questionnaires

Section I: Curriculum Design experts

1. Rate the relevance of the following factors in your decision to use information technologies in teaching/learning as an integral part of syllabuses **(Write one number that apply against each statement given below)**

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
1	**2**	**3**	**4**	**5**

	Factor	Rating
i.	Integrating e-contents (videos, animations, simulations, CD-ROMs etc) and online resources in teaching and learning creates a more learner-centered classroom where students can be able to explore their own questions and build their own knowledge	
ii.	Integration of computer technology into teaching and learning makes teachers less useful as an educator and more becomes more	
	Integration of computer technology tools into teaching and learning	
iii.	Gives teachers the opportunity to be learning facilitators instead of information providers.	
iv.	Motivates students to get more involved in learning activities independently.	
v.	Can provide teachers with easy access to instructional materials (eg. E-books, Tutorials sites, free lecture videos, podcasts etc)	
vi.	Promotes the development of students' interpersonal skills (e.g., ability to relate or work with others).	
vii.	Is not useful for improving student learning of critical concepts and ideas.	
viii.	Is effective only when extensive computer resources are available	
ix.	Can increase students desire to learn information technology and related subjects	

Interview Guide Questions

2. How does you decision to use ICT in schools have influence on Governments decision to invest in ICT in education?
3. How do you project the future of ICT use in education based on the present situation, especially government readiness, teachers' willingness, and Students exposure to the use of ICT?

Section II: Teacher Trainees

Section C: Technology Use /Application in Teaching

Very strong	Strong	Adequate	Weak	Very weak

1	2	3	4	5

14. State what are your perceptions, when required to learn, use, and apply the information technologies stated below. (Write only one that applies for each statement).

15. The question in this part asks for your honest opinions about different technologies, their role in education, and the future of different technologies. (Write the number that apply to your response)

	Competency	**Perception ranking**
i.	Learning how to use a new piece of software.	
ii.	Using the internet for general searching	
iii.	Searching for content specific instruction on the internet	
iv.	Using productivity tools (word processing, spreadsheets, presentation tools, etc.)	
v.	Teaching or sharing with others how to use technology in classroom	
vi.	Integrating technology into daily lessons	
vii.	Using technology in support of curriculum standards	
viii.	Designing activities that will integrate technology	
ix.	Locating learning opportunities needed to advance my technology skills	

Strongly Agree	**Agree**	**Uncertain**	**Disagree**	**Strongly Disagree**
1	**2**	**3**	**4**	**5**

	I believe…	**Opinion**
i.	Most technology would do little to improve my ability to teach/learn	
ii.	Technology has changed the way that I teach/learn	
iii.	As a student, I'm more knowledgeable than many teachers when it comes to technology	
iv.	School systems expect us to learn new educational technologies without formal training	
v.	Too much technological changes without enough support for teachers trainee	
vi.	Technology is a good tool for collaboration with other students when building unit plans	
vii.	I learn new technologies best by figuring them out myself	
viii.	Technology is unreliable	

Section III: Tutors

1. Please indicate how frequently the following computer technologies can be integrated into teaching and learning activities. (Write that apply)

Often	**Sometimes**	**Rarely**	**Never**
1	**2**	**3**	**4**

	Computer Technologies /Applications	Integration
i.	Communicative applications (e.g., e-mail, computer conferencing, LCD projector)	
ii.	Organizational software (e.g., data base, spreadsheets, record keeping, lesson plan tools).	
iii.	Analytical/Programming tools (e.g., statistics, charting, graphing, drafting)	
iv.	Creative (e.g., desktop publishing, digital video, digital camera, scanners)	
v.	Informative (e.g., internet, CD-ROM, forums)	
vi.	Content specific applications (math, science, social studies, music, etc.)	
vii.	Audio/Video production/editing (e.g Audacity, GarageBand, iMovie, MovieMaker, etc.)	
viii.	Interactive whiteboard software (Promethean ActivInspire, SMART Notebook, etc.)	
ix.	Internet resources (e.g web posts, chart rooms, discussion forums, web 2.0 tools, Social media, etc)	
x.	Presentation software	
xi.	Simulations and animations application software	
xii.	Spreadsheets programs, Microsoft Mathematics, Database Management Systems	
xiii.	Videoconferencing	
xiv.	Video streaming (e.g Learn360, YouTube, etc.)	
xv.	Web portals	
xvi.	Blogs	
xvii.	DVD player, Video, TV, Radio, e-Posters, radio tapes etc	

2. Please use the following scale to rate how well you feel prepared to integrate various technologies in your teaching processes: (Write a number that apply)

Well Prepared	Moderately Prepared	Poorly Prepared	Not Prepared at all
1	2	3	4

	Personal Opinion	Rating
i.	Ability to create multimedia presentations using scanners, digital cameras and video cameras	
ii.	Ability to use computers for office applications programs (e. g : word processing and creating spreadsheets)	
iii.	Ability to use computers for accessing online resources and communicating (e.g electronic mail, accessing the internet)	
iv.	Ability to use computers and LCD Projector for making presentations.	
v.	Ability to enhance professional productivity through the use of computers/ interactive media	
vi.	Ability to enhance professional productivity through the use of audio/video conferencing.	
vii.	Ability to enhance instruction through the use of computers, interactive media, audio/video conferencing.	
viii.	Ability to apply research-based instructional practices (project or problem based	

	learning and inquiry based learning) through the use of computers and other related technological resources.	
ix.	Ability to use technological resources to support learning activities for individuals, small groups and large groups.	
x.	Ability to use technology in varied ways to assess student learning.	
xi.	I can use a wide range of teaching approaches in a classroom setting (collaborative learning, direct instruction, inquiry learning, problem/project based learning etc.).	
xii.	I can choose information technologies that enhance the teaching approaches for a lesson.	
xiii.	I can teach lessons that appropriately combine mathematics, technologies, and teaching approaches.	
xiv.	I can teach lessons that appropriately combine science, technologies and teaching approaches.	
xv.	I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn	
xvi.	I can choose information technology tools that enhance the content for a lesson.	

Section IV: Ministry of Education and Vocational Training (MoEVT)

1. Are there any ICT related projects that are /were implemented at the Ministry level with the intention to foster ICT use in teaching and learning in secondary schools? **YES** ☐ **NO** ☐

   If **YES** list them with their information source.

Project Name	Information Source

Section V: School Inspectors officers

1. List some few examples of the pedagogical ICT tools that you could suggest to be included in the curriculum as teaching/learning resources/aid

……
……
……

2. List some few examples of the pedagogical ICT tools that you could suggest to be included in the curriculum as teaching/learning resources/aid.

……
……
……

Section V: School Teachers

1. Please indicate how frequently you have integrated/used the following ICTs into teaching and learning process as teaching aids/resources *(For each statement, Write only one number that apply).*

Often	Sometimes	Occasionally	Rarely	Never
1	2	3	4	5

	Computer Technologies /Applications	Frequency
i.	Communicative applications (e.g., e-mail, computer conferencing, LCD projector)	
ii.	Organizational software (e.g., data base, spreadsheets, record keeping, lesson plan tools).	
iii.	Analytical/Programming tools (e.g., statistics, charting, graphing, drafting)	
iv.	Expansive software (e.g., simulations, experiments, brainstorming)	
v.	Creative (e.g., desktop publishing, digital video, digital camera, scanners)	
vi.	Informative (e.g., internet, CD-ROM, forums)	
vii.	Content specific applications (math, science, social studies, music, etc.)	
viii.	Audio/Video production/editing (Audacity, GarageBand, iMovie, MovieMaker, etc.)	
ix.	Interactive whiteboard software (Promethean ActivInspire, SMART Notebook, etc.)	
x.	Internet resources (web posts, chart rooms, discussion forums, web 2.0 tools, Social media, etc)	
xi.	Presentation software (e.g.Power point)	
xii.	Simulations /Animations programs/software	
xiii.	Spreadsheets programs, Microsoft Mathematics, Database Management Systems	
xiv.	Videoconferencing	
xv.	Video streaming (Discovery, Learn360, YouTube, etc.)	
xvi.	Web portals and forums	
xvii.	Blogs related to key subject areas	
xviii.	DVD player, Video, TV, Radio, e-Posters, radio tapes etc	

2. What are the examples of the ICTs in your opinion that are most useful and that should be included into the curriculum as teaching /learning resources? *(Mention as many as possible)*

Section V: School Students

1. What technology /device /tool that you have used previously/recently from the following list? *(Tick all that apply)*

Technology media/device	Tick
Computer/laptop	
Television	

VCR/VHS tapes	
DVD Player	
Projector	
ActivBoard /smart board	
Digital cameras (still)	
Digital video cameras	
i-pad	
Blogs	
Internet	
Youtube	
E-book reader	
Facebook	