



ADDIS ABABA UNIVERSITY

COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCES

SCHOOL OF INFORMATION SCIENCE

**TECHNICAL FACTORS AFFECTING SCHOOLNET PROJECT
IMPLEMENTATION IN ADDIS ABABA: CASE OF SELECTED
SECONDARY SCHOOLS IN KOLFE-KERANYO SUB-CITY**

By

YONAS AKLOG

March, 2019

ADDIS ABABA, ETHIOPIA



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A Thesis Submitted to School of Graduate Studies of Addis Ababa University in
Partial Fulfillment of the Requirements for the Degree of
Master of Science in Information Science

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March, 2019

Addis Ababa, Ethiopia



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Declaration

This thesis has not previously been accepted for any degree and is not being concurrently submitted in candidature for any degree in any university.

I declare that the thesis is a result of my own investigation, except where otherwise stated. I have undertaken the study independently with the guidance and support of my research advisor. Other sources are acknowledged by citations giving explicit references. A list of references is appended.

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This thesis has been submitted for examination with my approval as university advisor.

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Lemma Lessa (PhD)

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Addis Ababa, Ethiopia

Abstract

SchoolNet is the student-centric educational network that provides equal opportunities for students to get access to the Internet, and the contents and delivery of educational services. Actually, the Ethiopian government has spent a great amount of money since the SchoolNet project is a cross point of two prioritized sectors such as education and ICT. But there are many problems that faced schoolNet project implementation in Ethiopia. The purpose of the study is to investigate the technical factors affecting SchoolNet project Implementation in Kolfe-Keranyo secondary schools in Addis Ababa city administration.

In this paper, the major technical factors which affect schoolNet project implementation were identified and put based on the critical level of importance of the project. This research conducted as a qualitative case study on technical factors affecting schoolNet project implementation on four secondary schools of kolfe-keranyo sub-city in Addis Ababa. The data collection methods were face-to-face interview, field note and researchers' observation. The data was analyzed using thematic analysis method. The finding of this research shows the infrastructure-related factors and lack of technical expert was the major obstacle on schoolNet project implementation in Kolfe-Keranyo secondary schools. Finally, recommendation for successful solutions for schoolNet project implementations was proposed.

Keywords: *SchoolNet, project implementation, technical factors, ICT in education, ICT Project*

Table of Contents

Declaration.....	IV
Acknowledgements.....	V
Abstract.....	VI
List of Figures.....	X
List of Acronyms.....	XI
CHAPTER ONE.....	1
1. Introduction.....	1
1.1. Background of the Research.....	1
1.2. Statement of Problem.....	3
1.3. Research Questions.....	5
1.4. Objectives of the Study.....	5
1.5. Significance of the study.....	6
1.6. Scope of the Research.....	6
1.7. Organization of the Study.....	6
CHAPTER TWO.....	7
LITERATURE REVIEW.....	7
2.1. Introduction.....	7
2.2. ICT in education Ethiopia.....	7
2.3. Trends in ICT integration.....	9
2.4. SchoolNet Initiatives.....	10
2.5. The Ethiopian National SchoolNet Initiative.....	13
2.6. The Challenges Faced by national SchoolNet Initiatives.....	17
2.7. SchoolNet Implementation.....	21

2.8. Technical specification on the implementation of the SchoolNet project.....	25
2.9. Sources of Technical Factors.....	27
2.10. Understanding and managing technical issues	30
2.11. Related Works.....	31
2.12. Chapter summary	33
CHAPTER THREE	35
RESEARCH DESIGN AND METHODOLOGY	35
3.1. Introduction.....	35
3.2. Research process	35
3.3. Research Techniques	39
3.3. Interview guideline	41
3.4. Ethical consideration	42
3.5. Chapter summary.....	43
CHAPTER FOUR.....	44
DATA PRESENTATION, ANALYSIS AND DISCUSSION.....	44
4.1. INTRODUCTION	44
4.2. Respondent Information.....	44
4.3. Data Collection Process	44
4.4. Data presentation	45
4.5. DISCUSSION	68
4.6. Chapter Summary	71
CHAPTER FIVE	72
CONCLUSION AND RECOMMENDATIONS	72
5.1. Introduction.....	72
5.2. Summary of Key Findings.....	72

5.3. CONCLUSION.....	74
5.4. Limitation of the Study	76
5.5. RECOMMENDATION	77
5.6. FUTURE WORK.....	78
REFERENCES	79
APPENDICES	87

List of Figures

Figure 3.1: Research process	36
Figure 3.2: management process of building interviews (The source seven stages: Kvale 1996)	42

List of Acronyms

AAEB	Addis Ababa Education Bureau
ACOT	Apple Classroom of Tomorrow
CEICT	Center for Educational Information and Communication Technology
CET	Council for Educational Technology
EICTDA	Ethiopian Information and Communication Technology Development Agency
ENEDI	Ethiopian National E-education Initiative
EthERNet	Ethiopian Educational & Research Network
GDP	Gross Domestic Product
JOCV	Japan Overseas Cooperation Volunteer
IT	Information Technology
ICT4D	ICT for Development
ICT4E	ICT for education
IP	Internet Protocol
Linux-SIS	Linux School Internet Server
MOE	Ministry of Education
NECTEC	National Electronics and Computer Technology Center
NGfL	National Grid for Learning
PSCAP	public sector capacity building
UK	United Kingdom
US	United States
USA	United States of America
VoIP	Voice over IP
VPN	Virtual private Network

CHAPTER ONE

1. Introduction

This chapter provides information on historical background of trends of ICT application in Education, SchoolNet project in Ethiopia and the motivation to do the research on technical factors affecting SchoolNet project implementation in Addis Ababa secondary schools, statement of the problem, research questions and other related introductory issues.

1.1. Background of the Research

The key role that ICTs can play in widening access to education to a wider section of the population of African countries; and for supporting literacy education and for facilitating educational delivery and training at all levels has been acknowledged by the majority of African Governments. A number of these Governments are committed within the context of their national ICT for Development (ICT4D) programs to facilitating the deployment ICTs at all levels of their educational system (Dzidonu, 2010).

A major application area of the use of ICTs to support education at the level of the schools in a number of African countries is the implementation of SchoolNets. Countries like Egypt, Ghana, South Africa, Rwanda, Ethiopia, Senegal, Uganda, and a substantial number of other African countries have for a couple of years been experimenting with the SchoolNet concept using mainly the Internet and its resources as the development and delivery infrastructure. In each of these cases, the SchoolNet serves more or less as an ICT-mediated application development and delivery environment for the development and delivery of educational programs and other school-related materials targeted at schools at the pre-university level. For example, a SchoolNet serving as educational program development and delivery environment can in principle be used to facilitate all levels of interactions and collaborations including learner-teacher interaction, learner-teacher collaboration, learner-learner interaction, learner-learner collaboration, as well as teacher-teacher interaction and teacher-teacher collaboration (Dzidonu, 2010).

The United Nations Development Program helped establish the SchoolNet project in Ethiopia to integrate national educational resources and help ensure the availability of education all over the

country (Hare, 2007). The ICT in Education Implementation Strategy and its corresponding Action Plan are components of a wider Ethiopian national e-education initiative. This initiative forms one of the pillars of the ICT for Development 2010 Plan. The strategy is built on three main streams: Ethiopian National SchoolNet Initiative, The National ICTs in Higher Education Initiative, The National ICT Education, Training and Awareness Initiative. These three streams form the basis for the implementation of the strategy across the education sector. The National SchoolNet initiative, for instance, is aimed at the deployment and the exploitation of ICTs to facilitate the teaching and learning process within primary, secondary, technical and vocational schools (Hare, 2007).

There are different problems in the course of implementation of the schoolNetproject such as environmental, process, managerial, technical and administration factors. The environmental, managerial, pedagogical and the social aspects were studied with different researcher but the technical factors on the implementation of the project were not studied yet. Most of the schools are not properly using schoolNet programs (ICT labs are not well connected with internet, some of the classrooms with in a schools don't have a plasma education service, and so on) and the schoolNet is not well functioned. Some of the problems affecting the successful implementation of the schoolNet project are technical and others are non technical like managerial, environmental, social constructs. Those technical problems are originated as a result of installation problem, lack of skilled experts, infrastructure shortage, and technological standards. Those technical hazards on the implementation of SchoolNet project needs to be further investigated also addressed for educational leaders, technical committees, ICT staffs. So these technical problems to be investigated from the respective of the IT infrastructure, IT security, IT standard and IT expertise. Due to the multidimensional nature of the problem, the researcher motivated to investigate the technical factors that affect SchoolNet implementation in a more detail and suggest possible solutions to consider in future implementation of same or related ICT projects. The study, therefore, assesses the SchoolNet project implementation literature on what works and what does not work in relation to Addis Ababa city secondary schools. Finally, this study made the researcher to draw some conclusions on the technical aspects for implementing SchoolNet program in secondary schools in Ethiopia.

1.2. Statement of Problem

ICT has the capacity to enhance the learning process and facilitate communications within education institutions and between educators and learners but it must be used in education institutions under the supervision of qualified well-trained professionals with the expertise in pedagogy and in education to ensure that its impact does not damage or undermine the learning process or the development of learners (Srivastava, 2016). The use of ICT in education will make a difference in improving the teaching and learning process through the systematic integration of the use of ICT into existing educational curricula (Bangkok, 2004).

The Ethiopian Government has made the development of Information and communications technology as one of its priorities to enhance the country's overall socio-economic growth and its educational system (EICTDA, 2009). Among the big national ICT projects undertaken by the Federal government of Ethiopia are the WoredaNet and the SchoolNet. WoredaNet stands for "network of district (woreda) administrations." WoredaNet employs Internet Protocol (IP)-based satellite communication to provide a variety of services to the local administrations, such as Internet connection, email service, and Voice over IP (VoIP) service. However, the most common use for WoredaNet has been videoconferencing. Using 42-inch plasma TV screens, ministers, high-level civil servants, and trainers regularly communicate and instruct distant local officials on what they should be doing and how. SchoolNet uses a similar architecture to broadcast pre-recorded classes on a variety of subjects, from mathematics to civics, to all of Ethiopia's secondary schools, and also to offer political education to school teachers and other government officials. Together, the two systems initially required the deployment of more than 17,000 plasma TV screens and equipment to receive (and in the case of WoredaNet, initiate) transmissions (Gagliardone, I., 2014).

In the case of the SchoolNet project in Ethiopia, many kinds of problems, such as, poor infrastructure, low skills for maintenance, low motivation of teachers and language problem used in the contents, were identified by the author who worked as a Japan Overseas Cooperation Volunteer (JOCV) Information Technology (IT) teacher in a secondary and preparatory school in Ethiopia from 2003 to 2005 and also worked for various educational projects as a consultant for the Japan's Grant for Grassroots Human Security Projects in the Embassy of Japan in

Ethiopia from 2005 to 2007 (Takeuchi, 2008). The most challenging condition to implement ICT strategy in Ethiopian schools is inadequacy of existing infrastructures. Even though integrating ICT use in the teaching-learning process was given due recognition in the implementation strategy, only about 40 percent of schools in the country had computers, and most of which are in Addis Ababa. Moreover, those schools, which had computers, experienced limited or low access to internet connection (Mikre, 2011).

According to Adam (2008), one of the challenges observed was Ethiopia's lack of adequate human resource capacity to deal with complex ICT market, regulation and policy issues, and to implement large socio-technical projects like SchoolNet. McClure (2000) noticed that technical factors can cause e-services failure due to discontinued use by citizens. SchoolNet projects usually adopt a multifaceted approach, addressing technology issues (connectivity and infrastructure), curriculum integration processes, assessment and pedagogy, the professional development of teachers, identifying and developing suitable content and software, and creating online communities of practice using ICTs. SchoolNets may also be involved in reshaping the policy environment through advocacy, research, or support of policy processes underway. These projects are particularly susceptible to technical and connectivity failures, but all parts of the value chain should be given adequate attention. Reliable ICT infrastructure (computers and Internet connectivity) and responsive technical support is particularly important during professional development programs. Technical obstacles can quickly lower the motivation of teachers and disrupt online learning communities (Bangkok, 2004).

It was researchers' motivation to study the technical factors affecting schoolNet project implementation based on early demonstration that schoolNet service is not working properly in Addis Ababa secondary schools. Very recently, AAEB modifies the plasma service education that allows teachers to have recorded lessons. This let teachers to pose recorded lesson and interact with their students. Schools are also blaming the AAEB for negligence in immediate IT related support, TV maintenance and equipment supply. But still the Plasma service education is not given effectively. Most of the computers in ICT labs don't give service for students. Three and four computers are serving for more than 20 students in ICT labs in each school. Most of the issues come from technical aspects. The technical factors that affect the SchoolNet project implementation are not studied yet. Therefore, there searcher focused on investigating the

technical factors affecting schoolNet project implementation and proposes the possible solution to overcome this issue.

1.3. Research Questions

The research questions to be answered by the research are therefore:

- What are the main technical challenges affecting SchoolNet project implementations in Addis Ababa secondary schools?
- Which technical factors are more critical in the successful implementation of SchoolNet project?

1.4. Objectives of the Study

1.4.1. General Objective of the Study

The overall objective of this study is to identify the technical issues that affect the successful implementation of SchoolNet projects in Kolfe-Keranyo Sub-city secondary schools in Addis Ababa city administration.

1.4.2. Specific Objectives

The specific objectives of the study are:

- To identify the technical factors affecting schoolNet project implementation related with ICT infrastructure, ICT standard, ICT expert and ICT security in KolfeKeranyo sub city secondary schools.
- To review literature to identify the technical factors affecting ICT integration in secondary schools.
- Find out the different level of importance of each of the technical factors in the management process;
- Suggest different ways of managing those technical factors in order to accomplish the adoption of SchoolNet in the secondary schools.

1.5. Significance of the study

This research helps to investigate technical challenge of implementing SchoolNet project and minimize those challenges at implementation stage. It will also recommend possible solutions to the challenges facing the SchoolNet program implementation. Furthermore, it will inform the school principals, ICT staffs, policy makers and school governing bodies to fill technical gap in the implementation of the SchoolNet program. Since the research tries to investigate the technical factors in implementing the project, the success of the project will benefit school communities. And it will also be expected to serve as a baseline to inspire other researchers on this study area.

1.6. Scope of the Research

The purpose of the study is to investigate the technical factors affecting SchoolNet project Implementation in Kolfe-Keranyo sub-city secondary schools in Addis Ababa city. The research doesn't discuss other issues like social construct, environmental impact, and cultural, managerial aspects on schoolNet project implementation.

1.7. Organization of the Study

This thesis is structured into four chapters. It has an introductory chapter which includes abstract, an introduction, statement of the problem, objectives of the study, the research methodology used for the research, significance of the study and scope and limitations of the study. Chapter two discusses the review of related literature regarding technical factors affecting SchoolNet project implementation in Addis Ababa city administration. Chapter three discussion on the methodology used for conducting the research which tries to show what the research design is, the study population and outline of the interview and what the interview questions intends to find. Chapter four deal with data presentation, analysis, and discussion. Chapter five deal with summary, conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

This chapter contains information related to issues of problem statement and research questions. It starts by explaining the definition of SchoolNet and selecting the most suitable definition for the study. Then, it presents, ICT in education, trends on ICT integration and implementation in education, factors affecting ICT integration in education, the SchoolNet project initiatives, ICT education in Ethiopia, SchoolNet project in Ethiopia since all of these topics highly correlate to the research as well as to build understanding of these concepts. The technical factors affecting the implementation of the ICT project have been collected from different previous studies and theories. Moreover, the possible measures taken to overcome the technical factors affecting the SchoolNet project was discussed at the end of this chapter.

2.2. ICT in education Ethiopia

ICT is a generic term referring to technologies which are being used for collecting, storing, editing and passing on information in various forms SER (1997). Information and communications technology – or technologies (ICT) is an umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning (Phiri, 2016). Though the ICT use in Ethiopia is lower level than other countries, it seems that the situation has been improving recently. For example, the number of the Internet users has increased more than twenty times in the last decade. The improvement can be explained by the national policy which places importance on ICT.

The Government of Ethiopia as part of its ICT4D process is currently implementing a number of major projects and initiatives including: the public sector capacity building (PSCAP), the Ethiopian SchoolNet project; WoredaNet project and the E-service program among others. The implementation of these projects needs to be mainstreamed into the ICT4D-2010Plan. There has

been considerable advancement in ICT infrastructure across Ethiopia in the past decade (Hare 2007). The country has a comprehensive implementation strategy for ICT in Education that forms part of the ICT for Development 2010 Plan. The stated intention in this is that the strategy facilitates “the deployment of ICTs and other educational technologies and systems to aid the process of the enhancement of efficiency and the enrichment of the education and learning process within the Ethiopian educational system” (Dzidonu, 2006). As Hare (2007) notes, the challenge is therefore for the government to effectively co-ordinate the implementation of the strategy.

Despite this, Ethiopia has only 0.4 internet users per 100 population, making it the country with the second lowest proportion of internet users across Africa, higher only than Sierra Leone (ITU 2009) and considerably lower than the continent average of 4.2 users per 100 population (ITU 2009). Ethiopia was the country that expanded most rapidly in Africa between 2003 and 2008 regarding the use of mobile phones. However, despite this it still remains well below the regional average, with 4 mobile subscriptions per 100 inhabitants compared to an average of 33 per 100 (ITU 2009).

A recent high profile program has been the government run “plasma television” broadcasts that have operated in every secondary school since 2004 with a “plasma mode of instruction for 35 minutes of the 45 minutes assigned for each lesson period” (Bitew, 2008). The government of Ethiopia provides justification for the initiative stating that “in the globalised world, information and communication technology is vital; installation of satellite receiving devices known as plasma display panels in every classroom at secondary level is necessary” (FDRE, 2004 p.8). The pedagogical rationale, as explained by the government, is that the program ensures all students have access to model teachers, can view laboratory demonstrations, are taught complex concepts in a simplified manner and receive simultaneous education regardless of location (FDRE, 2004).

2.3. Trends in ICT integration

The integration of ICT is not simply a linear process, with a clear beginning, middle, and end. Every school needs to analyze its present position with regard to ICT integration and to develop a plan that will allow it to progress to the next stage (Stack, 2008). There has been a high level of investment in information and communications technology (ICT) in education over a prolonged period of time throughout the 'developed world' (Twining 2002). Interest in ICT in education in England stretches back to at least the mid-1960s, when the original National Council for Educational Technology was first formed (CET 1975). At this time, the main focus was often on further and higher education rather than on schools. Later there was expansion to the schools starting with secondary then primary schools through government funding.

Twining (2002) outlines some of the policies employed by government in England in order to meet the government targets for ICT in education. Funding was made available for; The National Grid for Learning (NGfL), connecting every school in the country to the Internet; providing additional computer equipment for every school; training every teacher in state schools in the United Kingdom (UK) to make effective use of ICT as a tool to support teaching; cutting bureaucracy in schools through the use of ICT and setting up of a number of Centers of Excellence for IT and High Technology training and Skills Challenge projects. United States of America (USA) also has a long history about technological innovation revolutionizing education in the US since the mid-1800s, starting with the introduction of text books and moving through technologies such as film, radio, television and computers (Kent and McNergney 1999). The use of computers in school level education in the US started in the sixties (Hasselbring, 1986). The first national educational technology plan, Getting America's Students Ready for the 21st Century: Meeting the Technology Literacy Challenge, was developed including four key goals for educational technology: giving all teachers in the nation the training and support they needed to help students learn using computers; all teachers and students were to have modern multimedia computers in their classrooms; every classroom to be connected to the information superhighway and making effective use of software and on-line learning resources an integral part of every school's curriculum.

Advanced countries with integrated ICT in the education system also include; Australia, South Korea, Denmark, Finland, Belgium, Sweden, Singapore among others. Some typical characteristics of these countries are as follows: almost all classrooms are equipped with computers and other ICT tools; the student/computer ratio is high; Internet access is available in all schools; curriculum revision ensures nationwide ICT integration; delivery of education is increasingly online (Bangkok, 2004). Integration of ICT in schools in developing countries especially in Africa is slow and uneven (Farrel G. and Shafika I. 2007).

2.4. SchoolNet Initiatives

The concept of a “SchoolNet” (SchoolNet work) has spread since the mid-1990s, when the Internet began to be used more widely in education. Individual definitions and activities of SchoolNet vary but a SchoolNet can be described, in general, as a network which is set up to support effective use of the information and communication technologies (ICT), particularly the Internet, for enhancing education, and for encouraging greater communication and co-operation among a network of schools (Scimeca, 2009). SchoolNet has become a strong voice for ICTs in schools and the education sector. Its wide contacts with key actors in the ICT and education sectors provide it with influence and leverage.

SchoolNet is the student-centric educational network that provides equal opportunities for students to get access to the Internet, and the contents and delivery of educational services (Tangsathitkulchai, 2010). SchoolNet has become a strong voice for ICTs in schools and the education sector. Its wide contacts with key actors in the ICT and education sectors provide it with influence and leverage. The main objective of SchoolNet project is to exchange and support the development and implementation of national initiatives through knowledge exchange focused on the implementation and integration of educational technologies in schools (Durando, 2017).

SchoolNet is considered as a core component of e-service projects (Dzidonu, 2006). Actually, the Ethiopian government has spent a great amount of money since the SchoolNet project is a cross point of two prioritized sectors such as education and ICT. It is a satellite-based network that provides Internet connectivity as well as TV-broadcast educational content to secondary schools across Ethiopia. SchoolNet aims to provide students in rural

schools with access to equal learning opportunities to those in urban schools. The research focused on one of the ICT an initiative that is SchoolNet and mainly focused on the investigating the technical factors affecting implementation of SchoolNet project in Kolfe-Keranyo sub-city secondary schools of Addis Ababa city. The projects intended to:

- Install computer networks with a server and dialup Internet connectivity in schools
- Develop the effective educational use of the provided ICT facilities by running a program of development for educators in using computers and the Internet in education;
- Provide appropriate technical training, onsite and telephonic technical support to the schools;
- Conduct a monitoring and evaluation process that assesses the qualitative and quantitative impact of the project.

Therefore, under this chapter the study provides a comprehensive overview of the way in which the projects have been implemented and investigate the technical factors in implementing in a SchoolNet project.

SchoolNet offers several types of services to support the development and use of the district's SchoolNet system. These services include an implementation procedure, technological support, and capacity building support in the form of consulting, professional development, and communication about the reform (SchoolNet, Inc., 2005g). SchoolNets vary in their goals and objectives, depending on such things as the policy environment in the country they are in and the accessibility of the required equipment. For example, the Thailand SchoolNet has so far focused on establishing Internet connectivity in schools, while the Malaysian SchoolNet, which faces a different policy environment and has fewer challenges in terms of connectivity, has focused on providing teachers with access to learning materials in the national language (Scimeca, 2009).

All SchoolNets promote partnerships in learning. For example, Canada's SchoolNet, one of the first national-level SchoolNets, explains a SchoolNet as follows: "a partnership with the provincial and territorial governments, the education community and the private sector, which promotes the effective use of information and communications technologies in learning". Canada's SchoolNet launched an innovative program to stimulate, among other things, the

integration of information and communication technologies (ICT) into the classrooms of the nation. Teachers spoke convincingly of how GrassRoots projects provided opportunities for students to improve their technical skills (e. g., website construction, email, digital photography, multimedia productions, and robotics) through working with other students and teachers on authentic learning problems. In addition, there is not enough extra technical staff in schools to take on the burden of maintaining the technological infrastructure. Moreover, structural conditions limit the changes; e.g. lessons usually last 45 minutes, the domains of subjects mainly change after each lesson (in secondary school), and one teacher is alone responsible for one class. Schools have very little extra funding for buying material, for organizing study trips or for inviting visiting experts to teach occasionally (David C. Dibbon, 2003).

The practical implementation of ICT has been based on a few particular aspects, which have been regarded as key elements, such as improvement of technical resources or (technical) teacher training. The UNESCO SchoolNet project was initiated with the following objectives in mind:

- To explore and demonstrate how ICT could be used in schools to improve the quality and reach of education so as to better prepare youth for the demands of knowledge societies.
- To implement innovative models of ICT use in schools, and encourage better ICT-based teaching and materials development.
- To improve connectivity and access to online educational resources, and to encourage sharing of resources.

UNESCO 2007 report demonstrates teachers' efforts to utilize the Internet and other forms of ICT in the classroom are often limited by a lack of access to equipment and of appropriate teaching materials and technical support. Also, teachers are hindered in efforts to utilize ICT by the rapid developments in ICT and a lack of time and experience in planning ICT-based instruction. The SchoolNet project focused on providing ICT tools and developing teachers' capacity to utilize modern forms of ICT in teaching. In particular, teachers were trained in how to utilize computers and the Internet, how to prepare appropriate lesson plans, teaching materials and learning resources, and how to use the Internet to enhance teaching and learning.

2.5. The Ethiopian National SchoolNet Initiative

The Ministry of Education of Ethiopia launched the SchoolNet Project in 2003 with support from UNDP. In 2017, around 1530 schools were connected through this project. The SchoolNet project is ongoing to connect more schools and to provide Internet access. The Ethiopian National SchoolNet Initiative forming a key component of the Ethiopian National E-education Initiative (ENEDI) is aimed at facilitating the deployment and the exploitation of ICTs to facilitate, teaching and learning process within the Ethiopian school system, including the primary, secondary, technical and vocational schools.

The strategic goal of this initiative is to improve student outcomes through effective deployment and utilization of ICTs to facilitate teaching and learning in Ethiopian schools; provide and broaden access to learning and other educational delivery technologies to a wider section of pupils within the Ethiopian school system and modernize and progressively facilitate the process of transformation of Ethiopian schools to meet the expectations of the information and knowledge society specifically targeting issues relating to curriculum and program development, management and delivery and improvements in learning opportunities and outcomes of pupils within the school system.

In terms of its strategic priorities areas, the national SchoolNet initiative is guided by the requirement to effectively integrate ICTs and other emerging educational delivery technologies and systems within the Ethiopian school system to support teaching and learning as well as management and administrative functions within the school system; promote and facilitate access to educational services and resources using the delivery infrastructure provided by these technologies; promote efficiency and effectiveness of the educational delivery system and process; ensure that ICTs and other educational delivery technologies are developed and effectively used to manage and administer teaching and learning resources and the learning process in the schools; facilitate the development and deployment of learning management and information systems within the school system; facilitate the use of ICTs to improve the efficiency and effectiveness of administrative and service delivery processes within the school system; ensure that school administrative, teaching and support staff have access to ICT resources and avail of associated training to enable them to work effectively and efficiently; ensure the development of the requisite educational delivery infrastructure capable of delivering

a wide range of educational application systems; facilitating the use of a wide range of educational technologies and systems; providing access to ranges of educational services and resources to learners, teachers and administrators; facilitating the delivering of educational services and providing system security and protection of legitimate users from inappropriate material.

In taking steps to achieve the strategic goals in terms of the identified strategic priorities for rolling-out SchoolNet system in Ethiopia, the proposed implementing strategy is guided by the need to develop programs and initiative, the implementation of which will progressively facilitate the process of integrating ICTs into the Ethiopian educational system. Generally, the process of implementation of SchoolNet systems goes through a number of stages: starting from the implementation of what could be describe as the basic minimal model with very little integration of ICTs into the teaching, learning and management activities of the participation schools; through a partial integration stage to what could be described as full integration (full integration model) stage.

Basically, the minimal model is characterized by schools getting involved in ICT-in-Education initiatives on a self-selection basis with most of these initiatives being pilot based small-scale initiatives. The emphasis is mainly on just putting a number of computers on the desks and in some cases connecting some of these computers to the Internet mainly via dial-up limited bandwidth link with most of the connected schools using the Internet mainly for e-mail access and web browsing.

The minimal model is also characterized by: limited or no provisions for computing or computer studies programs for the students; very little use of ICTs to support the teaching and learning process, hardly any integration of ICTs into the school curriculum; very little use of ICTs to support school administration and other non-teaching functions and areas of operations of the schools; very little use of ICTs by Ministry of Education and other national and regional agencies to support the management of the schools and their activities.

The strategy proposed for the rolling-out of the Ethiopian National SchoolNet Initiative is to move the Ethiopian school system from the current stage that is more or less similar to what is described as per the characteristics of the minimal model to a stage where ICTs is fully

integrated into the educational system as per the full integration model. It is anticipated that through the implementation of the details of the strategy in terms of specific programs and initiatives targeted at fully integrating ICTs into the Ethiopian educational system, it will be possible to develop for Ethiopia an operational SchoolNet system that among other things incorporates the implementation of a fully developed national computer curriculum which is implemented nationally with the participating schools offering computer studies program up to the school certificate level. The level of integration of ICTs into the educational system will encompass integrating into the teaching process (subject integration), the curriculum (curriculum integration) and as well as mainstreaming ICTs into the entire teaching and learning process.

As a full-fledged national SchoolNet program, it is expected that the emphasis will go beyond just putting the computer on the desks, with the participating schools using ICTs to support the teaching and learning process, using the Internet as an educational development and delivery platform to support teaching and collaborative learning and as well as for supporting school administration and other non-teaching functions and areas of operations of the schools.

According to Dzidonu (2006), the SchoolNet project arises from the need to integrate ICTs into Ethiopia's educational system. It is designed to develop a wide-area network linking all schools in the country and making internet and online education accessible to them. The initiative constitutes a key component of e-service program and aims at the application of ICTs for purposes of teaching and learning. The broad objectives of this initiative are to:

- effectively deploy and utilize ICT to facilitate teaching and learning in Ethiopian schools;
- ensure that ICT and other educational delivery technologies are developed and effectively used to manage and administer the processes of teaching and learning;
- broaden access to learning and other educational delivery technologies to a wider section of pupils within the Ethiopian school system;
- support teaching and learning and improve the efficiency and effectiveness of administrative and service-delivery processes within the school system;
- promote and facilitate access to educational services and resources;
- ensure that school administrative, teaching and support staff all have access to ICT resources to enhance their effectiveness and efficiency;

- develop educational delivery infrastructure capable of delivering a wide range of educational application systems;
- Provides access to educational services and resources for the benefit of learners, teachers and administrators.

The implementation of the on-going national SchoolNet project can be seen as an aspect of the implementation of the ICTs in Education sub-plan of the ICT4D-2010 plan (Dzidonu, 2006). The key elements of the ICTs-in-Education Implementation Strategy are defined in terms of a number of core activities grouped under three main initiatives namely the:

- Ethiopian National SchoolNet Initiative
- The National ICTs in Higher Education Initiatives
- The National ICT Education, Training and Awareness Initiative

The joint initiative by the Ministry of Education and UNDP is probably the most visible project in the country with a total of 181 schools equipped with a minimum of 15 networked computers per lab all connected to the Internet. An additional 15 schools were to be equipped with computers and a printer by the end of February 2007. There are new programs around this initiative in the planning stages, including creating an extranet that will connect the schools (Hare, 2007).

The SchoolNet project in Ethiopia is considered as a cross point of three spheres such as ICT4D (ICT for development), ICT4E (ICT for education), and e-service. ICT4D project in Ethiopia focus on SchoolNet program is to connect more than 550 high schools in the country with VSAT based broadband for delivery of video-based distance and standardised education conducted with ETC, Ministry of Education, Ministry of Capacity Building, World Bank, UNDP. SchoolNet project aims to broadcast video lectures of main subjects, which can be seen on plasma television displays equipped in classrooms, to almost all secondary and secondary schools (about 550 schools) from the capital city, Addis Ababa through a satellite network (Kinde, 2007), and to provide the internet connection for the schools in order to supply useful information about teaching and learning and to lessen the gap of education level between rural and urban areas (UNDP 2005; Bangkok 2004).

2.6. The Challenges Faced by national SchoolNet Initiatives

Extant literatures reveal that there are different factors affecting integration of ICTs in education. For instance, according to Isaacs (2000), the main barriers faced by African schools in relation to Internet access specifically are limited infrastructure generally and network infrastructure in particular; High cost of telephone and Internet; Limited expertise and ICT skills levels; and Lack of an appropriate policy environment.

Kaimuri(2010) study shows teachers lack of training in the usage of computers and other ICTs, teacher's low level of ICT proficiency and lack of computers and related software were the main hindrances to ICT syllabus integration in the teaching and learning in public secondary schools.

Factors that accompany the successful implementation of ICTs in schools are both networks of connectivity and ongoing teacher training, together with the uses of computers in administration and management (Howell, 2000). Secondary ICT implementation should begin with the identification of an educational problem and deciding what students, teachers or schools want to achieve, not with the provision of technology. Effective ICT implementation requires using ICTs as knowledge construction tools rather than instructional tools. Furthermore, ICT becomes significant when its use is linked to teachers' visions and levels of knowledge (Al-harbi, 2014).

Implementation of ICT in schools has remained elusive since most of them are not connected to electricity grid, has no capacity to buy the required infrastructure, and has school leaders and teachers who are either computer illiterate or technology ignorant, though the current global technology changes puts emphasis on digitalization and modernization of all sectors including schools. Despite the apparent benefits of the use of ICT in schools, research shows that many schools are not implementing it, thus depriving learners and the school community from accessing the potential of ICT (Mingaine, 2013). It is with this background that study on challenges in the implementation of ICT in public schools in Meru County was conceptualized.

There are a number of significant aspects required for effective implementation of ICT in the classroom. These aspects include: (1) avoiding techno-centric thinking, (2) starting with the identification of educational problems, and (3) promoting constructivist learning environments. The following paragraphs discuss each of these aspects in detail. The first aspect of effective ICT implementation is that educators should avoid techno-centric thinking. Students' involvement

within ICT-rich classroom “does not necessarily correlate with productive learning” (Geisert&Futrell,2000, p. 10).Without appropriate directions, making ICT available in classrooms does not “in itself” lead to better education (Ministerial Council on Education Employment Training and Youth Affairs, 2005). Changes in classroom practices will not occur simply because ICT is more available in the classrooms. On its own, ICT does not improve education. In other words, the availability of ICT in classrooms might not matter; rather, the significant issue here is how ICT improves the educational process (Bingimlas, 2010).

Mooij and Smeets (2001) suggested five successive phases of ICT implementation, representing different levels of ICT transformation of the educational and learning processes. These include:

- (1) the incidental and isolated use of ICT by one or more teachers
- (2) increasing awareness of ICT relevance at all levels
- (3) emphasis on ICT co-ordination and hardware
- (4) emphasis on didactic innovation and ICT support
- (5) use of ICT-integrated teaching and learning that is independent of time and place

Implementation of ICTs-in-Education Initiatives, The Study shows that the majority (70 percent) of public and private schools that participated in study do not have ICT expenditure allocation as part of their annual school budget. The implication of these findings is that the vast majority of Ethiopian schools have limited or no financial resources at their disposal to implement or fully participate in a national SchoolNet initiative (Kassa, 2012).

According to Phiri (2016) the implementation of ICT in schools has been affected negatively due to lack of ICT teachers, computers, ICT books, and prior preparation by the government; **over enrolment** is another challenge faced by the government to implement ICT subject which is a practical subject. The schools are highly over enrolled such that teaching is a very big problem. The classes are just unmanageable for ICT subject; **lack of ICT infrastructure:** The first thing to do to have a good ICT implementation is to build infrastructure to facilitate successful ICT implementation; **lack of training materials** was common among schools which make it very difficult for them to help in the implementation of ICT. For any school to implement ICT easily they need ICT training materials without which it is practically impossible to implement ICT in schools. It had a negative effect on pupils’ academic performance and was a recipe for failure in ICT subject; **lack of ICT teachers:** For pupils to do better in ICT there is need for trained

teachers, books, computers and other things like computer laboratory; The funding of ICT implementation was cardinal in the implementation of ICT; Low numbers of computers in schools has contributed to poor implementation of ICT; **lack of electricity**: lack of alternative power supply like generator and solar power in case of the interruption of electricity.

Kakida (2003) cited some of the challenges facing ICT implementation in the classroom as unreliable electricity, Lack of enough computers, Lack of technical skills, Fear of technology, Offensive content e.g. pornography on the internet, unreliable slow internet connectivity and Lack of national policy. Electricity has been marked as an impediment to ICT implementation. For instance, Statistics indicates that Kenya has 20,000 primary schools out of which only about 15% have power and only about 500 schools own computers but with limited internet access. In secondary schools out of the 4000 schools, almost 65% are connected to electric power. However, only about 750 schools have roughly 10 computers each though with narrow internet connectivity (Kinuthia, 2009). In Addis Ababa, there are 65 secondary schools under schoolNet program but schoolNet service doesn't work most of the time due to breakdown of electricity. Dzidonu (2006) stated the strategy for the implementation of a national SchoolNet system for Ethiopia is developed within the context of addressing a number of key challenges. A number of these challenges are identified below based on the findings for the Baseline Study:

Limited Penetration of Computers Schools The Baseline Study shows that currently close to 40 percent of the Ethiopian schools have no computers to support the teaching and learning process in the schools. The majority those with computers use them mainly to support school administration work. A key challenge therefore is the need to improve the computer penetration in the schools and put in place programs and initiatives aimed at the use of these technological resources to support the teaching and learning process as well as to support school administration and other extra-curriculum activities.

Minimal Integration of Computers in the Teaching and Learning Process Schools The percentage of teachers according to the findings of the Baseline Study who uses computers to support teaching, administrative work and/or have access to the Internet is low and this varies from school to school. A key challenge therefore relates to the need facilitate the process of assisting the majority of the Ethiopian schools to integrate ICTs into the teaching, learning and as well as the administrative activities of their schools.

Low level of ICT Deployment in the Ethiopia Schools: The Baseline Study shows that of the schools involved in the Study about 61 percent reported that none of their pupils use computers for learning and/or for access to the Internet. The implications of this findings is that a key challenge that need to be addressed as part of the implementation strategy to deploy ICTs to support the activities of the Ethiopian educational systems relates to the need to improve the level and scope of ICT use in the schools, targeting the implementation of initiatives that will raise the threshold of the number of pupils that uses computers to support their learning activities.

Limited Access to Computers by Teachers in the Ethiopian School System: According to the Baseline Study, home ownership of computers by teachers is not widespread in Ethiopian schools. Close to 74 percent of the schools reported that their staffs do not use computers at home.

A key challenge which need to be addressed relates to the need to improve access to computers to teachers and put in place initiatives that provide them with basic computing literacy and expertise on how to integrate computers in the subject-level teaching process and as well as using them to support administrative activities including, time-tabling, reporting as well as extra curriculum activities.

Limited and low access to the Internet in the Schools: The Baseline Study shows that a high percentage of Ethiopian schools do not have access to the Internet. Most of the schools with access to the Internet use it for only e-mail. Of the schools with Internet connectivity, 52percent reported that access is available to administrative and teaching staff only and no access to their students. A key challenge to the integration of ICTs into the Ethiopian school system therefore relates to the limited Internet penetration in the educational system with the majority of the schools in both public and private sector not having access.

Lack of Financial and other Resources for Supporting the Implementation of ICTs-in-Education Initiatives: The Baseline Study shows that the majority (70 percent) of public and private schools that participated in study do not have ICT expenditure allocation as part of their annual school budget. The implication of these findings is that the vast majority of Ethiopian schools have limited or no financial resources at their disposal to implement or fully participate

in a national SchoolNet initiative. A key challenge therefore is the lack of financial and other resources to support e-education initiatives within the schools. A key activity of the implementation strategy should therefore be targeted at the mobilization of the requisite financial and other technological resources by the Government to support the Ethiopian ICT-in-Education program.

In order to have efficient and effective e-service in Ethiopia, one of ICTs activities, such as SchoolNet implementation shall be managed in accordance with acceptable theories and practices (Kassa, 2012). Conducting research on SchoolNet practices to evaluate its effectiveness and identifying the major reasons that adversely affect its success may help e-service officials particularly Ethiopian ICT Development Agency and Ministry of Education:-

- To bring improvements in overall SchoolNet activities,
- To generate knowledge in respect with underutilization of resources and a means to get rid-off,
- To provide different techniques in manipulation of SchoolNet requirements with best level of competency,
- To create the prospective of successful implementation and getting away from the problem of mismanagement and underutilization of resources.

2.7. SchoolNet Implementation

SchoolNet offers an increasingly wide range of technical services and implementation supports (including professional development) to facilitate use of the system and foster data-driven practices (Bangkok, 2004). District leaders are the driving force in implementing SchoolNet. These leaders determine which SchoolNet products and services to lease or purchase, and then to whom, when, and how the data system will be introduced and used. In these initial decisions and subsequent implementation, SchoolNet serves as a supporting partner and advisor. SchoolNet representatives and administrators in each district viewed the full SchoolNet implementation as a lengthy process that would occur over years rather than months. District staff who worked closely with SchoolNet representatives shared a common understanding of the reform, how it supported district goals, and the overarching implementation plan.

SchoolNet has been successful in numerous areas with respect to increasing connectedness, including helping craft a national vision, building awareness of information and communication technologies (ICT) in learning; helping find ways to use the Internet effectively in the classroom and library; encouraging collaboration among stakeholders; and generally ensuring connectedness for schools and libraries. In fact, all aspects reviewed were rated relatively highly, with the single exception of helping solve technical ICT infrastructure problems, which was rated lower in importance (KPMG Consulting LP, 2000).

Apple Inc. sponsored a continuing research program called the Apple Classroom of Tomorrow (ACOT) between 1980 and 1990 in which a number of American schools were given computers and other associated resources. This was followed by a number of research studies so commissioned to investigate the effects of the technology on teaching and learning (Nyirongo, 2009).

Apple researchers (Dwyer, Ringstaff, & Sandholtz, 1991) derived five general phases of implementation from across the ACOT projects described as follows:

1. **Entry phase:** In the initial phase, teachers had problems getting started with the school year and the challenges of integrating the computers into their normal ways of doing things.
2. **Adoption phase:** After the initial shock, teachers started to integrate the technology in their traditional classroom but using traditional lecture and textbook methods. Despite positive attitudes by students reported by teachers, there was little or no change as far as student achievement was concerned.
3. **Adaptation phase:** While traditional teaching methods were still at work, word processing, database, some basic graphics, and computer-based instruction tended to characterize instruction at this phase. The major change associated with this phase was an increase in productivity and efficiency.
4. **Appropriation phase:** “The change hinged on each teacher’s personal mastery...of the technology”. More innovative instructional strategies were employed due to increased confidence in the technology and time with the technology. Team-teaching, interdisciplinary project-based instruction, and self paced instruction characterized this phase.

5. **Invention phase:** Although not actually a phase, this stage involved willingness on the part of the teachers to experiment and change.

Klein and Knight (2005) refer to successful implementation as one in which targets organizational members use the new idea regularly, in a consistent and committed manner. It is during implementation that issues relating to the use of the innovation arise (Durlak, 2008).

Resources are the ingredient that must be present if implementation is to work at all. And IT project that is not supported by resources such as hardware, software, money and personnel cannot take off let alone be successful. SchoolNet has since been heavily involved in supporting the development of educational resources available on-line. These resources include material of use to teachers in creating curricula content; material of use for students both for curriculum purposes and for personal interest (such as finding post-secondary employment using SkillNet.ca); material useful for parents; and material of use to school and library staff for administrative purposes.

An overview of results from the survey and the interviews indicate that while availability of computers and the internet facilitate digital faculty members' adoption of the technologies, lack of accessibility to available equipment, lack of knowledge and skills to use the technologies, lack of involvement in decision making involving electronic technologies by faculty members, lack of infrastructure to support the technologies, lack of technical, pedagogical and administrative support hindered the integration of the technologies in teaching and learning (Nyirongo, 2009).

In Thailand SchoolNet project, there were four main areas of activity under the SchoolNet project. First, SchoolNet connected schools to the Internet and promoted Internet usage through the development of free operating software known as Linux School Internet Server (Linux-SIS). Second, the development ICT skill among personnel in educational institutes was supported. During the early stages of SchoolNet, human resource development was considered to be of critical importance, and National Electronics and Computer Technology Center (NECTEC) supported various efforts to for staff to develop related skills, through efforts such as its cooperation with Rajabhat Institutes to provide training courses. Third, digital learning resources were developed. At that time, there were few such resources available in Thai. Teachers were encouraged and supported to develop and share educational content through the network. A new

digital library was created to serve as a knowledge resource, providing material in ten academic subject areas. NECTEC also developed the Digital Library Toolkit to help teachers to create their own websites. Fourth, NECTEC developed the website of SchoolNet to be the focal point for schools to share information, data, news, opinions and to provide solutions for technical problems in order to facilitate knowledge exchange across the network (Rattankhamfu, 2016).

A number of Southeast Asian countries have contributed their experiences to SchoolNet initiatives, which is a practical resource about ICTs in education, and more specifically about setting up and operating SchoolNet programs and projects. A SchoolNet program is an organized set of activities that expands the use of ICTs and promotes sharing of educational resources by teachers and students at schools. SchoolNet programs may be located inside or outside government, may be large initiatives with substantial funding, or smaller innovative projects without big budget (Bangkok, 2004).

Planning SchoolNet Programs is intended for policymakers and high-level managers, and for SchoolNet program managers. It examines the policy and planning implications of SchoolNet programs, such as relating ICT programs to broader economic and education development goals; understanding the financial and other resources that will be required and working within a range of constraints; establishing appropriate partnerships; and change management strategies. It describes ways in which the education system should respond to the introduction of ICTs, such as changes in curriculum structure, assessment strategies and professional development programs for teachers. Lastly, it looks at factors that influence sustainability at various levels, broadening and extending the impact of SchoolNet programs and methods of evaluating and assessing impact (Bangkok, 2004).

Implementing SchoolNet Programs is a practical and operational guide for managers of SchoolNet programs, covering project planning and implementation and the key elements involved in an ICT project; choosing appropriate technologies; putting in place support, maintenance and troubleshooting systems; models of training provision; creating and operating online services; creating SchoolNet communities; and indicators for measuring participation and impact.

2.8. Technical specification on the implementation of the SchoolNet project

When SchoolNet began, using the Internet for education was almost never done, and there was little information on how to best go about it. The program addressed many important barriers to increased use of ICT in the classroom. These included availability of connectivity, professional development for teachers, poor ICT infrastructure (including old, slow computers), not enough computers connected and networked, slow Internet access, etc. These barriers includes distrust of web-based learning, unfamiliarity of educators in using ICT technology, lack of understanding of using Internet content in teaching, lack of technical infrastructure and support, and simple lack of computers and associated hardware and software(KPMG Consulting LP, 2000.pp.55-56).The types of ICT barriers raised are generally consistent with those addressed by SchoolNet.

In sum, SchoolNet is seen as having had an important role in addressing past ICT barriers, and to have an important continuing role in this area. At the time SN were initiated, there was general consensus that the availability of connectivity (especially in remote areas), the costs of connectivity, and the lack of appropriate models and training for using information and communications technology (ICT), were all seen as major barriers to increased ICT use.

According to KPMG Consulting LP report (2005), the top five barriers identified by teacher/ principal/ library respondents in Canadian SchoolNet evaluation were Computers too old, slow, etc. (71.5% of all respondents); lack of professional development in computer/Internet use for educators and administrators (66%); not enough computers networked within school, or LAN is too slow (64.8%); lack of high-speed, high data rate communications systems (e.g., bandwidth for multi-media), at a low enough cost (62.3%) and not enough technical ICT support (61.4%)

The main problem prior to SchoolNet project implementation was lack of financial and technical resources to connect technical problems with their computer(s); Internet connections breaking down; problems with connecting the computer(s) to the Internet and disconnecting the computer(s) for supervision reasons.

According to The Canadian Education Association (2003) report, the technical specification to be questioned about the SchoolNet project is part of the project management specifications. These technical specifications are described interims of connectivity, consultations, expected outcomes, application of content and competencies.

Technical specification on Connectivity should comprises Minimum one year trial (with possibility of another year of service); Installation and operation of multimedia equipment in all sites; Adequate training and support to be provided; On site monitoring and reporting; Connection; Bandwidth usage measurement by each school during trial; Post-trial evaluation and report.

Technical specification on Consultations should consider Schools and their school boards/districts consulted on terms and conditions of their participation (goals, benefits, timing and duration and evaluation of trial); Schools and their school boards expected to contribute resources to the project; SchoolNet to provide ongoing support through appropriate programs.

Technical specification on Expected Outcomes involve School staff and students experience high-speed access to Internet and off-site pedagogical resources; Students have opportunities to link up with other schools and do collaborative work; Students have access to off-site learning material and interactive learning; Teachers comfortable with multimedia equipment and applications; Staff has access to and is using new multimedia learning applications; Schools are paired for mentoring; Students develop and operate their web sites; Schools apply and qualify for Grass Roots project funding.

Technical specification on Applications and content should consist of appropriate interactive learning material and learn ware available; Monitoring of applications used and their effectiveness; Trials' learning activities successfully integrated into existing e-learning programs and networks; Pedagogical support available to teachers; Post-trial evaluation.

Technical specification on Competencies: Teachers and staff to be trained in use of multimedia equipment Staff and students linked up with other schools and learning networks; Schools have shared information among themselves and with trial manager on their learning experience; Post-trial evaluation of competencies acquired.

There is a wide variety of barriers to effective ICT use that will be important in the near future, including technical issues related to high-speed access to the Internet, lack of ICT technical support, and so on.

2.9.Sources of Technical Factors

Technical Problems are related to the configuration standards of the computers, as well as other factors such as the speed of Direct PC connection and the bandwidth available. This is due to the rapid expansion of material available on the Internet, and the increasingly complex nature of this material (requiring high speed file transfers), the computers required will need to be correspondingly more sophisticated (KPMG Consulting LP, 2010). According to Albugami (2015) some factors that might hinder the implementation of ICT in schools are lack of ICT policy and strategy; Lack of proper infrastructure and access to ICT resources; lack of management roles Lack of teachers role; lack of school staff training; lack of technical support and maintenance; and Negative attitudes, beliefs and behavior towards ICT tools.

2.9.1. ICT infrastructure

ICT infrastructure is one of the significant factors which make changes in the implementation of the project. Hew and Brush (2007) commented, “Without adequate hardware and software, there is little opportunity for teachers to integrate technology into the curriculum, even in cases where technology is abundant; there is no guarantee that teachers have easy access to those resources”.

There are a number of barriers associated with inadequate ICT infrastructure. According to a report by Becta (2004), levels of access to ICT are important in determining levels of use of ICT by educators, but it is not guaranteed that a school with low access means that school does not have enough resources; it may be these resources are inappropriately organized in the school. Similarly, in the report by Balanskat, et al. (2006), the authors emphasized that the accessibility of ICT equipments does not necessarily lead to effective implementation. The lack of high quality hardware and suitable educational software are also considered by the majority of educators to be significant barriers to effective ICT implementation.

In a study by Korte and Hüsing (2006), the majority of teachers stated that the lack of ICT infrastructure in schools prohibited them from using ICT in their practices.

2.9.2. IT Security

Security is treated as the most important concern in the online world (Nikkhahan *et al.*, 2009). IT security is considered to be one of the most significant divisions of information security (Euting&Weimert, 2009). The main purposes of the information security are protecting the information and guarantee to obtain ability, privacy and honesty of information (Aljifri&Navarro, 2003; Elmarie&Elme, 2000).

2.9.3. IT standards

Standards have been described as conformity of system elements that would help software and hardware within the system to build up new services differently from each other. However, they should be appropriate and well-matched in with each other (Keen, 1991; Weerakkodyet *al.*, 2011). IT is developing fast, and the need to have the same technology type and criteria is an essential indicator that makes the work compatible, which is referred to as ICT standards (Borras, 2004).

In Web-based learning, technical standardization of content has also become a pressing issue. Standardization allows different applications to share content and learning systems. Specifications in content, structure, and test formats are proposed so that interoperability may exist between different management systems, resulting in some cost-efficiencies. Standards must be general enough to support all kinds of learning systems and content (Creative Commons Attribution-Share Alike License, 2018). In addition, ICT standards have been defined by Freeman as specification for hardware and software that are either widely used and accepted or sanctioned by a standard organizational (Freeman, 1997).

There are some advantages of technical interoperability, such as it has minimal intellectual property restrictions, or should be royalty-free on a logical and fair-minded basis. Also the standards allow technical interoperability between different products, and enable multiple competing implementations so that users are able to choose whatever product they want whereas the products work in interoperability properly (DeNardis, 2009). Moreover, it helps to improve government's efficiency, building the knowledge economy (Borras, 2004). So IT standards would be considered as a technical factor in the implementation of schoolNet project.

2.9.3. Technical Expertise

Technical skills may be sufficient for ordinary classroom practices with pupils and for home use, but many teachers may still lack the confidence to make the best use of the new technical resources (Condie et al., 2007). According to Becta's report (2004), "if there is a lack of technical support available in a school, then it is likely that preventative technical maintenance will not be carried out regularly, resulting in a higher risk of technical breakdowns".

Lack of technical education and training is a barrier to the successful implementation of ICTs in classrooms (Al-Alwani, 2005; Al-Oteawi, 2002; Almaghlouth, 2008). Albirini (2006) indicated that teachers' lack of knowledge leads to their lack of confidence to integrate computers in education. Similarly, when responding to Becta's survey, most teachers who stated that their lack of confidence was a barrier, also indicated that they had limited knowledge in the area of ICT (Becta, 2004). Furthermore, teachers' attitudes towards computers have been found to be significantly influenced by teachers' computer competence (Albirini, 2006).

The lack of infrastructure may be compensated for by the commitment of the teachers. In some countries, projects focus on training for the implementation and sustainability of ICT-based interventions in education. Some see pre-service training as essential, such as the revised national policy on education in Botswana and the aims of SchoolNet Namibia (Bigum, 2000) while others consider in-service training the appropriate response. Some hope that "cascade" models will work, like in the Ministry of Education in Gambia (Bigum, 2000). Some claim that it has already done so, as in the case of Ghana (Bigum, 2000). Others still rely on volunteers, both young and old, to sustain the intervention. Training goals vary but most are based on training schedules using workshops to cover the various skills. In general, training is seen more in terms of time spent on training than in terms of outcomes such as proficiency in the skills, comfort with the technology or experience in integrating use of the Internet into curricula. Training generally includes basic computer literacy, exposure to the basics of email, search engines, website design and the integration of technology in the classroom, in a concentrated period with groups at various levels of competence. ICTs have clearly made new demands on an already stretched sector while simultaneously offering opportunities in support of

current difficulties. The enthusiasm for ICTs may well ultimately be the catalyst for transforming dominant education practices (James, 2001).

2.10. Understanding and managing technical issues

According to the British Computer Society BCS 2006 report, in order to achieve a high quality specification, low cost and less time, the project manager must understand and manage technical issues properly. Technologies need to be found and tested to ensure that it will achieve project objectives. In some cases, this testing of technology may reveal new business possibilities that had not been previously considered. The project manager also needs to be aware of technological development, adopt these in the project whenever necessary, and ensure they maintain a healthy step ahead of their competitors. Technical measures should be considered as a second-level approach to the problem, especially as many technical solutions are imperfect and can sometimes be circumvented by determined users (Bangkok, 2004).

2.10.1 Management of IT security

Technical security controls for risk mitigation can be configured to protect against given types of threats. These controls may range from simple to complex measures and usually involve system architectures; engineering disciplines; and security packages with a mix of hardware, software, and firmware. All of these measures should work together to secure critical and sensitive data, information, and IT system functions. Information security practices are a combination of technical and human solutions (Stoneburner, 2002). Technical solutions include Anti-virus protection on workstations, servers and e-mail servers; Backup solutions so that data and servers can be quickly restored if lost; IP level security to protect against unauthorized interception of data or passwords on the network or Internet, and unauthorized access to services. This can be implemented by using end-to-end encryption (e.g., secure Web sites or VPNs) and firewalls (restricting access to certain services to and from specific network and Internet addresses) (Bangkok, 2004).

2.10.2 Management of IT infrastructure

There is a need to provide teachers with the technology, equipment, and support. Furthermore, resources should be organized in such a way to ensure maximum accessibility for all users

(Becta, 2004). Providing access for and increased availability of technology will promote its implementation into classrooms (Al-Alwani, 2005).

2.10.3 Management of IT Expertise

SchoolNet's volunteer and training programs are the primary instruments by which it strengthens and passes on ICT skills. The emphasis has been on technical skills, especially to refurbish, install, and maintain computers and to install connectivity in schools. Training in schools, the 'front line' in a sense, is also focused on technical issues including use of the Internet (Ballantyne, 2004).

2.10.4 Management of IT standards

Choose appropriate technologies that are stable and easy to support, with affordable operating costs. Avoid vendor lock-in and high switching costs by adopting open standards. ICT architectures should be vendor neutral. Technical support staff should exist in schools. Schools must be able to designate a centre manager (CM) and an assistant manager (ACM) to take charge of the day-to-day running of the education venture Center. These activities include Visual inspection and technical assessment; an interview with the school administrator; School profiling and needs assessment (Bangkok, 2004).

Therefore, the study assessed the technical factors that inhibit the implementation of the SchoolNet project so as to determine the capacity of secondary schools to equip students in sharing and accessing of knowledge and skills using technology based SchoolNet program.

2.11 Related Works

Researchers have been done by scholars from abroad regarding assessment factors affecting schoolNet project implementation. Some of them are discussed as follows.

Albugami (2015) focused on identifying the critical success factors for the implementation of ICT secondary schools, by reviewing the relevant literature, highlighting the barriers that may hinder the utilization of ICT. The literature revealed that a successful implementation of ICT in education requires paying attention to some factors such as providing adequate infrastructure,

adequate management support, adequate teacher training on ICT and pedagogy, a clear educational policy and evaluation on an ongoing basis.

Generosa G. & Cossa, (2004) researched the understanding level of the global phenomenon of using ICT and internet-based learning in secondary schools. They have used case study method. Their study shows that the lack of qualified human resources in the field of ICT-based education in the country did not allow the hiring of adequate people to play the roles of pedagogical and technical coordinators of the project on a full-time basis.

Mugambi (2010) investigate the factors that were hindering implementation of ICT syllabus in the secondary schools. On the research, quantitative data was analyzed using descriptive statistics and qualitative data was analyzed thematically. The result indicates there was a strong indication that the extent, to which ICT syllabus had been implemented in most of the secondary schools curriculum in the study area, was limited.

Kipsoi (2012) point out on the research ICT policies must be dynamic, cost-effective, adaptable, and differentiated between sectors and between the various segments of educational management in order to contribute effectively to education management.

Al-harbi, H. (2014) studied the extent to which Saudi high school teachers have effectively implemented ICT into their classroom practices and describe Saudi high school teachers' level of technological pedagogical and content knowledge. The study applied a sequential mixed methods design by using quantitative questionnaires and qualitative interviews with Saudi high school teachers in the Al-Madinah administrative area of Saudi Arabia. The finding indicates ICT implementation should begin with the identification of an educational problem and deciding what students, teachers or schools want to achieve, not with the provision of technology. This study adopted a sequential mixed method design. A quantitative phase was followed by a qualitative phase.

Mingaine (2013) explored the challenges that hindered sustainable implementation of ICT in public secondary schools in Meru County, Kenya. Questionnaires tool and descriptive survey research design method was adopted. The finding shows limited supply of qualified teachers and high cost of infrastructure were impediments to implementation of ICT.

Aguyo (2010) point out that ICT in school can be viewed as a cost effective especially in terms of manpower as one teacher can reach many learners through internet, interactive white board and video conference technologies. Lambiano (2016) argue that in many instances, school leaders' supports implementation of the technology in their school through acquiring the needed infrastructure.

Kipsoi(2012) analyses the lethargy that has surrounded education management in schools with respect to acquisition of Information Communication Technology. The finding indicate that ICT policies must be dynamic, cost-effective, adaptable, and differentiated between sectors and between the various segments of education management in order to contribute effectively to education management.

Srivastava (2016) integrates the findings and key points from a review of significant part of the available literature associated with ICTs for Education and ICTs in Education. Schools with higher level of e-maturity show a rapid increase in performances in scores compared to those with lower level.

Lambiano(2016) establish the instructional leadership problems encountered when implementing ICT in secondary schools. The finding indicates lack of technological, transformational, curriculum and instructional leadership and role models as custodian of school ICT implementation programs in secondary schools was inadequate. The researcher used quantitative descriptive survey design methodology.

2.12 Chapter summary

This chapter overviewed that the major challenges that influences the schoolNet project implementation in Ethiopian school. Limited and low access to the internet in the Schools, lack of financial and infrastructural resources, maintenance and technical support for supporting the implementation of ICTs-in-education initiatives, limited penetration of computers schools, Minimal Integration of Computers in the Teaching and Learning Process Schools are some of the barriers that influence the schoolNet project implementation in Ethiopian schools. The schoolNet initiatives and the challenges faced in implementing schoolNet initiatives were look in detail in this chapter. The ICT integration in Ethiopian schools and the technical problems and the possible ways of managing the technical factors were accessed from different literatures and

journals. The chapter reveals the technical factors affecting schoolNet project implementation comes from the source of lack of ICT infrastructure, absence of ICT expert in school, low level of ICT standard and ICT security.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1. Introduction

This chapter describes the research design and methodology which is intended to meet the objectives of this research. Thus, the chapter discusses the research design and techniques used to answer the research questions. It covers the research process, research methodology, data collection methods, and data source, validity and reliability and data analysis issues.

3.2. Research process

The research process in this study started from that the literature reviews from the beginning while scoping and choosing the problem and continues until the end. The explanation of technical factors which are affecting the implementation of SchoolNet project and other topics in chapter two of this thesis were supported by different literature. Furthermore, some findings from other related literature were discussed and analyzed from what has been written in that part. Also, the researcher followed the same procedure for the results that were collected after the findings in order to explain them in discussion and conclusions part. The research process of the study is illustrated in figure 3.1.

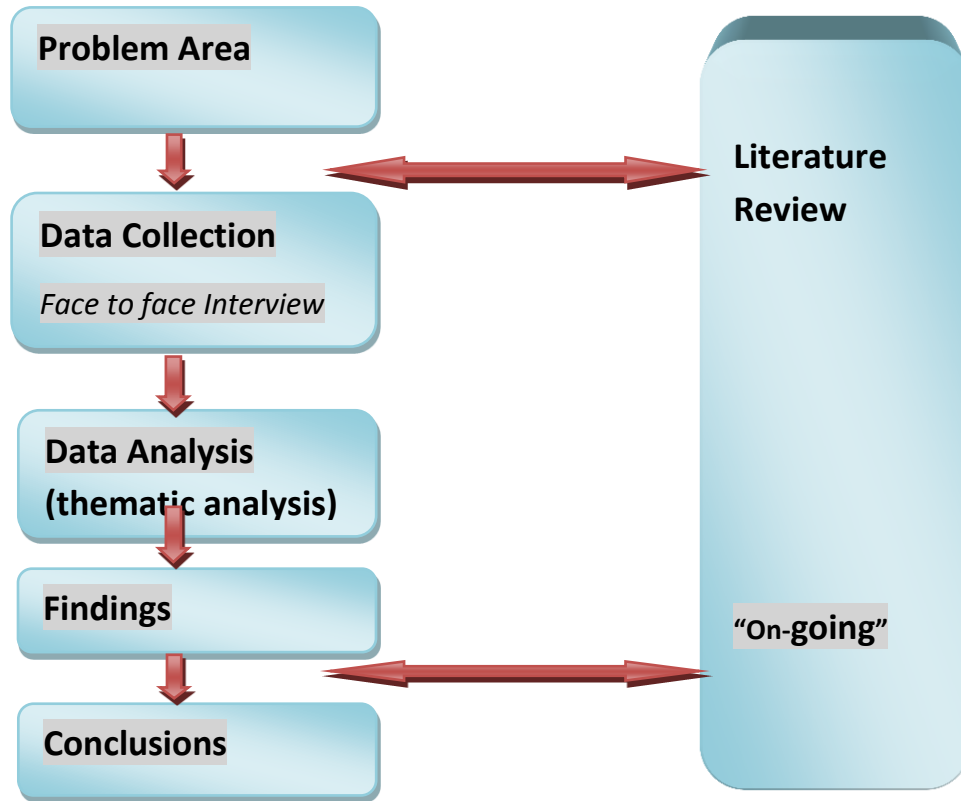


Figure 3.1: Research Process

3.2.1. Research Strategy

This research is case study survey which involved the use of structured interview, which is personally delivered randomly to the respondents and qualitative research methods, was taken. Case studies are well suited for development of detailed, intensive knowledge about a single case, or of a small number of related cases moreover it focuses in contemporary events and it is applicable to real world organizations (Yin, 2009), which is where the focus of this study is. Yin described that the applicability of case study to research questions in a form of How & Why and were thus chosen as the preferred research strategy. This is because the context is usually an integral part of the research design. The selected research design enables the attainment of the above mentioned objectives. For this research, various data sources used to investigate the technical issues that are major challenges on the implementation of the SchoolNet project.

3.2.2. Research Approach

Qualitative interviews are a well-known and powerful tool for information collection in qualitative research (Myers.D & Newman.M, 2007). They allow for the researchers to view the phenomenon from the interviewees' perspective and understand why and how they got that particular perspective (Cassell.C & Symon.G, 2004). Qualitative data that were gathered from interviews presented in audio record format. The data gathered have been analyzed in terms of the study objective already designed. After the data had been obtained through interview, it has been aggregated and seen in relation with the information obtained from the interview; and the discussion analysis of the results had been made accordingly.

As it is stated in the introductory part of this chapter, the researcher has chosen to use the qualitative method in order to study the technical factor affecting schoolNet project implementation. The researcher deployed the qualitative methods in order to understand the experiences and justification of the of resolving the technical challenges faced on implementing the schoolNet service of implementing bodies of the education sector Center for Educational Information and Communication Technology and the Addis Ababa Education Bureau ICT staffs, secondary school principals, ICT technicians in schools, (key stakeholders of implementing bodies of the program). This method allows the researcher to answer questions about the ‘what’, ‘how’ or ‘why’ of the schoolNet implementation challenges. To address the research questions and achieve the objectives, the researcher employed the data collection tools which are in-depth interview with the implementers of the program and the researchers’ observation of the schoolNet service in schools.

3.2.3. Study setting

The population of the study is grouped in to secondary school directors, ICT staffs from the Addis Ababa City Administration Education Bureau, and Center for Excellence Information and Communication Technology and the sub city ICT head. Based on this, the study is carried on three hierarchical levels. In the first level, ICT technical staffs from the Addis Ababa City Administration Education Bureau and Center for Educational Information and Communication Technology are addressed implementers, as they are key stakeholders. In level two, school

directors and ICT technician were taken as implementers. ICT official at sub-city was in the third hierarchical level.

3.2.4. Case selection/Sample selection

In Addis Ababa, Capital city of Ethiopia, there are 65 high schools covered in SchoolNet Program. There are 8 secondary and preparatory schools in Kolfe-Keranyo sub city out of this 4 schools were selected purposively for the study based on the adoption of the SchoolNet program (old and new school), well used SchoolNet School and the one with SchoolNet program but not well used). This in turn provides a chance to get bigger picture or more data on the topic. Total number of schools directors/principals and ICT technician (plasma technician) that were covered in this study were 4 school vice principals (one from each school) and an ICT technician from the selected 4 schools. Among the school principals, the vice principals were purposely selected because they were in charge of the entire academic process and they are project implementers at the school level.

3.2.5. Study participants

The informants of the study who were participating during the data collection period were composed of individuals who belong to the implementation of the SchoolNet Project. The sample derived from the management team of the coordination office, ICT technical staff, and schools principals of different high schools used as the interviewee of the study. The focused groups on the research are Addis Ababa education bureau project staffs, School principals, school technical staffs. Researchers' observation was also conducted around ICT staffs, ICT labs, plasma session Class to understand functionality of SchoolNet service.

Interviewees were secondary school vice principals, school ICT technician, ICT technical expert at the sub city and ICT expert at AAEB and technical ICT expert at CEICT. Among ten sub-cities in A.A city administration, this study focused on technical factors affecting SchoolNet project implementation in Kolfe-Keranyo sub-city. This is due to more number of schools are there in this sub-city and same project is applied and implemented across all the sub cities of the schools. Teachers and students are not included for this study. This is because even though teachers and students are key beneficiary of the project, they are not the main bodies to run the

project implementation. The researcher can't get the necessary information about the project implementation from teachers and students. So the research focuses on the main implementers of the project (AAEB ICT staffs, vice- principals, plasma / ICT technicians, CEICT technical expert).

3.3. Research Techniques

3.3.1. Data Collection

In this study, data was collected from face to face interview and researchers' observation and document review. The type of interview questions to be delivered was determined based on the schools ICT staffs and technical staffs. The interview questions were taken by adopting and customizing the interview questions on the research 'technical factors affecting the adoption of e-government' early related works regarding on factors affecting on schoolNet implementations and delivered for school ICT technician, ICT administrators, principals and Addis Ababa education bureau ICT staffs based on the ICT infrastructure, ICT standard, ICT security, ICT expert of the schoolNet implementers. Primary data are collected through personal interviews with stakeholders that to be considered. The following data-gathering techniques were applied:

Document reviews: This included project proposals, progress reports, planning documents, correspondence, annual reports and websites, as well as policy documentation as secondary source of data.

In-depth interviews (face-to-face and telephone): Key stakeholders included school principals and plasma technician, AAEB ICT technical staffs, Kolfe-Keranyo sub city schools ICT head for this research were included. Observation is also used as a method to collect the primary data. Secondary data was used from variety of preliminary study and related works on the area and documentation.

3.3.2. Data Analysis Strategy

The data gathered from these instruments were then be subjected to analysis. The collected data is sorted out through applicable tables. The analysis was characterized by descriptive analysis and thematic analysis approaches.

Thematic analysis (TA) is a widely-used qualitative data analysis method. It is one of a cluster of methods that focus on identifying patterned meaning across a dataset. Thematic analysis is a search for themes that emerge as being important to the description of the phenomenon (Daly, Kellehear, & Gliksman, 1997). The process involves the identification of themes through “careful reading and re-reading of the data” (Rice & Ezzy, 1999). It is a form of pattern recognition within the data, where emerging themes become the categories for analysis. In the case of the SchoolNet project particularly, some reports written by Ethiopian government, especially, Ethiopian Information and Communication Technology Development Agency (EICTDA), international organizations such as UNDP and UNESCO, and several researchers were used.

The primary data obtained from schools vice principals, plasma technician, AAEB ICT technical staffs, Kolfe-Keranyo sub city ICT officer and technical expert at CEICT interviews were carefully transcribed and organized based on the research question under discussion section. The study employed appropriate method for the discussion analysis of qualitative data collected from primary and secondary sources.

3.3.3. Validity and Reliability

Validity in research is concerned with the accuracy and truthfulness of scientific findings (LeCompte and Goetz 1982: 32). Valid study should demonstrate what actually exists and a valid instrument or measure should actually measure what it is supposed to measure. As the triangulation ‘can produce a more complete, holistic and contextual portrait of the object under the study’ (Ghauri, *et al*, 1995:94) it provides advantage to the research. Even it can be useful technique in complex phenomena (Cohen & Manion, 1989). Validity issues need to be considered when designing a research project and evaluated when analyzing the credibility of research results. Construct validity concerns whether a study measures what it sets out to measure (Robson.C, 2011). Both interviewees and the researcher maybe biased, either consciously or unconsciously (Diefenbach.T, 2009). Bias may be overcome by a number of strategies, such as triangulation and member checking. Data triangulation means using several methods for collecting evidence, such as interviews, document analysis, and observations. This allows for studying a phenomenon from different perspectives and increases

data quality (Yin, 2009). Member checking involves returning data material to the respondents for review and shows that their contributions are valued.

Reliability is concerned with the consistency, stability and repeatability of the informant's accounts as well as the investigators' ability to collect and record information accurately (Seltiz, et al., 1976). It refers to the ability of a research method to yield consistently the same results over repeated testing periods. In order to reduce risks to validity and reliability of this research, the researcher performed the following tasks:

- To reduce sample bias, sample selection was based on the ability of the respondents to provide data relevant to the research questions. The researcher judgment based upon the best available evidence to choose interview participants who know enough was applied.
- The researcher clarified the nature of the research for the participant of the interview. There was a discussion between the researcher and each of the interviewee 2 days before the interview conducted. During the discussion participant were able to understand why the research conducted the study, how the data collected, and for what purpose it used. Hence, it was possible to build a trust-relationship among the interviewees and the researcher.

3.3. Interview guideline

In this research study, the researcher would like to obtain knowledge about the technical factors that are affecting the schoolNet project implementation in Kolfe-keranyo sub-city, as a case study. Moreover, researcher would like to know the role of each factor and how those factors can be managed and if the management process of a certain factor was influenced by external pressures or limitations, to increase the overall success of the schoolNet project implementation. Therefore, research erupted for using the interview method to discover and describe those main objectives as the best qualitative method for this research. Researcher chose Kvale (1996) interview approach as a guide line to perform research interviews. Kvale's (1996) approach contains seven methodological stages which are thematizing, designing interviews, transcribing, analyzing, verifying and reporting. The qualitative research interview is a process of creating knowledge and that take place by the interaction between the interviewer and the interviewee; therefore, the project should be planned with the whole process in mind (Kvale&Brinkmann, 2009). Figure (3.2) is showing research process of building interviews.

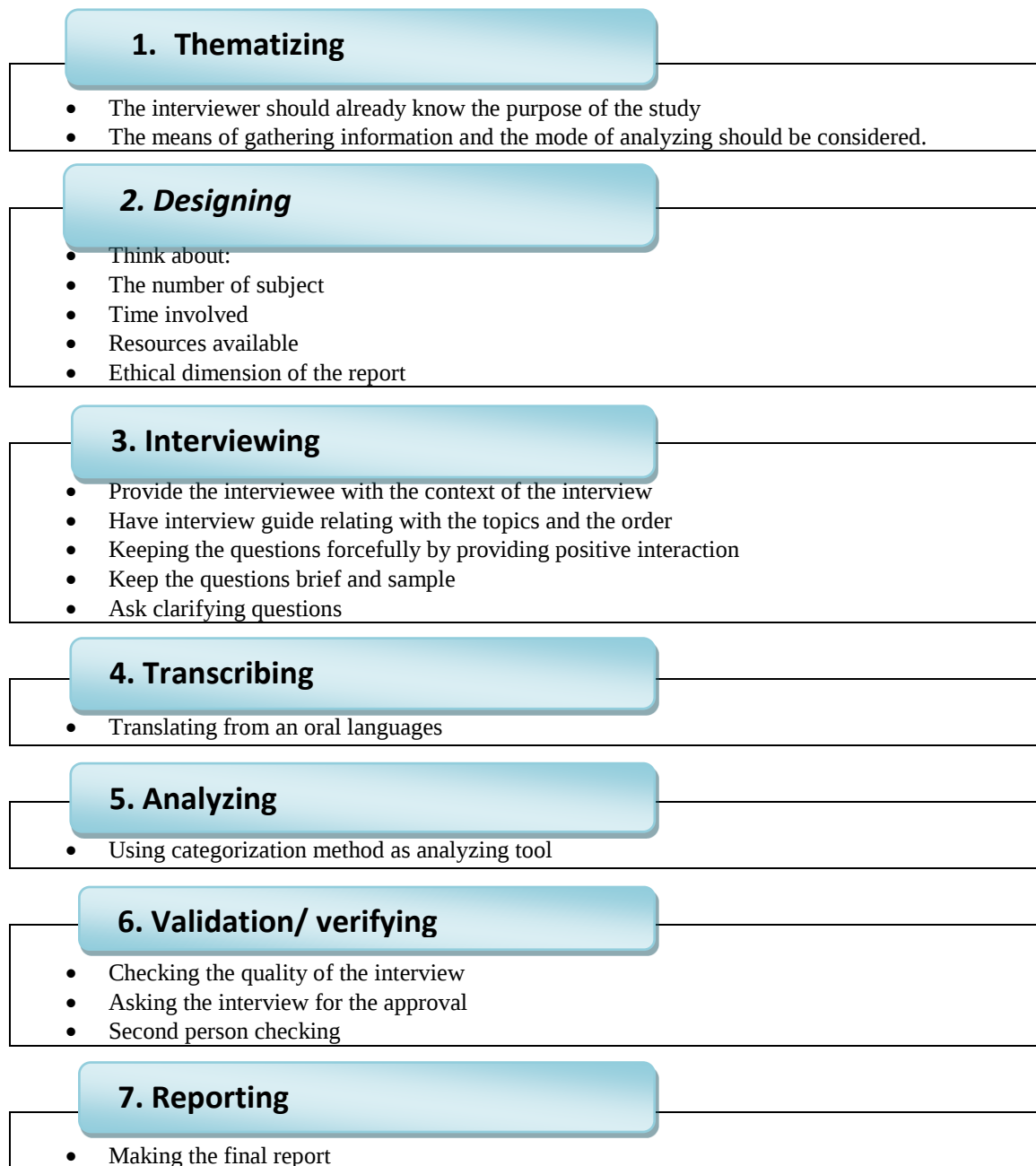


Figure 3.2: management process of building interviews (The source seven stages: Kvale 1996)

3.4. Ethical consideration

According to Vanderstoep and Johnston (2009), research ethics deals with how someone treats those who participate in our studies and how he/she handles the data after he/she collected. Ethical considerations are very important for every research or study. Interviewees were informed that this work is purely for academic purposes and not for other reasons. Therefore,

respondents of this study were assured of confidentiality in respect of all information that they provided. As they were not volunteers to be recorded, to assure them further, recording devices were not used in order to give respondents/ interviewees the confidence to speak all thing what they know about the issue. In every case, names are kept confidential thus collective names like 'the respondents was used in the study. All documents used have also been properly acknowledged and documented to avoid issues of plagiarism.

3.5. Chapter summary

The research design and methodology has been discussed in this chapter. The chapter clarified that, qualitative research was the design of this study followed by inductive research approach. As a method for this research case study was employed. Among the qualitative research data collection instruments, face-to-face interview and phone line interview was discussed in this chapter, as this instruments used to collect relevant and in depth data related to this study. The phone line record was carried out by adjusting a time to make interview and telling first the objective of the research to the interviewer. Moreover, the chapter presented the thematic analysis method. Steps that were performed to address Validity and reliability issues of this research have been also discussed in this chapter. Finally, the data analysis process of this research was presented. The next chapter will discusses about, data presentation, analysis and discussion of this research.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1. INTRODUCTION

This chapter presents the research findings from face to face interviews, researchers' observation and document review. In the discussion part, links between the research questions and findings are established. The findings from face-to-face interview were described separately but the grouping of the information is based on the four technical factors on schoolNet project implementation.

4.2. Respondent Information

The respondents of the research include school vice principals who are engaged in managerial position and those who play significant role in teaching learning activities have a great role in monitoring SchoolNet project implementation. The researcher plan was to take two interviewees from each school that are vice principals and the schools' ICT technician, the Kolfe-Keranyo sub-city education ICT expert, three Addis Ababa education bureau ICT experts that have a major role in SchoolNet project occupation and a technical expert at CEICT . But, there was only one technical staff in one school. The job titles of the interviewees are vice- principals (four) and plasma technician from a school (one), ICT coordinator of the Kolfe-Keranyo sub city (one), network & system administrator, database expert and ICT expert from AAEB (three) and a technical expert at CEICT. Totally, there were ten interviewees involved on face to face interview for this research. It was the researcher impression to carry out face-to-face interview with ICT technicians, schools vice principals as well as SchoolNet head officer in Addis Ababa education bureau was tied up in different activities in their working positions.

4.3. Data Collection Process

Data was taken from interviewee with audio record device. The recorded data was transcribed and verified with interviewee. Cooperation letter from AAU to school principals and Addis

Ababa education bureau ICT Coordinator office was submitted by the researcher on the middle of November. The researcher made several meetings to arrange for the meeting with the school principals and Addis Ababa education bureau ICT officer, ICT expert on CEICT and ICT expert of sub-city. After waiting for a week, the first meeting held with the school Principals to clarify the nature of the research. Four working days took to made interview with the school principals and technicians. Additional three days was held meeting and carried out interview with sub city expert, AAEB ICT expert and the expert at CEICT. The researcher went back again and again to the technical expert to get another chance to explain more so that the expert can be convinced. The good thing was both interviewee from schools and the experts agreed to discuss again. The researcher was able to convince interviewee and the data collection started by conducting the first interview with the ICT expert.

4.4. Data presentation

The previous chapter presented the methodology that was used in the study. This chapter presents the back ground characteristics of the interviewee, the answer to each of the research question and further presents the findings of the study on ‘the technical factors affecting schoolNet project implementation in Kolfe-Keranyo secondary schools’ addressing the technical challenge affecting schoolNet project implementation; the degree of the level of importance of the technical factors among schools; the possible solution of the managing of the technical factors in the implementation of schoolNet project.

4.4.1. Data from Face-To –Face Interview

Under this part, the data presented as it is introduced by interviewees using face-to-face interview. The first step is to collect the data. Audio record should be collected to study the talk of a session of interview (Spradley, 1979). From the transcribed conversations, patterns of experiences can be listed. This come from direct quotes or paraphrasing common ideas. The interviewees were school vice principals, school plasma technician, and ICT experts from Addis Ababa education bureau, Kolfe-Keranyo education and CEICT. The interview report is well organized and discussed in classification of ICT infrastructure, ICT standard, ICT security and ICT experts.

In the following section contextual information of the respondents on schoolNet implementation process, the main technical factors in the implementation of the schoolNet project among four secondary schools in kolfe-Keranyo sub-city were explained and the degree of the technical factors based on the importance of the context of the schools were discussed as follows.

Interviewees were asked about the schoolNet implementation process in school. AAEB expert described that currently there are 65 secondary schools out of 265 schools deployed in schoolNet project implementation in Addis Ababa city. For this project Huawei company is the vendor in installation and provision of infrastructure. ICT expert from Kolfe-Keranyo sub city confirms that eight secondary and preparatory schools were involved in schoolNet program in Kolfe-Keranyo sub city.

Ayertena vice principal explained the challenge of schoolNet implementation process of the school in terms of the scalability of the project. There is a lack of capacity to extend the schoolNet in case of more new learning rooms built. He described as follows:

“In our school, the schoolNet installation stage is not completed. On old buildings, there is complete installation and it’s functional but there is no installation on the new buildings of the learning classrooms. AAEB will make the installation after the bid process complete with additional extension of the project for the old buildings. Due to this, the plasma education service doesn’t exist on the new buildings of classrooms. On the old building, there are also some challenges on the schoolNet activities. We weren’t doing effective work on it. Because our plasmas are old models, which are sliding plasma displays. When they slide, the cables are damaged and difficult to purchase the accessories on the market. So those plasmas weren’t gave education service effectively. It should be replaced with latest technologies”

The plasma technician in Ayertena school explained the schoolNet implementation process challenges as follows.

“The schoolNet doesn’t work properly in our school. The reason is mostly the Set top box material which is used to make remote access of the plasma program and thick clients on the ICT labs are stolen by the students. There is no access on local market. The system by itself has problem. The school server is monitored by the Huawei Company. So we don’t have any privilege to run the system. We are normally serving as a guard for the server. So it’s difficult to

manage such problems. The thick-clients are mostly out of the cloud system. To solve this issue there must be a report for an expert of AAEB or the Huawei Company. For this, the system becomes paused for a week or two weeks. Mostly when students used USB flash, the thick client becomes out of the cloud due to attack of virus. When students changed their IP address the thick-client easily out from the cloud. Every time 5 up to 7 thick-clients becomes out of the cloud system. On one computer, up to four students placed and are difficult to adjust these thick-clients”.

According to AAEB ICT network and system administrator interview response, network breakdown and power issues are the main challenges in most of the schools; the ICT materials are easily burned and there is hard disk allocation problem since in one ICT lab, 20 computers are virtually connected with server of the school via switch. Since VPN service is used, there is no problem with data center. If the bandwidth problem is resolved, data can be stored securely with VPN on desktop cloud sever system. So there is not much important to focus on IT security aspect.

Interviewees also addressed that the schoolNet project implementation could be also be affected by external pressures like interruption of electric power, internet facility in the country, government regulations and citizens’awareness about utilization of ICT resources.

One principal respond the external factors regarding on the schoolNet project implementation as follows.

“The first external influence is the breakdown of the electricity. The materials are damaged form power fluctuation. We try to have a generator but it is out of the school capacity. We don’t have the budget to buy transformer. To print one paper I took almost two hours when I edit and try to print the electricity become off after time being it will come and when I open my computer it will goes and take my time this much difficulties.”

Interviewees were asked about the technical factors affecting schoolNet project implementation in secondary school. All interviewee argues that there are problems with network infrastructure and physical infrastructure.

Interview respond of AAEB ICT Officer (E1)

AAEB ICT officer worked for six years and he is graduated in computer science. He discussed on the technical factors affecting schoolNet project implementation and explained the following research questions.

Q. What is the schoolNet implementation process in Addis Ababa secondary schools?

“Currently there are 65 secondary schools out of 265 schools of Addis Ababa are deployed in schoolNet project. For this project Huawei company is the vendor in installation and provision of infrastructure.”

Q. What are the technical factors affecting schoolNet project implementation in Addis Ababa secondary schools?

“There is network breakdown, power issues are the main challenges in most of the schools, and most of the ICT materials are easily burned. The main problem is the only net provider is ETC we asked to have more than 162 megabytes broadband service but only 4 megabytes is released which is the bigger problem to scale up schoolNet service and since up to four computers are virtually connector with One CPU there is hard disk size problem. Since VPN service is used, there is no problem with data center. If the bandwidth problem is resolved data can be stored securely with VPN on desktop cloud sever system. So there is not much important to focus on IT security aspect.”

Q. What are the technical factors related with infrastructure in Addis Ababa secondary schools?

“There is a problem with network infrastructure. The main internet service provider is only provider ETC. We asked to have more than 162 Gigabytes broadband service but only 4 Gigabytes is released which is the bigger problem to scale up schoolNet service. Network breakdown, power issues are the main challenges in most of the schools; the ICT materials are easily burned and there is hard disk allocation problem since in one ICT lab, 20 computers are virtually connected with server of the school via switch. The other problem on our side is the materials are not accessible. We enforce the company to fulfill the materials efficiently. Otherwise, we plan to import those accessories or materials with investors or merchant.”

Q. What are the technical factors related with security in Addis Ababa secondary schools?

“Since VPN service is used, there is no problem with data center. If the bandwidth problem is resolved, data can be stored securely with VPN on desktop cloud sever system. So there is not much important to focus on IT security aspect”.

Q. How could the technical factors of schoolNet project implementation resolved in Addis Ababa secondary schools?

“To have successful implementation of schoolNet project the first and very important thing is to have an expert that is well skilled and trained in schoolNet. The bureau expert is to give follow up of the thing. So, when you go to school, there is no ICT expert. There exist infrastructure problem. Most of the materials are damaged with dust or eaten by mice. We prepare ICT policy. There is no accountability or responsibility base on the level of task. The other problem on our side is the materials are not accessible. We enforce the company to fulfill the materials efficiently. Otherwise, we plan to import those accessories or materials with investors or merchant. AAEB gives training at summer. In the middle also gives training for technicians. But when the project started, it gives training for 4000 teachers. After that, the school will continue to do. Mostly there is power breakdown. It gives training on the system and function. Because there is no right expert at a school level, we should give support to schools to the bottom level. The schools also support the system in its capacity. We have 65 schools in schoolNet program. There is power interruption due to this there are tasks to be carried by schools. But to regulate such problem as a bureau we have to go to school to support and to have the right professional skilled person. This is not enough adequate support. I said there are 65 schools in the program and mostly there is an electricity problem. In case of power fluctuation the ICT materials becomes damaged. At least we provide training at summer. Some of teachers by themselves support their school. But few teachers made trouble on the system by changing password of the system”.

Interview responds from vice principal of Ayertena secondary and preparatory school (p1)

The vice principal of Ayertena secondary school worked as a director for six years facilitate and he was graduated in degree in educational planning and management. He runs over all teaching learning activities including the schoolNet program in Ayertena secondary and preparatory

schools. He explained on our interview the main technical factors affecting the schoolNet implementation in Ayertena secondary and preparatory schools as follows.

Q. What is the schoolNet implementation process in Ayertena secondary school?

“The overall schoolNet installation is launched on AAEB in collaboration with the china company. In general, we don’t believe the schoolNet project is working properly in Ayertena secondary and preparatory School. We have 4 ICT lab rooms and 12 ICT teachers in our school. Teachers teach using ICT technologies even though there is no installation problem on the old buildings. But sometime network is not inline which is out of the cloud server. There is breakdown of network but the server is working efficiently in our school. The ICT lab rooms are now working better than the plasma service education. At the first stage of the implementation, we aren’t involved to run the project. This is because Huawei is directly working the installation. Even they damaged the existing network provided by the telecom. We were expecting the online system directly with the schoolNet program. Due to that, we aren’t managing it at the initial stage. But finally, we are following both the online system with the schoolNet. We don’t have the idea about the installation at first stage. I resemble the online system works directly with schoolNet. But finally, we understand the system work.”

Q. What are the technical challenges affecting SchoolNet implementation in Ayertena secondary school?

“In Ayertena secondary and preparatory school, the schoolNet installation stage is not completed. On old buildings, there is complete installation and it’s functional but there is no installation on the new buildings of the learning classrooms. AAEB will make the installation after the bid process completed with additional extension of the project for the old buildings. Due to this, the plasma education service doesn’t exist on the new buildings of classrooms. On the old building, there are also some challenges on the schoolNet activities. We weren’t doing effective work on it. Because our plasmas are old models, which are sliding plasma displays. When they slide, the cables are damaged and difficult to purchase the accessories on the market. So those plasmas weren’t gave service effectively. Those new Samsung plasmas work without any interruption of the service.”

Q. What are the technical factors affecting schoolNet project related to ICT infrastructure in Ayertena secondary and preparatory schools?

“The four ICT lab rooms don’t have the capacity to teach about 2900 students in our school. We need additional four ICT lab rooms to work on the standard. This is only 50% work. We need much to work on the standard in collaboration with AAEB. We used one computer for three students. On UNESCO, standard one computer should be for one student.”

Q. What are the technical factors affecting schoolNet project related to ICT expert in Ayertena secondary and preparatory schools?

“Regarding to technical expert, we can look in two categories. First, ICT is assisted by teachers, ICT rooms has no ICT expert. Secondly, when come to plasma service we have the expert. We have an expert work as the plasma and ICT technician in our school. Just like plasma service, the ICT rooms need an expert. The teachers are manipulating the ICT rooms but if there is an ICT lab room expert, he can manage by protecting ICT equipments from dust and virus, updating and installing different software of teaching content by organizing and structuring the ICT lab rooms every time. But now such expert doesn’t have a position to be employed in schools.”

Q. What are the technical factors affecting schoolNet project related to ICT security in Ayertena secondary and preparatory schools?

“There are 20 computers in each ICT lab rooms. The 20 computers can be monitored by the server if there is an ICT expert. But now all computers are open and students can use computers for what they need without any restriction. They also used for academic and nonacademic purpose like gaming and accessing pornographic content. If the computers are closed the students don’t have access to use, the technology by itself becomes idle. So, there is no restriction on using computers for any students.”

Q. How could these technical factors resolved to have successful implementation of the schoolNet project in Ayertena secondary schools? Can you suggest the possible solutions to resolve the issues with respect to ICT infrastructure, ICT standard, ICT experts and ICT security?

“There are problems which are resolved on school capacity and beyond school capacity on the schoolNet implementation. Those problems which are above our capacity will be reported to AAEB and the education bureau put possible measure to solve the problem. For instance having the right ICT expert can’t be resolved on schools capacity. We questioned many times to have the position on ICT expert in collaboration with the city of public service sector. The infrastructure should be enough purchased and fulfilled by the AAEB. Accessories and additional computers should be purchased and supplied, since we don’t get such accessories at local market. Additional computers and accessories should be delivered to school for additional ICT lab rooms. We have the room but we don’t have the infrastructure to open additional ICT labs. In terms of the ICT infrastructure, the AAEB should provide stocks of accessories and computers to have settled schoolNet program in our school. Regarding on ICT infrastructure issue the school can’t resolve but AAEB made agreement with china’s company. In order to get these accessories in schools, the government should promote merchants and foreign investors to import and distribute those accessories in schools. Regarding with ICT security problem, the ICT teachers should get training to develop the skills in keeping the plasma service education and ICT lab rooms functional for teaching. This can be done on the capacity of schools by inviting professionals to train on ICT security aspect and preparing training manuals for teachers to develop their skill. Regarding on infrastructure and placement of the ICT technical expert should be resolved by AAEB and the sub-city.”

Q. Which of the four technical factors take priority to manage the program?

“First additional infrastructure should be provided to schools. Since the system already launched on schools, it doesn’t have much problem. There is a room, teachers and installation but there must be infrastructure. So, additional computers and infrastructure must exist at first. Secondly, ICT expert comes. If these two issues are resolved, surely the four technical problems should be resolved together. Regarding with ICT standard; adequate ICT materials in school will create the standard. Using one computer is for one student shows students learn at the standard level. The materials are new. New technology is installed but the big problem is the number of the students and the number of the infrastructure is not proportional. This is how we look about the standard.”

Interview responds from vice principals of Millennium secondary and preparatory school (P2)

Millennium vice principal worked for five years and made interview based on the technical factor affecting SchoolNet project implementation as follows:

Q. How is SchoolNet implementation process in Millennium preparatory and secondary school?

“There are four ICT labs and all school community used the technology to make their work simple and create conducive working area. Our school leaders work to fulfilling the ICT materials like computers and accessories which are applicable in ICT program.”

We have problem on network breakdown, lack of professionals trained on schoolNet works. These problems should be resolved by the responsible sectors AAEB.

Q. What are the technical factors affecting schoolNet project related to ICT infrastructure in Millennium secondary and preparatory schools?

“It’s already fulfilled by the AAEB. We don’t have problems on ICT infrastructure.”

Q. What are the technical factors affecting schoolNet project related to ICT security in Millennium secondary and preparatory schools?

“ICT security can be view interims of the quality of materials or computers used. Most of the materials didn’t used for long period of time. They are damaged due to improper usage of the materials and power fluctuation. One computer is used for more than three students. The plasma technician is working in collaboration with AAEB.”

Q. What are the technical factors affecting schoolNet project related to ICT expert in Millennium secondary and preparatory schools?

“The ICT expert works to resolve problems in collaboration with AAEB expert. There is no trained skilled person in schoolNet program. The expert is assigned just to cover the position. He is doesn’t have the right skill to maintain and deserve the system. He was graduated by electrical engineering. No one can use the technology properly. The technology is very easy like TV

manipulating. But what is difficult is that if a problem arises related with network nobody can manipulate at school level. If there is sever technical problem no one can resolve it.”

Q. Which of these technical factors to be given more attention on the management of your school? Can you order the four technical factor based on the level of significance in your school?

“The most important thing to give priority is the expertise. Since infrastructure is already fulfilled, what next thing to come our school context are the experts or technicians. If the expert is not initiative to work and maintain the service, everyone can reject the plasma, and ICT lab rooms. If he has the interest to work on that position, the schoolNet program can run effectively. According to our school, we have a problem on ICT technician expert to maintain and update the service. The previous plasma technician resigned the job. Secondly, ICT standard follows. IT infrastructure and ICT security comes third and fourth respectively.”

Q. How could these technical factors resolved to have successful implementation of the schoolNet project in Millennium secondary preparatory schools? Can you suggest the possible solutions to resolve the issues with respect to ICT infrastructure, ICT standard, ICT experts and ICT security?

“To resolve the technical problems we are using the reporting system that’s reported by the technicians. Those problems on the schoolNet are identified and the responsible person tries to resolve the problem. The responsible person may be the school leaders, ICT technicians, and AAEB team expert. So we first identified and discussed those problems with the school technician. If the problem is on the capacity of our school, we resolve the issue. Otherwise, it will be reported to AAEB experts.”

Interview respond from the vice principal of EwuketLefere secondary school (p3)

Q. What is the level of SchoolNet implementation process in EwketLefere secondary school?

“There are 3 ICT labs and 20 plasma sections in EwketLefere secondary school. All bureaus are using broadband connection. Wi-Fi service works better in our school. AAEB improves the bandwidth of the Wi-Fi service. As a standard, there should be four ICT labs. In our school, the connection service is fast. This is due to the small number of sections in our school. The school is narrow so the previous leadership made three ICT lab rooms with in a school.” But the

expected number of ICT labs in a school is four (MoE, 2018). This indicates that the school is working under standard of MoE criteria.

Q. What are the Challenges affecting the schoolNet implementation in your school?

“According to Addis Ababa city, there are many challenges. The first challenge is utilization and awareness of technology of the community including the leadership. Secondly, there is technology abuse. Student used most of their time by browsing restricted contents. Due to this, we restrict students not to bring their cell phone. Students used their cell phone to capture their gesture of teachers, access game and pornographic contents. Thirdly, there exist breakdown of the network, lack of accessories or spare parts to maintain when it is stacked. This is because the materials are obtained from China Company. If we used the program effectively, we can apply to teach science education in addition to ICT education.”

Q. What are the technical factors affecting schoolNet project related to ICT infrastructure in EwketLefere secondary school?

“Accessories and spare parts can’t be obtained at the right time and condition. The three ICT labs are enough to the current number of our students.”

Q. What are the technical factors affecting schoolNet project related to ICT standard in EwketLefere secondary school?

“As a high school, there should be a minimum of four ICT labs. But according to our school, the three ICT labs are working for about 1000 students. It is possible to address the students effectively. For the schools with more than 2000 students four ICT labs are not enough to serve students. They don’t have structural problem and there is no quality problem on the ICT materials but the materials aren’t available that much. The installation was done on the classes prepared for schoolNet purpose.”

Q. What are the technical factors affecting schoolNet project related to ICT expert in EwketLefere secondary school?

“AAEB and china company expert come and launch the network and the line installation effectively and submitted the projects to school leaders. There is an ICT expert and plasma

expert in our school. But these experts aren't directly trained in manipulating the schoolNet program. But after the expert come their skill becomes improved and become subject wise. We get large screen size Fana television from AAEB to display the plasma education service."

Q. IS there any external factor affecting schoolNet project implementation in EwketLefere Secondary school? If exist can you mention?

"The first external influence is the breakdown of the electricity. The materials are damaged form power fluctuation. We try to have a generator but it is out of the school capacity. We don't have the budget to buy transformer."

"Let me tell you one incident indicating this challenge., to print one paper I took almost two hours when I edit and try to print the electricity become off after time being it will come and when I open my computer it will goes and take my time this much difficulties. The other problem is stealing of materials by communities since we don't have enough school guard to protect our property."

Q. How could these technical factors resolved to have successful implementation of the schoolNet project in EwketLefere secondary schools? Can you suggest the possible solutions to resolve the issues with respect to ICT infrastructure, ICT standard, ICT experts and ICT security?

"If there is the right expert in the field, the schoolNet service becomes stable. And those accessories or spare parts should be imported sufficiently."

Q. Which technical factor you consider more priority in managing of the schoolNet implementation?

"It is difficult to put the four technical factors in rank. If one exists, the others will also exist in it. It's difficult to say this is the first thing to be prioritized, all of them are very important. To our school context infrastructure should filled first. Secondly the standard should come. The ICT labs must be four. Thirdly, there should be well trained schoolNet expert. If ICT expert exist, security is the result of ICT expert. The expert's efficiency is based on their field. If we have well trained ICT experts, security issue will become definitely resolved."

Interview responds from Yemanebrhan secondary school vice principal (P4)

Yemanebrhan secondary school vice principal worked for about six years. He manages and follows up the teaching learning system in Yemanebrhan secondary school for six years.

Q. What looks schoolNet implementation process in Yemaneberhan secondary school?

“At the time of 2016/2017, the connection worked properly. There are four ICT laboratories. The four labs were functional. But now the server battery is damaged and the service is slow. Even as a bureau the network is very slow. Think of the connection on ICT labs how it works. So there is ICT laboratories and computers. But the server is damaged and the power fluctuation problem the service is not functional. To make schoolNet program successful, the maintenance service should be immediate and the programs should be updated. Up to last year, teachers used the schoolNet program effectively to teach using ICT resource in a class room in a good manner. To keep the learning system effective in case of the absence of teachers, the system should be functional and maintenance service should be given immediate. Secondly, there should be technical expert in the area of schoolNet program. Those experts in schools are not trained to manipulate the plasma service education and the ICT laboratories. Some of the expert comes from the electrical engineering. They don’t have the clue about the work. They come in order to have the job simply. Some of them have purely ICT knowledge but they don’t have a skill and knowledge about how was the schoolNet program launched and how it is implemented to maintain the schoolNet service”.

Q. What looks schoolNet implementation challenge in Yemaneberhan secondary school?

“SchoolNet program is not properly working in Yemanebrhan secondary school. The program worked properly up to 2017 but this year the schoolNet program doesn’t give service with different mechanism. In order to mention those challenges, we can look with four sections. The first thing is related with ICT infrastructure supply. The ICT materials become damaged due to power fluctuation especially the server is out of the service. The other is ICT materials are damaged and stolen especially the HDMI cables, set box and power cable. Secondly, we don’t have a schoolNet expert to run the plasma and the schoolNet program. Due to this schoolNet program is not well implemented.”

Q. What are the technical factors affecting schoolNet project related to ICT security in Yemaneberhan secondary school?

“We don’t have the ICT expert. ICT teachers work from their early knowledge. So, no ICT labs are protected well.”

Q. What are the technical factors affecting schoolNet project related to ICT standard in Yemaneberhan secondary school?

“In Yemanebrhan secondary school one computer is for two students. In one section, there are 40 students. So relatively, the standard is good. With four ICT labs, there are 80 computers for 160 students. In one section, the maximum number of student is 50. Almost we are reaching to the standard with the number of computers. In terms of the structure, the location matters. The learning rooms are there the labs are here. Students kill their time moving here and there. So it’s not convenient. Secondly, rooms by themselves are not built for ICT lab purpose. The rooms are dark. There are no materials like LCD and projector. So in terms of the standard, there are so many drawbacks on the ICT implementation. The other problem is the network installation is over the wall of the class room. That’s wall to wall. It’s exposed for many things. There will be cable breakdown, stealing of materials. When we compare the installation of the connective materials under the wall and over the wall, it has the design and the structure issues.”

Q. which technical factor takes more priority for the successful implementation of the project in your school? Can you reorder the four technical factors based on the significance of your school?

“At first expert must exist. The class rooms were built, and the books exist but with the absence of teacher, teaching learning process becomes meaningless. The structure is there, the materials also there. These conditions require a little work or modification to make the system stable. But in a school, the responsible technical expert doesn’t exist. If there is a technical expert in SchoolNet, the expert can fill the security aspect because he has the knowledge in addition through process he can fill the gap on the structure and design problems then security will be resolved follows the structure or the standard finally the infrastructure since we have the infrastructure. The first an expert trained in ICT and there should be to identify what things to be required from ICT, secondly an expert trained on plasma service and schoolNet program and if it is linked with the updated maintenance service, the schoolNet program will be important to our

country, students and teachers. But now the above conditions are not fulfilled and we are not effective in schoolNet program. If we aren't being effective, we have to plan and work on this condition. In fact, we can't satisfy on school capacity since it requires budget and an expert. If the expert comes on the side of government, the schoolNet program will become successful. In addition, the accessories and other infrastructure should be fulfilled.”

Q. What should be the possible measure to make successful implementation of schoolNet project?

“As a school vice principals and ICT teachers are taking the responsibility on the system. For example, the structural problem is visible. Daily there is infrastructure usage and knowledge flow on the ICT Service. We have to keep the ICT infrastructures and the knowledge flow. For the future the MoE and AAEB should give attention to the program. There should be a schoolNet expert that is well trained and skilled in a school. If it is possible, it requires a lot of capacity and resource in cost. The structure and design should be again revised especially for the network installation the accessories for maintenance should be stored sufficiently. If these conditions fulfilled, both the materials for maintenance and the right schoolNet expert meet, system become effective. But if we go as a previous work practice, the existing ICT infrastructure or the system will be lost or damaged.”

Interview respond of Kolfe-Keranyo sub-city SchoolNet program officer (E2)

The respondent of Kolfe-Keranyo sub-city SchoolNet program officer (E2) was asked about the schoolNet implementation process and the technical Challenges facing implementation of the schoolNet in Kolfe-Keranyo secondary schools. He described as follows.

“In Kolfe-Keranyo sub-city there are eight secondary and preparatory schools three of them are up to preparatory level which includes grade 11 and grade 12. In some how the implementation process takes place in all, but there are some challenges in some of the schools regarding the implementations to the status of the school. The first challenge is the leadership problem that is the capacity of the principals to implement the project. Secondly, the problem related with lack of skill. There are persons who don't know how to implement and use the schoolNet. It is as a result of lack of training. But institutions with good skilled expertise and adequate training for the employees have a better knowledge. Thirdly incase of the overturn of the expertise, teachers

can't manipulate the schoolNet system. They don't have the knowledge in updating and monitoring the system. There is no adequate human resource other than the technical expertise in monitoring the project. The main challenge is for instance if there were 50 sections in schoolNet and if there is a plan to have additional section, these new sections can't easily get the schoolNet system. It can't be resolved on the capacity of the school. Such problem might be beyond the school level or above the capacity of AAEB. On usage of the electric power service, a fuse for fifty sections then for additional hundred sections will result damage of the ICT equipments. Breakdown of eclectic power, lack of well trained expertise, lack of the infrastructure and accessories and the type of the plasma TV used are some of the challenges related with the schoolNet service.”

Interview respond Ayertena secondary and preparatory school ICT technician (T1)

Ayertena ICT technician is graduated in computer engineering and works as a plasma technician for three years. He explained the challenges on ICT implementation as:

“The schoolNet doesn't work properly in our school. The reason is mostly the Sep top box material which is used to make remote access of the plasma program and thick clients on the ICT labs are stolen by the students. There is no access on local market. The system by itself has problem. The school server is monitored by the Huawei Company. So we don't have any privilege to run the system. We are normally serving as a guard for the server. So it's difficult to manage such problems. The thick-clients are mostly out of the cloud system. To solve this issue there must be a report for an expert of AAEB or the Huawei Company. For this, the system becomes paused for a week or two weeks. Mostly when students used USB flash, the thick client becomes out of the cloud due to attack of virus. When students changed their IP address the thick-client easily out from the cloud. Every time 5 up to 7 thick-clients becomes out of the cloud system. On one computer, up to four students placed and are difficult to adjust these thick-clients.”

The plasma technician (T1) was also asked about the technical factors affecting schoolNet project related to ICT infrastructure in Ayertena secondary and preparatory school. He described the challenges as follows.

“The materials aren’t easily accessed. The company doesn’t have a stock for the accessories. We don’t access the materials everywhere. When the equipments damaged or stolen, we report to education bureau and the materials become, searched if exist then we access. So, the accessories aren’t easily obtained and it is difficult to maintain the system. The projectors are now slow and the thick-clients are most of the time stacked, and the sep top boxes become failed from time of their service. So there is no supply of these materials. They might change one or two things but they don’t have the access to change overall. The contract of the project doesn’t terminate. So, we don’t know the reason beyond this.”

The plasma technician also described the technical factors affecting schoolNet project related to ICT standard in Ayertena secondary and preparatory school as follows.

“Mostly the installation is good. For instance, the ICT labs are located on the good place. But there is a problem on the installation of plasma switches are on the classroom and they are exposed to damage. The switches are on the walls of the classroom and UPS and other materials are taken by the students. The switch boxes are sliding on their sides and are not locked. As the initial stage, there are enough infrastructures. But now most of them were damaged. There is no extension of the project on the new learning buildings. The building is built after the installation of the system on the old buildings. After the new buildings built, we asked many times to launch the system. The installation is done after calling a bid. It can’t be given the bid for one company. We have to wait until other companies participate on the bid; the bid system takes lot time to finish the project. Due to this reason, there is a problem on network infrastructure and there is no schoolNet service on the new buildings.”

The plasma technician also described the challenges in using school generator in case of power breaking as follows.

“There is too much power fluctuation. We can’t use the generator due to power fluctuation. The electric power is between 150 up to 180 volts, the generator works all time and it doesn’t sense the power since it is under the capacity of the generator and the generator consider the power as off situation. Due to this many materials become burned.”

The plasma technician described that the network problem is due to lack of provisional support from AAEB. He mentioned the problem with from his practice and experience as follows

“I think the network problem is the result of lack of technical support from AAEB, I can’t assume of the problem of the telecom. Most of the time, they don’t even configure and update the server. For example when the system off, I ping the network and looked on the other computer, the network exist. So the problem is not the telecom. I think the education bureau have lack of the expert.”

The thick-clients are working virtually from the server. They allocate the hard disk from the server virtually. The existing hard disk is enough for students work on lab. But sometimes this hard disk becomes burned or damaged. On our server three hard disks are burned. This can’t be resolved on time by the AAEB. They don’t have sufficient hard disk.

Q. What are the technical aspects related with ICT security?

“There is no data to be loaded on the server. Since we don’t use database to store data’s on the system there is no much problem on the security aspect. But the password is governed by few peoples so the system can be easily hacked.”

Q. What is the technical challenge related with ICT experts?

“After the launching of the schoolNet project, the electrical engineers are assigned to manipulate the system. These experts don’t have advanced training and they don’t have privilege to password of the server. They are paid below the degree payment. Normally they are working as a school guard. They are not the right expert to manipulate the system. These persons don’t support the system.”

Q. What are the possible measures for successful implementation?

“The person on the position should be given advanced training and in addition, it is possible to make the school to create its database and to use online service. The first problem is Huawie Company doesn’t submit its contract to the education bureau and the work is not at the completed. The education bureau should deliver the project and the right technical person should be assigned to manage the system for better service in school.”

Q. Which technical factor could be more prioritized based on the level of the significance of the school stage?

“At first, there should be access to spare parts then after good expert, if expert exist security comes finally if this conditions meet the standard comes. The standard can’t come at once.”

Interview respond with ICT expert at AAEB (E3)

The expert from AAEB work in at the Network made a discussion on the technical factors affecting the schoolNet project implementation. The expert described the technical factors related with ICT infrastructure as follows

“Some of the materials like UPS, power cable, HDMI cable might be stolen and those lost accessories cannot easily obtain locally. The main challenge comes from project scalability. For instance, if there were fifty sections in schoolNet and if there is a plan to have additional section, these new sections can’t easily get the schoolNet system. It can’t be resolved on the capacity of the school. Such problem might be beyond the school level or above the capacity of AAEB. On usage of the electric power service, a fuse for fifty sections then for additional hundred sections will result damage of the ICT equipments. Breakdown of electric power, lack of the infrastructure and accessories and the type of the plasma TV used are some of the challenges related with the infrastructure service.”

The expert was asked on the technical factors challenges affecting schoolNet project in secondary schools. She told about the skill gap with leadership and explained as follows:

“The first challenge is the leadership problem that is the capacity of the principals to implement the project. Secondly, the problem related with lack of skill. There are persons who don’t know how to implement and use the schoolNet. It is as a result of lack of training. But institutions with good skilled expertise and adequate training for the employees have a better knowledge. Thirdly incase of the overturn of the expertise, teachers can’t manipulate the schoolNet system. They don’t have the knowledge in updating and monitoring the system. There is no adequate human resource other than the technical expertise in monitoring the project”.

Q. What are the factors related with ICT security?

“ICT technicians will follow every security task of ICT works. Bringing ICT security without ICT expert is impossible. We follow up each data center of schools from here. We identify which data center works and which don’t.”

Q. what are the factors related with ICT expert?

“There is no ICT expert in each school. There is only plasma technician in each school. Due to this, the problems aren’t solved immediately. The ICT materials should be managed every time. The technical errors and problems can be easily identified by the expert. There are few experts on education bureau. It is difficult to take the responsibility. There should be a person accountable and responsible for the ICT works on schools.”

Q. What are the factors related with ICT standard?

“The datacenter is set with design starting from the ground. There is a datacenter in each school and it’s accessible for each class properly. The network infrastructure and the structure is safe for all the service. We use fiber cable for the network and the network bandwidth exceed above 80 gigahertz. There are two connection services on the schoolNet. There is LAN and internet in each school. The education is broadcasted through LAN service. Using switch from the datacenter will be reachable for each class. There is no problem of bandwidth on LAN. We have a plan to take additional bandwidth to provide for schools as education bureau support.”

Interview respond with ICT expert at AAEB (E4)

The AAEB ICT (E4) expert also responds on the technical issues related with ICT Infrastructure. The expert described about the issues relating with infrastructure as follows.

“There is no problem on the network infrastructure. Mostly there is utilization problem and knowledge skill gap. The ICT materials are damaged with electric power fluctuation. The UPS doesn’t function for long period of time. Most of the materials like UPS and set-top box are easily stolen since there is no responsible and accountable person for ICT materials. In one class, students learn on set-top box and on the other class students learn with absence of set-top box. This will make a difference among students”.

The AAEB ICT expert (E4) was asked to express the technical challenges related with ICT expert in implementation of the schoolNet service and he described as follows.

“There is lack of experts in each school to implement the project effectively. At first, there was training in plasma service. The payment for the technicians made the experts unmotivated to

work. They felt that due to low payment of their work the community gives low estimation considering like guard of school. Mostly they don't have interest on their work".

The expert described the technical factors related with ICT standard as

"Even though the standard is not meet at once, there is problem on using the existed materials properly. The big problem of this project is at first there is no creation of awareness about the technology among users. Lack of the electric power make inconvenient to use the infrastructure properly. This will result negative influence standard".

The expert described the technical factors related with ICT security as follows

"There is no the right person to take responsibility and accountability of the ICT materials. So there is loss and damage of the equipments. The materials are not protected and most of the software is outdated and secured".

Interview responds of CEICT technical expert (C1)

In the schoolNet program, it is expected that Center for Educational Information and Communication Technology is the key implementing organization of the program. It is responsible for designing, preparing and extension of schoolNet programs throughout the country. The respondent was asked on strategies planed to have more trained ICT expert in schools. He described as

"There is lack of skilled personnel in ICT domain to handle large scale implementation of schoolNet service. There was training for ICT technical staffs in each school every summer on managing of plasma service, server and network installation. But the expert on the technical staffs on school have poor background on the networking and system maintenance some of the problems on the schoolNet services are not easily managed at individual capacity. It requires evaluation of system and finding a solution in a technical team."

He also described the vision of CEICT with regard to schoolNet implementation

"Our center has a plan in giving training of the technical staff of every school, there is also a plan to an evaluation of the schoolNet process and there is a plan to make audit analysis of the

schoolNet project implementation in Addis Ababa secondary schools. This will make a better function and utilization of the service”

The researcher also asked the future plan of the CEICT management to avoid the technical problem affecting the implementation of schoolNet project. The expert responds as follows:

“There is a plan to provide advance training in network management, server management, and system repair for ICT professionals at city level and for ICT staffs of AAEB.”

The expert also expressed the factors that affect ICT integration in schools as follows:

“There is low estimation for ICT use and not giving enough time for ICT development by teachers that is low perception towards usage of ICT by school management and teachers are the barriers of ICT integration in most of the secondary schools .”

Q. What is your opinion about the technical factors which affect the implementation of the SchoolNet projects?

“In my perception the challenge comes from two things. One is low ICT infrastructure of schoolNet in schools and lack of a skilled technical expert for ICT implementation”

Q. Can you mention the major types of ICT security problems you faced on the implementation of SchoolNet project experienced?

“There is no that much issues on ICT security in Schools but stealing of ICT infrastructures like UPS, set top box, HDMI cables are the major challenge on the implementation of the project.”

Q. Which factor of the following technical factors has applied the most challenges to your organization? Could you explain why?

“There is lack of skilled personnel in ICT domain to handle large scale implementation of schoolNet service. On the implementation of the project ,...the very important one is the there should be a right skilled professionals in any project,...but school leaders report that they have a problem on getting the right skilled ICT experts in managing the schoolNet service and next thing is lack of the infrastructure and accessories. The infrastructure is not proportional to the need of the students and teachers. Most of the schools department don't have basic ICT

infrastructure. Thirdly, there is no clear ICT policy and standards. Most of the schools worked under the baseline of the ICT standards. Finally, we can put security aspects to the last stage. This can be handle by existence of the ICT expert or technician. Of course the infrastructure will be the first, second will be the expertise, third will be the security, and finally is ICT standards”.

4.4.2. Data from Researchers' Observation

The researchers’ observation revealed that most of the problem on schoolNet implementation drives from the four technical factors and which comes from using low grade network materials; lack of expertise of ICT resources; students don't access their educational content periodically due to electricity problems and network breakdown; there is no skilled ICT expert to maintain the system; computers are not secured, they are infected with virus, malware and junk files and the dust on computers not cleaned ; useful software's are not purchased due to financial issue; it's not possible to access information within schools via internet. There is no school to school connection and school to districts; lack of fund rising activity by schools to sustain the project; Scalability and performance issues; schoolNet service doesn’t exist on new built classrooms and takes more time to have contract with vendors for new installation; Wi-Fi is not reachable everywhere within schools for students and teachers to access educational information, the service is restricted on teacher’s cafeteria; most schools don't have their own portal websites.

The researcher observed that only few computers are used by teacher in ICT lab to teach students. Most of the computers don’t work. In most ICT labratories there were only three computers used by 20 students.

4.5. DISCUSSION

4.5.1. What are the main technical challenges affecting SchoolNet project implementations in Kolfe-Keranyo Sub-city secondary schools in A.A City Administration?

The main technical factors which affect the implementation of the schoolNet project among four schools in kolfe-Keranyo sub-city were explained. The major technical factors affecting schoolNet project implementation were discussed in relation with ICT infrastructure, ICT experts, ICT standards and ICT security as follows.

4.5.1.1. Technical factors related with ICT infrastructure:

Misnikov (2003) and Alshehry (2008) emphasized that the ICT infrastructure should be the main concern for the e-service and based on the IBM (2001), the ICT infrastructure for an e-service involves technologies - with network readiness at the beginning - including application servers, hardware resources, software, operating systems ,Internet, websites and data centre.

The infrastructure-related factors were the most important factor to cause failure of the schoolNet project implementation. This was mainly due to the factors lack of the ICT resources and network infrastructure issues.

There were many problems faced by schools regarding the implementing ICT in schools (hardware and software). Insufficient number of computers; damage of ICT materials due to power fluctuation; insufficient of computers with simultaneous access to the Internet and outdated or lack of school network or LAN were seen as major obstacles affecting the realization of the computer-related problems of the schools. In addition, the most frequently mentioned obstacles by schools principals and coordinators were limited software in schools with not enough copies and types of software for instructional purposes (Hinostroza *et al.*, 2003; Pelgrum& Anderson, 2001; and Howie *el at.*, 2005).

Based on the findings from school directors through interview, one of the main challenges hinders the effective implementation of plasma education is frequent power interruption. Not only that, but among the 4 schools covered in this study, it is only two Secondary School that have generator as a power back up. However, directors of these schools reported that generators

of the two schools are not functioning with their full capacity. The power backup in one of the schools is old and it doesn't operate automatically when the power returns. The generator in one of secondary schools is not functioning due to lack of budget for purchase and supply of gas. The existing poor technological infrastructure (e.g. consistent power failures) during transmission is one of the drawbacks that make the policy goals unachievable as reported by policy implementers.

There is lack of spare parts supply and immediate response from the Addis Ababa Education Bureau. Participants reported that due to lack of supply, even for minor spare parts such as cables, UPS, set top box several plasma TVs are stored without service. In one school due to class expansion they can't get a power from the electric power supply institution (Ethiopian Electric Utility) for one year. Still there is no improvement at this point.

Interviewee described that Most of the secondary schools don't have good network infrastructure, lack of physical infrastructures like computer furniture and there is also a problem with accessing of accessories for damaged and lost ICT infrastructures.

4.5.1.2. Technical factors related with ICT standard

Standards have been described as conformity of system elements that would help software and hardware within the system to build up new services differently from each other. However, they should be appropriate and well-matched in with each other (Keen, 1991; Weerakkodyet *al.*, 2011). In addition, ICT standards have been defined by Freeman as —specification for hardware and software that are either widely used and accepted or sanctioned by a standard organization (Blind, 2010).

Several researchers and authors have argued that lack of physical educational facilities, like buildings, is the major hindrance to implementation of ICT in schools in Africa, (Hennessy et al., 2010). ICTs do require supporting physical infrastructure to be in place before they can be implemented. The researcher discussed with the interviewees on the technical issues affecting schools standard affecting schoolNet project implementation.

Regarding with ICT standard, existence of adequate ICT infrastructure in school and existence of a skilled ICT expert will create the standard. Using one computer for one student shows students

learn at the standard level. The materials are new. New technology is installed but the big problem is the number of the students and the number of the infrastructure is not proportional. This shows the lack of standard.

4.5.1.3. Technical factors related with ICT expert

On the interviews, the researcher discussed the technical issues on technical expertise with the interviewees and the level of importance it has in managing of the technical factors. The researcher discussed with the AAEB ICT head on the ICT expert's problem.

The other challenge in place is unsuitable staff allocation at the ICT department of the Addis Ababa Education Bureau (AAEB). Respondents said that during the policy formulation the task at the educational bureau were underestimated; as a result few staff members (12) are allocated to provide support for all secondary schools in Addis Ababa secondary schools.

4.5.1.4. Technical factors related with ICT security

Some of the respondents stressed that ICT teachers should get training to develop the skills in keeping the plasma service education and ICT lab rooms functional for teaching. This can be done on the capacity of schools by inviting professionals to train on ICT security aspect and preparing training manuals for teachers to develop their skill.

Lesson learned:

- Interviewee reported that the schoolNet implementation did not include school context, especially related to development of skilled expert and technical assistance. This perception was further amplified as school ICT technical staff had limited experience in system maintenance, and interviewer noted that available ICT resources, such as accessories, were largely ineffective.
- Successful schoolNet implementation needs strong leadership from a managing partner that accepts leadership responsibilities, understands its strengths and limitations, is able to evaluate and prioritize with a lens on teaching and learning, addresses staffing gaps, and leverages key partners to fill areas of need (Sosenko, L., Mesecar, D., 2014).

- From interviewee respond the researcher understand that there is a new insight and evidence that to the question regarding on lack of technical expert which can be answered by the schools capacity.

4.5.2. Which technical factors more critical in the successful implementation of SchoolNet project?

In this section the researcher put the degree of the technical factors affecting, the schoolNet project implementations based the interviewee respond. Every school has its own priorities in term of challenges. Experts' discussion suggested that the one which is more critical factor for a school may be less significance for other school.

As can be seen from discussion, most of the interviewee put the ICT security is third level of importance in their management of technical factors. ICT infrastructure, IT standards and IT expertise are more likely to influence the schoolNet implementation process.

Interviewee discussion reveals that ICT infrastructure and ICT experts have a great role in implementation of the project. They are inseparable in any project. All school vice principals interview revealed that there is lack of expert in most of the secondary schools. If there is the right expert, security of the project will be maintained and finally the standard becomes deserved.

4.6. Chapter Summary

In the chapter, the data gathered from the participant of this study was presented and assessed on the technical factors affecting the schoolNet project implementation among four schools, and the technical expert of Kolfe-Keranyo sub city, and AAEB ICT administrator. The data analyses and findings from this research discussed. The gaps and challenges for in implementation of the schoolNet project and the level of importance of the technical factors from the ICT infrastructure, ICT standard, ICT security and ICT expertise based on the schools context also identified. The next chapter will present summery of key findings, conclusion, recommendation .limitation and future work of this research.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

This is the last chapter of this study. It has been tried to present the comprehensive conclusion or major finding of the research and recommendations derived from the data discussion.

5.2. Summary of Key Findings

The purpose of the study was to investigate and propose the solution for the technical factors affecting SchoolNet project Implementation in Kolfe-Keranyo sub-city in Addis Ababa city administration. The overall objective of this study was to identify the technical issues that affect the successful implementation of SchoolNet projects in Kolfe-Keranyo Sub-city secondary schools in Addis Ababa city administration. It was expected that the implementation of Schoolnet would influence teachers' instructional practices in ways that could, in turn, improve educational outcomes for students.

The researcher concludes from interviewer respond that there are also external challenges on schoolNet project implementations in secondary schools. The major challenge is utilization and awareness of technology of the community including the leadership. There is lack of creation on the citizens' awareness about adoption of information communication technologies and lack of responsiveness or accountability on the implementation of the project.

The researcher made conclusion on the possible measures to overcome the technical factors affecting the schoolNet project implementation. In order to have efficient and effective result in education service, one of ICTs activities, such as SchoolNet implementation shall be managed in accordance with acceptable theories and practices. Conducting research on SchoolNet practices to evaluate its effectiveness and identifying the major reasons that adversely affect its success may help e-service officials particularly Ethiopian ICT Development Agency and Ministry of Education:-To bring improvements in overall School Net activities, to generate knowledge in respect with underutilization of resources and a means to get rid-off, to provide different techniques in manipulation of SchoolNet requirements with best level of competency, to create

the prospective of successful implementation and getting away from the problem of mismanagement and underutilization of resources.

From the interview discussion principals confirmed that loss of accessories, lack of physical infrastructure like ICT furniture's; printers are some of the challenges related with ICT infrastructure in secondary schools. Similarly, all of the respondents indicate there is no right skilled ICT expert in secondary schools. All interviewee argued that technical problems related with ICT infrastructure affecting the implementation of schoolNet drives from both physical infrastructure and network infrastructure.

Experts argued that most secondary schools don't meet schools ICT standard due to infrastructure issue and lack of ICT expert at national level. Experts also argued lack of accountability, low awareness of the community on ICT service, technology frustration, less technical support, lack of clear guidelines & policy and lack of responsiveness are the major issues on the implementation of the schoolNet project in secondary schools.

All the participants regarded the absence of maintenance and technical assistance as a hindrance for sustainable operation of the SchoolNet in the study setting. This is because there is no skilled person on schoolNet project activities in schools, which has a direct impact on teachers' work due to constant fear of technical breakdowns or failures. Kozma (2008) stated that teachers will have no interest in using ICT if they feel they will face technical problems that require a long time to fix (Jones, 2004). Ensminger (2004) stressed the significance of full time technical support to aid in the process of ICT incorporation. Furthermore, management leadership is crucial in building the ICT infrastructure through finding necessary resources, determining technological structures, and establishing partnerships with other educational institutions (Stensaker et al, 2007).

The researchers' observation revealed that most of the problem on schoolNet implementation drives from the four technical factors and which comes from using low grade network materials; lack of expertise of ICT resources; students don't access their educational content periodically due to electricity problems and network breakdown; there is no skilled ICT expert to maintain the system; computers are not secured, they are infected with virus, malware and junk files and the dust on computers not cleaned ; useful software's are not purchased due to financial issue; it's

not possible to access information within schools via internet. There is no school to school connection and school to districts; lack of fund rising activity by schools to sustain the project; Scalability and performance issues; schoolNet service doesn't exist on new built classrooms and takes more time to have contract with vendors for new installation; Wi-Fi is not reachable everywhere within schools for students and teachers to access educational information, the service is restricted on teacher's cafeteria; most schools don't have their own portal websites. Due to this, it's impossible to access and control students and teachers activity. Parents enables the system to follow up their students how they learn which subject learnt and which subject don't learn, what results achieved in each subject generally it is very significance to know the academic and behavioral change of their students. This will result poor strategic decision for administrators and government officials to set policy.

5.3. CONCLUSION

In this thesis the researcher, conclude that in order to have a successful schoolNet project implementation the government must understand the importance of different factors affecting the schoolNet project implementation in order to avoid the failure of schoolNet services in their current schoolNet project or future projects. To know the major key factors will lead to a successful schoolNet implementation.

The main objective of this research was to identify the technical factor affecting the implementation of the schoolNet project in Addis Ababa at Kolfe-Keranyo secondary schools. Those technical factors in terms of the infrastructure, standard, security and technical expert were studied in this research. The four technical factors are also arranged based on the level of the importance the school context.

Based on our research questions in section 1.3, in this chapter the researcher aim to answer those questions as concluded from previous chapters:

❖ **What are the main technical challenges affecting SchoolNet project implementations in Addis Ababa secondary schools?**

This study has identified four main technical factors affecting the schoolNet project implementation which are collected from different publications and validate them throughout the

studied cases. The major sources of our technical factors on the implementation of the schoolNet project are lack of ICT infrastructure, technical problems related with ICT security& ICT standard and lack of skilled ICT expertise in schools.

The external factors influencing on the implementation of the schoolNet project are

- Lack of accountability and responsiveness
- Lack of fund raising activities for the project
- Citizens awareness
- Over enrollment of the students in a school result shortage of ICT resources and other learning materials

Those factors have been studied in a real case to ascertain their role in the adoption process of schoolNet project. The study revealed that adequate physical and technological infrastructures are necessary conditions for effective schoolNet project implementation. The study has shown that those factors are affecting the current schoolNet project in Addis Ababa secondary schools were influenced by those four technical factors, in addition to the two non-technical factors, but with a different impact order.

❖ Which technical factors are more critical in the successful implementation of SchoolNet project?

All the factors were important but each one has a different level of significance which depends on its impact on the offering of schoolNet service and the need to solve the complexity of that factor. Therefore, the researcher found different views for each of the factors which depend on the school context and the quality of the school leadership. In general, ICT expert received the first level of significance in three secondary schools which means it is the most important factor that needs to be considered in order to improve its schoolNet service. Then ICT Infrastructure is the second factor of importance in managing schoolNet service as seven out of ten interviewee said it is level two of importance, or higher. The third factor is ICT security, which got level three in importance in four secondary schools. However from interviewees' opinions we cannot say the fourth factor is ICT Standards because it got equal balance between different projects, three of the managers said it was level three and three said it was level four,

therefore this factor could be similar in importance as ICT security, or less, so it is in level three or four.

According to Lee (2004) the implementation of any project should go into phases for it to be successful. Before implementation there is a need to have all the resources available needed to implement it available i.e. human resource and equipment together with training materials like books, computers, overhead projectors, etc. The researcher concludes that ICT infrastructure and ICT experts have a great role in implementation of the project. They are inseparable in any project. There is a lack of expert in most of the secondary schools. If there is the right expert, security of the project will be maintained and finally the standard becomes deserved. From interviewees' discussion the researcher concludes the schoolNet project implementation could also be affected by external pressures like internet facility in the country, government regulations and citizens' awareness about utilization of ICT resources.

5.4. Limitation of the Study

In this study, the researcher limited his study to one of the ten sub cities in Addis Ababa city. Kolfe-keranyo sub city was chosen due to limited time and financial resources in which to carry out the research. The population of study is made up of school vice principals, AAEB ICT technical staffs, school plasma technician, sub city ICT expert and an expert from CEICT. This study will be complete if the information from project vendor involved. But due to non termination of the project by the contractor, responsible person on the vendor side are not volunteer to give information for the research and the study doesn't look all schools due to time and budget constraints.

Interviews respond and researchers' observation revealed that there is a similar view in terms of the technical factors related with implementation of schoolNet project and there is a different view on prioritizing significant of the technical factors which are dependent on the school context. This made a limitation on the formation of the prioritization of those technical factors. This made it difficult to justify the result due to limited number of interviewee for data triangulation.

5.5. RECOMMENDATION

Based on the research findings and conclusions drawn, the following recommendations have been forwarded to Education policy makers and other concerned stakeholders to give attention and consideration for successful implementation of schoolNet project.

- School principals must work together with ICT technician and AAEB ICT technical experts so as creation of better schoolNet service in school.
- There should be continuous follow up of the project starting from installation of the infrastructure to provisional technical support. This is achieved by properly integration of the ICT resource, right skilled technical expert.
- Immediate technical service should be provided by regional technicians when schoolNet service has a trouble.
- Training should be given properly to ICT teachers and technical experts to manipulate the schoolNet, the project leaders should also give orientation for everyone about awareness and the controlling system mechanism of the project.
- Every stakeholder should take share or responsibility to resolve the problem. For instance, in case of power supply electric power agent should work evenly to reach the power service for all schools. ETC should provide sufficient bandwidth network connection for running the schoolNet program.
- There should be designed Schoolnet Instructional Management guidelines to help ICT staffs at all levels to improve student achievement and create program coherence around curriculum, instruction, assessment, and reporting.
- Each stakeholder should take share or responsibility to solve problem. For instance, in case of power supply electric power agent should work evenly to reach the power service for all schools. ETC should provide sufficient bandwidth network connection for running the schoolNet program.
- Accessories for maintenance must be available in stock sufficiently. Adequate spare part should be kept in all schools or enough budgets must be allocated for spare parts purchase at school level.

- To successfully implement schoolNet in schools, access to good quality electricity is a primordial provision. Each secondary school should be equipped with basic infrastructure such as regular electricity and generator
- There must be well skilled and trained in schoolNet services. Secondly, equipping school with relevant infrastructure like building, retrofitting physical facilities, purchases of hardware and software and the like must be considered. Thirdly, professional development of teachers through in-service courses should be well planned. Lastly, school leaders should have interest, committed and champion the implementation. To achieve this, the government should partner with private sector and other stakeholders in the process of implementing schoolNet project in schools. Further, the Ministry of Education has been conducting in-service courses to equip teachers and school leaders with necessary ICT skills.

5.6. FUTURE WORK

Though it is believed that this study has helped to fill some gaps, there are remaining areas that are yet unexplored or not fully understood. That is, it would be particularly important that future studies should investigate the impact of the schoolNet service on the quality of the education, satisfaction of the school communities on the schoolNet service, investigate the adoption of better schoolNet technologies for better service. Further studies can also be carried out to investigate the contribution and impact of the schoolNet service on pedagogies, social development and study the audit analysis of the project throughout the country.

REFERENCES

- Adam, L. (2008). '2007Ethiopia telecommunications sector performance review a supply side analysis of policy outcomes'. *Research ICT Africa Network*
- Aguyo, S. (2010). The Real cost of computer in schools. In Getao& Werner (Eds.), *Power upwith information Technology*. Archry Technology Management Ltd, Nairobi, Kenya.
- Al-Alwani, A. E. S. (2005). Barriers to integrating information technology in Saudi Arabia science education. Unpublished dissertation, University of Kansas
- Al-Harbi, H. (2014). Towards successful implementation of ICT in education. In *The 2014 WEI International Academic Conference Proceedings* (pp. 33-46).
- Al-Oteawi, S. M. (2002). The perceptions of administrators and teachers in utilizing information technology in instruction, administrative work, technology planning and staff development in Saudi Arabia. (Doctoral dissertation, Ohio University, 2002).
- Albirini, A. (2006). Teachers' attitudes toward information and communication technologies: the case of Syrian EFL teachers. *Computers & Education*, 47(4), 373-398. doi: DOI: 10.1016/j.compedu.2004.10.013
- Albugami, S. (2015). Towards Successful implementation of ICT in Saudi Schools. (literature review). University of Salford.
- Aljifri H, Navarro DS, (2003). International legal aspects of cryptography. *Computers & Security*; 22(3):196–203
- Almaghlouth, O. A. D. (2008). Saudi secondary school science teachers' perceptions of the use of ICT tools to support teaching and learning. Unpublished M.Ed thesis, University of Waikato. Retrieved from <http://researchcommons.waikato.ac.nz/handle/10289/2432>
- Alshehry, M., (2008). —Transformation towards e-government in Kingdom of Saudi Arabia: Technological and Organisational Perspectives, Academic, the School of Comuting, CCSR, De Montfort University
- Balanskat, A., Blamire, R., &Kefala, S. (2006). The ICT impact report: A review of studies of ICT impact on schools in Europe. Brussels: European SchoolNet
- Ballantyne, P. (2004). *Evaluation of Swedish support to SchoolNet Namibia*. Sida..Sida
- Bangkok, U. N. E. S. C. O. (2004). Schoolnet Toolkit. *Bangkok: UNESCO Bangkok*. Retrieved June, 15, 2005.

- Becta. (2004). A review of the research literature on barriers to the uptake of ICT by teachers. Coventry: British Educational Communications and Technology Agency
- Bigum C. (2000). Solutions in Search of Educational Problems: Speaking for Computers in Schools. [Electronic Version] *Educational Policy*, 12 (5), 586-596.
- Bingimlas, K. A. (2010). Evaluating the quality of science teachers' practices in ICT-supported learning and teaching environments in Saudi primary schools. (PhD, RMIT University, 2010)
- Bitew, G. D. (2008). Using "plasma TV" broadcasts in Ethiopian secondary schools: A brief survey. *Australasian Journal of Educational Technology*, 24(2), 150-167.
<http://www.ascilite.org.au/ajet/ajet24/bitew.html>
- Blind, K., Gauch, S., & Hawkins, R. (2010). How stakeholders view the impacts of international ICT standards. *Telecommunications Policy*, 34(3), 162-174.
- Borras, J. (2004). International Technical Standards for e-service, *Electronic Journal of e-government*, Vol. 2, Pp. 75-80.
- Canada's SchoolNet, www.SchoolNet.ca/home/e/whatis.asp
- Cassell, C., & Symon, G. (Eds.).(2004). *Essential guide to qualitative methods in organizational research*. Sage.
- Cohen, L., & Manion, L. (1989). *Research methods in Education*. Becknham; Croom Helm.
- Condie, R., & Munro, R. K. (2007). The impact of ICT in schools-a landscape review. Coventry UK: British Educational Communication and Technology Agency.
- Daly, J., Kellehear, A., Gliksman, M., & Daly, K. G. (1997). *The public health researcher: A methodological guide* (pp. 89-106). Melbourne: Oxford University Press.
- DeNardis, L. (2009). "Open Standards and Global Politics", *International Journal of Communications Law &Policy*, Issue 13.
- Dibbon, D. C. (2003). Creating a culture of innovation in Canadian schools. *Managing Global Transitions*, 1(1), 69.
- Diefenbach, T. (2009). Are case study more than sophisticated story telling?: methodological problems of qualitative empirical research mainly based on semi-structured interview. vol.43, no.6, pp.875.
- Durando, M. (2017). Driving innovation in education. How far we have come and where we are going. European SchoolNet, Brussels

- Durlak, J. A., & DuPre, E. P. (2008). Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. *American journal of community psychology*, 41(3-4), 327.
- Dwyer, D. C., Ringstaff, C., & Sandholtz, J. H. (1991). Changes in teachers' beliefs and practices in technology-rich classrooms. *Educational leadership*, 48(8), 45-52.
- Dzidonu, C. (2006). The National ICT for Development (ICT4D) Five Years Action Plan for Ethiopia [2006–2010]. *A United Nations Development Programme (UNDP) Initiative*.
- EICTDA (2004). ETHIOPIA - ICT assisted development project. Updated Project Information Document (PID)
- Elmarie K, Elme S, (2000). Information security management: An information security retrieval and awareness model for industry. *Computers & Security* 2008;27: 224-231
- Ensminger, D. C., Surry, D. W., Porter, B. E. & Wright, D. (2004). "Factors contributing to the successful implementation of technology innovations". *Educational Technology & Society*, vol.7, no.3, pp.61-72.
- Euting, T. & Weimert, B. (2009). Information security, In: Bullinger, H.-J.: *Technology guide: Principles, applications, trends*, Berlin: Springer, 2009, S.498-503
- Farrell, G. and Shafika, I (2007). Survey of ICT and education in Africa: A Summary Report, based on 53 country surveys. Washington, infoDev.<http://www.infodev.org/en/publication.353.html>.
- FDRE (2004). Development of education in Ethiopia. The Federal Democratic Republic of Ethiopia. A Report to the UNESCO Forty-Seventh Session of the International Conference on Education, 8-11 September 2004. Switzerland: Geneva.
- Freeman, P. A. (1997). Elements of effective computer science. *Computer*, (11), 47-48.
- Gagliardone, I. (2014). New media and the developmental state in Ethiopia. *African Affairs: Oxford Academic*. 113 (451), 279-299, 2014
- Ghauri, P., & Gronhaug, K. (1995). *Research methods in business studies: A practical guide*.
- Geisert, P. G., & Futrell, M. K. (2000). Teachers, computers, and curriculum: Microcomputers in the classroom 3rd Ed. Boston: Allyn and Bacon.
- Hare, H. (2007). Survey of ICT and Education in Africa: Ethiopia Country Report (ICT in Education in Ethiopia). www.infodev.org

- Hasselbring, T.S. (1986). History and status of computers in education. In C. Kinzer, R. Sherwood, & J. Bransford (Eds.), *Computer Strategies for Education: Foundations and Content Area Applications* (pp. 15-30). Columbus, OH: Charles E. Merrill Publishing Company.
- Hennessy, S., Onguko, B., Harrison, D., Ang'odi, E., Namalefe, S., Naseem, A., Wamakote, L. (2010). *Developing the use of Information and Communication Technology to enhance teaching and learning in east African schools: Review of the Literature*. Aga Khan University, Nairobi Kenya
- Hew, K., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research. *Educational Technology Research and Development*, 55(3), 223-252. doi: 10.1007/s11423-006-9022-5
- Hinostroza E., Hepp P., Cox C. & Guzman A., (2003). National Policies and Practices on ICT in Education: Chile. In Plomp, T., Anderson, R., Law, N. & Quale, A. *Cross national information and communication technology policies and practices in education*. Greenwich: Information Age.
- Howell, C., & Lundall, P. (2000). *Computers in schools. Education Policy Unit University of Western Cape and The International Development Research Centre, Cape Town*.
- Howie, Muller & Paterson (2005). *Information and Communication Technologies in South Africa Secondary Schools*. Cape Town: Human Science Research Council.
- Isaacs, S. (2000). *ICTs in African Schools: A Multi-Media Approach for Enhancing Learning and Teaching*. TechKnowLogia, January-March.
- James, T. (2004). *Information and communication technologies for development in Africa: networking institutions of learning-SchoolNet*; v. 3. IDRC, Ottawa, ON, CA.
- Jodi A. (1994). *A Pragmatic View of Thematic Analysis*
- Johnston, D. D., & VanderStoep, S. W. (2009). *Research methods for everyday life: Blending qualitative and quantitative approaches*. Jossey-Bass.
- Jones, C. (2004). Networks and learning: communities, practices and the metaphor of networks—a response. *ALT-J*, 12(2), 195-198.
- Kaimuri, M. (2010). *Factors hindering implementation of ICT syllabus in secondary schools Imenti sub-county, Kenya*.

- Kassa, F. (2012). *Assessment of the Effectiveness of ICTs for Development in Ethiopia* (Doctoral dissertation, st. Mary's University).
- Keen, P.G.W. (1991). *Shaping the Future: Business Design through Information Technology*, Harvard Business School Press, Cambridge, MA.
- Kent, T. W., &McNergney, R. F. (1999). *Will Technology Really Change Education? From Blackboard to Web*. Corwin Press, Inc., A Sage Publications Company, 2455 Teller Road, Thousand Oaks, CA 91320.
- Kinde, S. (2007).Internet in Ethiopia-Is Ethiopia Off-line or Wired to the Rim?.*Media Ethiopia*.
- Kinuthia, W. (2009). Educational development in Kenya and the role of ICT International Journal of Education and Development using ICT.
- Kipsoi, E. J., Chang'ach, J. K., & Sang, H. C. (2012). Challenges facing adoption of information communication technology (ICT) in educational management in schools in Kenya. *Journal of Sociological research*, 3(1), 18-28.
- Klein, K. J., & Knight, A. P. (2005). Innovation implementation: Overcoming the challenge. *Current directions in psychological science*, 14(5), 243-246.
- Korte, W. B., &Hüsing, T. (2006). Benchmarking access and use of ICT in European schools 2006: Results from Head Teacher and A Classroom Teacher Surveys in 27 European countries. *empirica*, 1, 0.
- KPMG Consulting LP (2000). Evaluation of the Canadian SchoolNet Initiative. (unpublished)
- KPMG Consulting LP (2010). Evaluation of the SchoolNet1 Initiative. Final report. (unpublished)
- Kvale, S., &Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research interviewing*. Sage.
- Lai, C, S, A, and Pires, G. (2010). Testing of a Model Evaluating e-service Portal Acceptance and Satisfaction, *The Electronic Journal Information Systems Evaluation* Volume 13 No.1.
- LeCompte, M. D., & Goetz, J. P. (1982).Problems of reliability and validity in ethnographic research. *Review of educational research*, 52(1), 31-60.
- Lee David S. (2004), *Trimming for Bounds on Treatment Effects with Missing Out-comes*, Center for Labor Economics working Paper No. 38, Berkeley, University of California.

- Lambiano, E. (2016). *Leadership challenges faced by school principals when implementing ICT-based curriculum and instructions in secondary schools in ElegeyoMarakwet County* (Doctoral dissertation, Kisii University).
- McClure, D. (2000). Electronic government: Federal initiatives are evolving rapidly but they face significant challenges. *Statement of David L. McClure, US General Accounting Office, before the Subcommittee on Government Management, Information and Technology, Committee on Government Reform, House of Representatives.*
- Mikre, F.(2011). The roles of information communication technology in education. *Ethiopian Journal of Education & science.* Vol. 6 No. 2
- Mingaine, L. (2013). Leadership Challenges in the Implementation of ICT in Public Secondary Schools, Kenya. *Journal of education and learning*, 2(1), 32-43.
- Misnikov, Y. (2003). How ICTs Can Serve Good Governance. *How Good Governance Can Sere E-government and How Regional Cooperation Can Serve Information Society,[w:]„Local government Brief, the quarterly journal of the local government and public services reform initiative”*, zima.
- MoE (2018). Education Statistics Annual Abstract 2009 E.C (2016/17 G.C) 2017-2018. A.A.
- Mooij, T. and Smeets, G. (2001): “Modeling and supporting ICT implementation in secondary schools”, *Computers & Education*.
- Myers, M. D., & Newman, M. (2007). The qualitative interview in IS research: Examining the craft. *Information and organization*, 17(1), 2-26.
- Nikkhahan *et al.*,(2009). E-government security: A honey net approach. *International Journal of Advanced Science and Technology*, Volume 5.
- Nyirongo, N. K. (2009). *Technology adoption and integration: A descriptive study of a higher education institution in a developing nation* (Doctoral dissertation, Virginia Tech).
- Pelgrum, W. J. & Anderson, R. E. (eds). (2001). *ICT and emerging paradigm for life long learning: A worldwide educational assessment of infrastructure, goals and practices.* Enschede, the Netherlands: IEA.
- Phiri, W., &Phiri, G. G. (2016). Factors affecting ICT Implementation in selected secondary schools in Chipata district. *International Journal of Multidisciplinary Research and Development*, 3(10), 161-175.

- Rattankhamfu, S. (2016). Building and Sustaining National ICT Education Agencies: Lessons from Thailand (Schoolnet Thailand).
- Rice, P. L., & Ezzy, D. (1999). *Qualitative research methods: A health focus* (Vol. 720). Victoria, Australia: Oxford.
- Robson, C. (2011). Real world research. John Wiley & sons Ltd.
- SchoolNet, Inc. (2005g). Services: Instructional management services. New York: Author.
- Scimeca, S., Dumitru, P., Durando, M., Gilleran, A., Joyce, A., & Vuorikari, R. (2009). European Schoolnet: Enabling School Networking. *European Journal of Education*, 44(4), 475-492.
- Seltiz, C. & Wrightsman, L. C. & Cook, W. S. (1976). Research methods in social relations. 3rd ed. New York: Holt Rinehart & Winston.
- Spradley, J. P. (1979). The ethnographic interview. New York: Holt, Rhinehart & Winston.
- Sosenko, L., Mesecar, D. (2014). Lessons Learned from Idaho's Instructional Improvement System: Executive Summary. The Institute for Evidence-Based Change.
- Srivastava, S. (2016). ICT implementation for Education and Learning. *Journal of Research & Method in Education (IOSR-JRME)*, 40-44.
- Stack, E. (2008). ICT in schools: Inspectorate evaluation studies.
- Stensaker, B. (2007). Quality as fashion: Exploring the translation of a management idea into higher education. In *Quality assurance in higher education* (pp. 99-118). Springer, Dordrecht.
- Stoneburner, G., Goguen, A., & Feringa, A. (2002). Risk management guide for information technology systems. *National Institute of Standards and Technology*
- Takeuchi, T. (2008). ICTs for development in Ethiopia. A Case of the SchoolNet Project
- Tangsathitkulchai, W., & Angchun, P. (2010). Can SchoolNet Bridge the Digital Divide in Education in Thailand? Perspectives from Policy Makers to End-users.
- Twining, P. (2002). ICT in Schools Estimating the level of investment. Report No: 02.01
- UNDP (2005) 'Implementation of LAN and Internet Connection in the UNDP-assisted Ethiopia SchoolNet Project'
- Weerakkody, V., El-Haddadeh, R., & Al-Shafi, S. (2011). Exploring the complexities of e-government implementation and diffusion in a developing country: Some lessons from the State of Qatar. *Journal of Enterprise Information Management*, 24(2), 172-196.

Yin, R. K. (2009). Case study research: Design and methods. Sage publications. *Thousand oaks*.

APPENDICES

Appendix 1:

Interview guide (for project office and principals and ICT Technicians)

The study is purely for academic research purpose required for partial fulfillment of MSC of Addis Ababa University (AAU). The main objective of the research is to investigate technical factors and indicate the possible measures in managing such technical factors that affects the implementation of SchoolNet project in Addis Ababa City Administration. Your frank and genuine responses to the questions are highly indispensable.

Therefore, indicating that you may not need to mention your name, and promising that all the information that is collected from you would be kept confidential and used only for the purpose of the study, the researcher hereby kindly request your cooperation for the same. I kindly request you to fill up this questionnaire and return to me at your earliest.

Thank you so much for giving this chance to conduct the interview with you, the researcher a student form AAU, The researcher conducting interview for master thesis and my topic is about the technical factors affecting the implementation of SchoolNet Project in Secondary schools. First of all I would like you to give me a background about this project, and tell when the initial start of it took place.

Yonas Aklog, 2019.

Phone :- +251-929191923

Interview method:

Time/Date:

Opening questions:

1. School name:.....

2. Title Name:

3. What is your working position? And since when you have been working in this ICT manager?

.....

4. Can you explain your major responsibilities in your job?

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.....

5. Have you been trained in ICT? What specific training did you receive? If not, how did you gain the skills?

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6. What strategies should be used to train more teachers?

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7. What is the vision of your school with regard to ICT implementation?

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8. How does the school leadership facilitate the ICT implementation process?

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.....

9. How involved is the school leadership? Does the school leadership suggest or prescribe to you the type of ICT for use in a classroom?

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.....

SchoolNet project implementation:

10. Could you please give me a background about the SchoolNet project in your organization and since when did the ministry of education adopt the SchoolNet project?

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.....

11. What's the future plan of the management to avoid the technical problem affecting the implementation of schoolNet project?

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12. What are the factors that affect ICT integration in schools?

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13. What is your opinion about the technical factors which affect the implementation of the SchoolNet projects?

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14. Can you mention the major types of ICT security problems you faced on the implementation of SchoolNet project experienced?

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15. Which factor of the following technical factors has applied the most challenges to your organization? Could you explain why?

- ICT Infrastructure (Internet, network, data center)
- IT security
- IT standards
- Technical expertise

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16. What about other factors do you think they are influence implementation of schoolNet program?

Can you reorder them from the most to the least important or the one which does not related?

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.....

17. Is there any technical factor that you would like to add to this list? How this factor influences the implementation of the SchoolNet project and how do you plan to manage it?

.....

.....

.....

The management of a factor:

18. What is your plan to manage the technical factor ICT infrastructure (Internet, network, data center)?

- Is the management of this factor affected by external pressures or limitations, e.g. public policies or the level of technical skills of the public; and so on? If yes, what are those external pressures?

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.....

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19. What is your plan to manage the technical factor IT security?

- Is the management of this factor affected by external pressures or limitations? What are they?

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20. What is your plan to manage the technical factor IT standards?

- Is the management of this factor affected by external pressures or limitations? What are they?

.....

.....

.....

21. What is your plan to manage the technical factor technical expertise?

Is the management of this factor affected by external pressures or limitations? What are they?

.....

.....
.....

22. What is your plan to manage the technical factor (additional factor if any)?

- Is the management of this factor affected by external pressures or limitations? If yes, could you explain more?

.....
.....
.....

23. What about SchoolNet project in Addis Ababa City in general, what is its' progress?

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.....
.....
.....

24. Of the four technical factors we have in this interview, we have infrastructure which consists of Internet, network and data-center. Another technical factor is IT security. A third one is IT standards and the final one is Technical expertise. Which one would you give the most important technical factor? Why?

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.....
.....

25. How would you integrate these technical factors and work to minimize the problem as a result of the implementation of the SchoolNet.

.....

.....

Closing questions:

26. Would you like to add anything more?

.....

.....

27. Could I use your name in this thesis?

28. Could I contact you for a follow-up questions and how I can contact you?

.....

.....

Thank you

Appendix 2

Interviewees respond on Technical factors related with ICT infrastructure

Participants	Technical problems related with ICT infrastructure
E1	There is a problem with network infrastructure. The main internet service provider is only provider ETC. We asked to have more than 162 Gigabytes broadband service but only 4 Gigabytes is released which is the bigger problem to scale up schoolNet service. Network breakdown, power issues are the main challenges in most of the schools; the ICT materials are easily burned and there is hard disk allocation problem since in one ICT lab, 20 computers are virtually connected with server of the school via switch. The other problem on our side is the materials are not accessible. We enforce the company to fulfill the materials efficiently. Otherwise, we plan to import those accessories or materials with investors or merchant.
E2	Some of the materials like UPS, power cable, HDMI cable might be stolen and those lost accessories cannot easily obtain locally. The main challenge comes from project scalability. For instance, if there were fifty sections in schoolNet and if there is a plan to have additional section, these new sections can't easily get the schoolNet system. It can't be resolved on the capacity of the school. Such problem might be beyond the school level or above the capacity of AAEB. On usage of the electric power service, a fuse for fifty sections then for additional hundred sections will result damage of the ICT equipments. Breakdown of electric power, lack of the infrastructure and accessories, the type of the plasma TV used are some of the challenges related with the infrastructure service.
E3	There is no problem on the network infrastructure. Mostly there is utilization problem and knowledge skill gap. The ICT materials are damaged with electric power fluctuation. The UPS doesn't function for long period of time. Most of the materials like UPS and set-top box are easily stolen since there is no responsible and accountable person for ICT materials. In one class, students learn on set-top box and on the other class students learn with absence of set-top box. This will make a difference among students.
E4	There are problems on the installation and stealing and improper use of materials. This is due to poor management of the materials.
P1	We have the room but we don't have the infrastructure to open additional ICT labs. We don't get ICT Infrastructure accessories at local market. Additional computers and accessories should be delivered to school for additional ICT lab rooms.

P2	Most of the materials didn't used for long period of time. They are damaged due to improper usage of the materials and power fluctuation. We have problem on network breakdown. One computer is used for more than three students.
P3	Accessories and spare parts can't be obtained at the right time and condition. This is because the materials are obtained from China Company. There exist breakdown of the network, lack of accessories or spare parts to maintain when it is stacked.
P4	The ICT materials become damaged due to power fluctuation especially the server is out of the service. The server battery is damaged and the service is slow The other is ICT materials are damaged and stolen especially the HDMI cables, set top box and power cable.
T1	The materials aren't easily accessed. The company doesn't have a stock for the accessories. We don't access the materials everywhere. When the equipments damaged or stolen, we report to education bureau and the materials become, searched if exist then we access. So, the accessories aren't easily obtained and it is difficult to maintain the system. The projectors are now slow and the thick-clients are most of the time stacked, and the Set-top boxes become failed from time of their service. So there is no supply of these materials. They might change one or two things but they don't have the access to change overall. The contract of the project doesn't terminate. So, we don't know the reason beyond this.

Appendix3:

Interviewees respond on Technical factors related with ICT security

Interviewees	Technical problems with ICT security
E1	VPN service is used; there is no problem with data center. If the bandwidth problem is resolved, data can be stored securely with VPN on desktop cloud sever system. So there is not much important to focus on IT security aspect.
E2	Some of the materials like UPS, power cable, HDMI cable might be stolen and those lost accessories cannot easily obtain locally.
E3	ICT technicians will follow every security task of ICT works. Bringing ICT security without ICT expert is impossible. We follow up each data center of schools from here. We identify which data center works and which don't.
E4	There is no the right person to take responsibility and accountability of the ICT materials. So there is loss and damage of the equipments. The materials are not protected and most of the software are outdated and secured.

P1	Regarding with ICT security problem, the ICT teachers should get training to develop the skills in keeping the plasma service education and ICT lab rooms functional for teaching. This can be done on the capacity of schools by inviting professionals to train on ICT security aspect and preparing training manuals for teachers to develop their skill.
P2	Some of the ICT equipments are stolen and damaged. Due to this, there should be responsible person for the ICT materials. But now we don't have.
P3	There is technology abuse. Student used most of their time by browsing restricted contents. Due to this, we restrict students not to upload unwanted contents on the desktop and not to bring their cell phone. Students used their cell phone to capture their gesture of teachers, access game and pornographic contents.
P4	We don't have an ICT expert. The ICT teachers work from their custom experience. No ICT labs were protected. The ICT security is tied with the ICT expert.
T1	Data's were loaded on the server. Since we don't use database to store data's on the system there is no much problem on the security aspect. But the password is governed by few peoples so the system can be easily hacked.
C1	There is no that much issues on ICT security in Schools but stealing of ICT infrastructures like UPS, set top box, HDMI cables are the major challenge on the implementation of the project.

Appendix4:

Interviewees respond on Technical factors related with ICT experts

Interviewer	Technical problems with ICT experts
E1	At least we provide training at summer. Some of teachers by themselves support their school. But few teachers made trouble on the system by changing password of the system.
E2	The first challenge is the leadership problem that is the capacity of the principals to implement the project. Secondly, the problem related with lack of skill. There are persons who don't know how to implement and use the schoolNet. It is as a result of lack of training. But institutions with good skilled expertise and adequate training for the employees have a better knowledge. Thirdly incase of the overturn of the expertise, teachers can't manipulate the schoolNet system. They don't have the knowledge in updating and monitoring the system. There is no adequate human resource other than the technical expertise in monitoring the project.

E3	There is no ICT expert in each school. There is only plasma technician in each school. Due to this, the problems aren't solved immediately. The ICT materials should be managed every time. The technical errors and problems can be easily identified by the expert. There are few experts on education bureau. It is difficult to take the responsibility. There should be a person accountable and responsible for the ICT works on schools.
E4	There is lack of experts in each school to implement the project effectively. At first there was training in plasma service. The payment for the technicians made the experts unmotivated to work. They felt that due to low payment of their work the community gives low estimation considering like guard of school. Mostly they don't have interest on their work.
P1	Regarding to technical expert, we can look in two categories. First thing ICT is assisted by teachers, ICT rooms has no ICT expert. Secondly, when come to plasma service we have the expert. We have the plasma and ICT technicians in our school. So, we don't have that much issue regarding on ICT expert. Just like plasma service, the ICT rooms need an expert. The teachers are manipulating the ICT rooms but if there is an ICT lab room expert, he can manage by protecting ICT equipments from dust and virus, updating and installing different software of teaching content by organizing and structuring the ICT lab rooms every time. But now such expert doesn't have a position to be employed in schools.
P2	The ICT expert works to resolve problems in collaboration with AAEB expert. There is no trained skilled person in schoolNet program. The expert is assigned just to cover the position. He doesn't have the right skill to maintain and deserve the system. He was graduated by electrical engineering.
P3	AAEB and china company expert come and launch the network and the line installation effectively and submitted the projects to school leaders. There is an ICT expert and plasma expert in our school. But these experts aren't directly trained in manipulating the schoolNet program. But after the expert come their skill becomes improved and become subject wise. We get large screen size Fana television from AAEB to display the plasma education service.
P4	There should be technical expert in the area of schoolNet program. Those experts in schools are not trained to manipulate the plasma service education and the ICT laboratories. Some of the expert comes from the electrical engineering. They don't have the clue about the work. They come in order to have the job simply. Some of them have purely ICT knowledge but they don't have a skill and knowledge about how was the schoolNet program launched and how it is implemented to maintain the schoolNet service.
T1	After the launching of the schoolNet project, the electrical engineers are assigned

	to manipulate the system. These experts don't have advanced training and they don't have privilege to password of the server. They are paid below the degree payment. Normally they are working as a school guard. They are not the right expert to manipulate the system. These persons don't support the system.
C1	There is lack of skilled personnel in ICT domain to handle large scale implementation of schoolNet service

Appendix5:

Interviewees Respond on Technical Factors Related with ICT Standard

Interviewer	Technical problems with ICT standards
E1	There is a problem with network bandwidth service. The main internet service provider is only provider ETC. We asked to have more than 162 Gigabytes broadband service to reach the standard but only 4 Gigabytes is released which is the bigger problem to scale up schoolNet service.
E2	The number of computers in each school is not proportioned with student's size. ICT labs aren't sufficiently enough to reach the standard.
E3	The datacenter is set with design starting from the ground. There is a datacenter in each school and it's accessible for each class properly. The network infrastructure and the structure is safe for all the service. We use fiber cable for the network and the network bandwidth exceed above 80 gigahertz. There are two connection services on the schoolNet. There is LAN and internet in each school. The education is broadcasted through LAN service. Using switch from the datacenter will be reachable for each class. There is no problem of bandwidth on LAN. We have a plan to take additional bandwidth to provide for schools as education bureau support.
E4	Even though the standard is not meet at once, there is problem on using the existed materials properly. The big problem of this project is at first there in no creation of awareness about the technology among users. Lack of the electric power make inconvenient to use the infrastructure properly. This will result negative influence standard.
P1	The four ICT lab rooms don't have the capacity to teach about 2900 students in our school. We need additional four ICT lab rooms to work on the standard. This is only 50% work. We need much to work on the standard in collaboration with AAEB. We used one computer for three students. On UNESCO, standard one computer should be for one student.
P2	There are four ICT labs and all school community used the technology to make their work simple and create conducive working area. Our school leaders work to

	fulfilling the ICT materials like computers and accessories which are applicable in ICT program to have the standard.
P3	ICTs do require supporting physical infrastructure to be in place before they can be implemented. As a high school, there should be a minimum of four ICT labs. But according to our school, the three ICT labs are working for about 1000 students. It is possible to address the students effectively. For the schools with more than 2000 students four ICT labs are not enough to serve students. They don't have structural problem and there is no quality problem on the ICT materials but the materials aren't available that much.
P4	One computer is for two students. In one section, there are forty students. So, relatively the standard is good. With four ICT labs, there are 80 computers for 160 students. To maximum, we have 50 students. Almost we are reaching to the standard with the number of computers. In terms of the structure, the location matters. The sections are there the labs are here. Students kill their time moving here and there. So, it's not convenience. Secondly, the rooms were not built for ICT lab purpose. The rooms are dark. The other thing is there is no materials like LCD, projector. So there are many drawbacks on the ICT standards. It should be revised.
T1	The switches are on the walls of the classroom and UPS and other materials are taken by the students. The switch boxes are sliding on their sides and are not locked. As the initial stage, there are enough infrastructures. There is no extension of the project on the new learning buildings. The building is built after the installation of the system on the old buildings. After the new buildings built, we asked many times to launch the system. The installation is done after calling a bid. It can't be given the bid for one company. We have to wait until other companies participate on the bid; the bid system takes lot time to finish the project. Due to this reason, there is no network installation and there is no schoolNet service on the new buildings.

Appendix 6: Researcher observation

Researchers' Observation			
Infrastructure related	Standard issues	Security related	Expert related
Loss of UPS & Sep top box materials in class room	1 computer for about five to seven students used in ICT lab	Most computers don't have Updated antivirus and they are stacked	Lack of ICT experts Lack of training,
Plasma remote controls are not available sufficiently	Few ICT labs for large number of students	Switches are not locked and the network cables are easily damaged	Low cost employee
Projectors and printers are not available sufficiently on each ICT labs	Most computer furniture are not suitable to use	Stealing of HDMI cables, mouse, and other	Unrelated professionals at the position
Lack of spare parts & accessories	Low processing capacity computers/ too old generation computers used		
Not sufficient printers in school	Structural and design issues		
Lack of generator most in case of power interruption			
Few schools have white board most of them don't have			
Old plasma TV screens used			