UNIVERSITY OF NAIROBI

SCHOOL OF COMPUTING AND INFORMATICS

A FRAMEWORK FOR EVALUATING THE OUTCOME OF USE OF ICT ON EARLY GRADE LITERACY ASSESSMENT; A CASE STUDY OF TUSOME LITERACY PROGRAMME IN KENYA

BY

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ABSTRACT

Previous research work in the field of education has highlighted how information and communication technology plays an integral role in deepening and accelerating learning. Little has been done focusing on its adoption among public schools in Kenya. Systematic use of mobile devices and other information and communication technologies to assess early grade literacy and numeracy, especially in developing countries, remains limited to date. The purpose of this study is to develop a framework for evaluating the outcomes of ICT use on early grade literacy assessment. The focus of this study is on Tusome Literacy program, which is a USAID funded program of over five years, which has been adopted by the Kenyan Government. Education officials under Ministry of Education are equipped with tablets that have pre-installed software to be used for continuous assessment of Curriculum Support Officers, teachers and learners in early grade literacy in public primary schools.

The specific objectives are: the relationship between the ICT infrastructure and the level of use of the assessment tool; the relationship between the ICT skills of the Curriculum Support Officer/County Director of Education and the level of use of the assessment tool; the relationship between the local support and the level of use of the assessment tool; the relationship between the level of use of the assessment tool and the frequency of the lessons observed; the relationship between the frequency of lessons observed and the literacy score of the learners.

The design of this study is a survey research that was conducted in three counties in Kenya i.e Uasin Gishu, Bungoma and Busia counties. The sample size determination for the CSOs was equal to the population. The study targeted 30 CSOs and 2 County Directors from Bungoma, 14 CSOs and 2 County Directors from Busia; and 17 CSOs and 2 County Directors from Uasin Gishu. Questionnaires were used to collect data. The response rate was 89%. Analysis of the data was done by both descriptive statistics and inferential analysis.

The study found out that the issuance of tablets with preloaded monitoring tools and applications to the CSOs and County Directors of Education enabled implementation and use of the ICT tools. The tablets had a source of internet connection so as to send the collected data to a central server. Continuous training and support of the CSOs on use of the ICT gadgets for classroom support was also key. Proper implementation resulted to increased frequency of CSOs visit to schools to

continuously support teachers and assess teachers and learners using the ICT tools. Frequency of lessons observed and the implementation (use of the assessment tools) was significantly related as the OR=1.599, p=0.004. The study compared the literacy score and the ICT outcome (frequency of lessons observed by CSOs). The result showed that the ICT outcome significantly relates to the literacy score the with an odds ratio OR=9.531E-019, p=0.001.

In conclusion, Tusome Literacy Programme has enabled improved literacy on early grade learners through use of ICT tools to monitor and support teachers and continuous assessment of learners in the early grade. A recommendation for further research is the integration of the ICT monitoring tool (Tangerine:Tutor) with other Ministry of Education systems such as The National Education Management Information System (NEMIS). The integrated data and information would enable better use for decision-making and formulation of transparent and accountable policies within the education sector in Kenya.

DECLARATION

I declare that this is my original thesis and has not been submitted to any other examination or degree awarding body.

Signature: …… Date: ……

Doreen Olubendi

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This thesis has been submitted for review with our approval as Academic Supervisors

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DEDICATION

First, I dedicate this thesis to the God, whose love and mercy allow me to live day after day, despite myself.

Secondly, I dedicate this thesis to the loving memory of my father, Patrice Olubendi, who always believed in my capabilities. Thoughts of you evoke a fondness beyond measure. And with sincere gratitude to my mother Anne Olubendi and uncle Hesbon Owino, who always encouraged me to pursue further studies.

My final dedication is with tender love to my husband Edwin Argwings and our children Zara and Lulu.

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This thesis has contributed to a new territory on the link between use of ICT for assessment and early grade literacy in public schools in Kenya. My background in Computer Science contributed to the excitement of new insights and approaches in this study. This journey could not have been completed without certain individuals and organisations.

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Lastly, I thank my family members and friends who not only believed in me, and gave the necessary support but remained patient as I put many hours into this thesis. My mother Anne Olubendi, my husband Edwin Argwings, and my children Zara Anne and Lulu Patrice were amazingly sacrificial to enable me to achieve this goal. I remain forever grateful for this.

Above all, I thank the Almighty God, to whom all Glory and Honor belongs.

ABBREVIATIONS

ICT	Refers to technologies that provide access to information through telecommunications. It is similar to Information Technology (IT), but focuses primarily on communication technologies. This includes the Internet, wireless networks, cell phones, and other communication mediums.
TUSOME	Taking its name from the Kiswahili word for "let's read," Tusome is a program designed to dramatically improve primary literacy outcomes for a Kenyan children in grades 1–3.
MOE	Ministry of Education, Kenya.
USAID	An American agency that leads international development and humanitarian efforts to save lives, reduce poverty, strengthen democratic governance and help people progress beyond assistance.
NEMIS	The National Education Management Information System (NEMIS) is web based data management solution which collects data and information from education institutions; processes and reports the status of designed indicators; and provides the sector a solid ground for effective management to ensure that every Learner counts.
OLPC	One laptop per child
CSO	Curriculum Support Officer

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CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter provides a brief background of the study followed by a statement of the problem, research objectives and then with the significance and justification of the study.

1.1 Background of the Study

According to the World Bank (2013), millions of children are affected by a global learning crisis. Despite having more learners enrolled in schools, the level of learning by the learners has been alarmingly low. As a result, governments, international organizations, and other stakeholders are putting more emphasis on improving quality of education. According to Wagner (2010), learning assessment system measure the gains and losses in education. In effect, this improves the quality of education.

Kenya has a number of programmes to address quality issues in education. Ministry of Education (formerly MoEST) has increased its focus on quality of education in early grade literacy and numeracy. In 2007, the Early Grade Reading Assessment (EGRA) was piloted by the Government of Kenya to assess literacy outcomes in Malindi. After piloting between 2007 and 2009, the country adopted the two models and carried out a research on literacy and numeracy where the findings indicated that pupils in class 1 to 3, have low literacy and numeracy skills. The research findings showed that the early grade section received less attention from the stakeholders and the teachers did not use appropriate instructional methods (MOEST, 2015).

The constitution of Kenya, promulgated in August 2010, clearly articulates in the Bill of Rights, Article 53:1b that 'every child has the right to free and compulsory basic education'. According to the Uwezo Kenya annual learning assessment of 2011, 7 out 10 children in class 3 were not able to do class 2 work. This meant that children in school were not learning.

Primary Math and Reading (PRIMR) Initiative was implemented by MoE with financial support from USAID and technical support from a Non-Governmental Organization (NGO) namely RTI International from 2011 to 2014. PRIMR Implementation indicated that Teacher Advisory Centre (TAC) tutors, now known as Curriculum Support Officers (CSOs) and teachers can improve the quality of instruction and pupil outcomes significantly (MOEST, 2015). The PRIMR Endline Evaluation Report showed that pupils in PRIMR performed better than those in control schools class 1 and 2 english. For letter-sound fluency, pupils in PRIMR intervention read at 47.0 letters per minute (clpm) correctly, compared to those in control schools who had a mean of 25.7 letters per minute. The pupils reading at benchmark was 28.3% in PRIMR compared to those in control schools (12.6%) (Mugenda, 2014).

The gains of PRIMR heavily influenced the development of Tusome as a national literacy program in Kenya. It targeted approximately 60,000 Teachers, 23,000 public primary schools and 1500 low-cost private schools (Aslam, 2017-18) for improved literacy outcomes.To improve on the TUSOME , ICT was incorporated to support a more efficient instructional assessment and feedback. From 2015 the CSOs have been trained termly on how to use the tablet. The tablets are pre-installed with a classroom observational tool, which allows the CSOs to record, assess and give feedback on teaching quality to the teacher, and to assess pupil learning. The tool collects a GPS reading at the point of assessment, and allows for the creation of a cloud-based national database of school information for reporting.

In the first year of Tusome, more than 40,000 lesson observations were performed by CSOs and more than 120,000 pupils assessed on fluency. The data was aggregated on web based dashboard which was shared out with MOE stakeholders. Based on the findings of the Midline Report, Tusome had a strong influence on reading outcomes. At midline, 30 percent of Class 1 pupils are emergent readers and 18 percent are fluent readers, while 29 percent of Class 2 pupils are emergent readers and 47 percent are fluent readers in English. Based on the midline results, English reading performance had improved (Davis, 2017).

Several successful reading programs around the globe include the Ethiopia READ project which supports the Ethiopian Ministry of Education (MOE) in its efforts to develop a nationwide reading and writing program. The program objective was to improve the reading and writing skills of children in grades one through eight in both their mother tongue and English. One of the strategies

undertaken to achieve the goal is supporting and enhancing teaching and learning through appropriate ICT interventions and teaching aids. (USAID, 2017). The baseline assessment brings Ethiopia READ to conclude that in the primary schools, the infrastructure for power and Internet connectivity, as well as physical building conditions present significant challenges even before addressing teacher ICT skills and capacities. Given that the use of ICT for teaching and learning, and for reading in particular, is a new and emerging field in Ethiopia, a recommendation was that READ TA should ensure that its activities in this field are carefully monitored and evaluated so as to generate documented, valuable knowledge relevant for replication and scale-up. Building local capacity in monitoring and evaluation of such initiatives and sharing findings should be a priority (Inveneo, 2013).

Another successful reading program is the USAID-funded Pakistan Reading Project (PRP), implemented by the International Rescue Committee (IRC) and its partners (Creative Associates International, World Learning, and Institute of Rural Management). PRP was a five-year project with the objective to improve reading skills of children in grades one and two. PRP is providing tablets to teachers preloaded with digital content focused on improving reading skills (International Rescue Committee, 2016). PRP has successfully organized 'Parent Sensitization Sessions' in schools which has strengthened parent's involvement in children's learning.

1.2 Statement of the Problem

The post-2015 global education agenda clearly focuses on boosting quality learning at the classroom level. Promoting an effective assessment system includes a focus on regular continuous assessments. Continues assessments improve teaching and learning on a daily basis through adjusting their practices (Clarke, 2012).

In Tusome Literacy Program in Kenya, Curriculum Support Officers (CSOs) who support public schools in Kenya's 1127 educational zones have been equipped with tablet devices pre-loaded with Tangerine software. Tangerine is used on tablets for use in areas with low or no internet connectivity CSOs use Tangerine for continuous assessments of pupils' early reading and teacher support. Results are used offline for immediate teacher feedback. The results collected are presented in form of a dashboard and reports.

Billions of US dollars are invested in ICT in Education projects by the public, international organisations and donors yet little is known of the impact of that investment (P.Heyneman, 2016). This study seeks to develop a framework for evaluating the outcome of use of ICT on early grade literacy assessment in Tusome Literacy program in Kenya.

1.3 Research Objectives

The following were the objectives of the study:

1. To determine the relationship between the ICT infrastructure and the level of use of the assessment tool
2. To determine the relationship between the ICT skills of the CSO/County Director of Education and the level of use of the assessment tool.
3. To determine the relationship between Local Support and the level of use of the assessment tool.
4. To determine the relationship between the level of use of the assessment tool and the frequency of the lessons observed.
5. To determine the relationship between the frequency of lessons observed and the literacy score of the learners.

1.4 Scope of the Study

This study on developing a framework for evaluating the outcome of use of ICT on early grade literacy assessment in Kenya will be guided by the research objectives.

The study will be a case study in Tusome Literacy Programme in Kenya. Tusome is national early grade literacy programme running in public primary schools run by the Ministry of Education (MOE) with technical support from RTI International. The program is funded by USAID, DFID and MoE.

The study will employ a survey research approach. Data will be collected using questionnaires and interviews. It will involve County Directors of Education and Curriculum Support Officers from MoE.

1.5 Justification of the Study

This study will deal with a subject of important issues which is the evaluation of ICT as a tool to assess, measure and analyze literacy gains in Tusome Literacy Programme in Kenya. The Kenyan government has initiated some capital investment towards the programme; funding has been achieved through partnerships between USAID and the Kenyan government. It is therefore important for the funders and implementers to realize the perceived benefits of ICT as a tool to measure and analyze the literacy gains in the programme.

This study aims at providing the IT department with recommendations and proposals about the use of ICT as a tool to measure and assess early literacy gains in the education sector in Kenya. It is important for IT Human resource and interested people in the institutions to be aware of the ICT infrastructure and skills needed for the implementation of the programme.

The study aims at contributing to the growing body of knowledge of ICT for Early Literacy programmes in Kenya. This will bridge the gap that exists from the previous studies done in ICT for development projects in Kenya. The knowledge will be beneficial to both academic and industry research.

1.6 Conclusion

This chapter served as an introduction of the study which sought to describe the background to the study, problem statement, research objectives, and scope of the study, justification and significance of the study. The next chapter explores the literature surrounding the area of the study as well as the theoretical framework guiding the study with the aim of identifying the gap.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter covers a review of the previous studies done on evaluation of Information and Communication Technology (ICT) tools used to measure the educational project gains. It starts with brief background information about the ICT in Education tools. It also highlights the technologies used such as tablets, cloud computing and Global Positioning System (GPS) mapping. Finally, it highlights the theoretical and conceptual framework on evaluation of ICT tools to measure and analyze early grade literacy gains.

2.1 A Global Perspectives of ICT Tools in Education

Information and Communication Technology (ICT) extensively used in the education sector includes hardware, software and networks such as computers, the Internet, radios, televisions and projectors among others. ICT is increasingly being successfully applied in education, learning, and evaluation. A number of previous studies have shown that a suitable use of ICT can increase the quality of education and connect learning with real-life situations (Odhiambo, 2013).

Computer technologies and other aspects of digital culture have changed people's ways of living, working, playing and learning (UNESCO, 2019). Digital literacy is being strengthened in many countries through the use of ICT in schools. Many typical ICT educational applications include: one laptop per child (OLPC), tablets, smart boards or interactive white boards, e-readers, and flipped classrooms (UNESCO, 2019). OLPC is a non-profit organization set up with the aim of improving learning for children around the world; this objective was to be accomplished through the creation and distribution of educational tools for the developing world and the development of technology and content for these devices. OLPC has put a lot of effort into designing a laptop that would work well in an environment in developing countries (Kraemer D. S., 2011). Nevertheless, in the developing countries where it was introduced, OLPC was not successful (Sonika, 2013).

Information technologies are not independent innovations, but system innovations, the value of which is largely dependent on an ecosystem that includes hardware, applications, peripherals, network infrastructure, and services (such as installation, training, repair, and technical assistance

Deployment includes teacher training, software and digital content creation, maintenance and support delivery, and long-term engagement. Such capabilities in developing countries are in short supply (Kraemer D. S., 2011). It also requires understanding the local environment to spread a new innovation (Kraemer K. &., 2009).

Although taking into account the advantages associated with enhanced education in ICT, it can be said that enhanced learning in ICT is better than a simple education. But there are many challenges that hamper ICT's exploration and exploitation of opportunities in education. ICT-enhanced education's main challenge is the inadequacy of ICT infrastructure (Franscisca, 2011). Another concern with the use of ICT in education is the shortage of ICT teachers (Habibu, 2012). Change management issues need to be addressed through the introduction of new work practices, new ways of managing and executing tasks (ICT4D, 2009)A significant number of teachers in educational institutions are generally non-ICT-competent and are therefore resistant to change. It is not an easy task to integrate ICT in education, as it demands a wide range of support including higher management and teachers. Therefore, it is necessary to properly convince them for their support, and for this task a leader is required (Enhanced Enrolement and Examination Process, 2013)

2.2 Background of ICT in Education in Kenya

Kenya's efforts to reform its educational institutions and systems have faced many obstacles. Nevertheless, progress has been made and reforms in education have been translated into more school children (Ministry of Education, 2019). After several years of effort, Kenya promulgated a National ICT Policy in January 2006 that aims to “improve the livelihoods of Kenyans by ensuring the availability of accessible, efficient, reliable and affordable ICT services” (Ministry of Information and Communications, 2006). This includes ICT use for education.

The policy framework of the ministry states that there are a number of challenges related to access and use of ICT in Kenya, including high levels of poverty, limited rural electrification and frequent power disruptions (Ministry of Education, 2019). Most high schools have some computer equipment, but this could consist of one computer in the school head's office. Very few high schools have enough ICT resources for teachers and students. Even in schools that do have computers, the student-computer ratio is 150:1 (Ministry of Education, 2019). The majority of schools with ICT infrastructure have acquired it through programs funded by families,

government, NGOs or other development agencies and the private sector, including the NEPAD e-Schools programme (2005-2006) (East Africa Commission, 2006). Assessment of deeper understanding and competency is the latest teaching and learning paradigm where we have tests that allow an educator to assess learning while it is taking place. This is achieved by continuous monitoring, providing feedback, responding to learner's progress, encouraging adaptation and improvements in learning outcomes, and involving students in meaningful self and peer assessments (Charles Nyakito, 2018).

The introduction of laptops to Kenya's primary schools has faced numerous implementation challenges. Some of the results of a study on factors that influence its execution include tablet procurement processes, government financial constraints and the capacity of teachers (Kanini, 2014). Others argued that implementation faced some infrastructural and personal challenges, limited schools with ICT facilities, expensive Internet access, limited sharing of information, limited ICT integration skills (Swarts&Wachira, 2010), labor shortages due to the inability of educational institutions to produce ICT technicians and labor market professionals (Mendes et al. 2003).

Two countries in sub-Saharan Africa, Kenya and South Africa, have already developed national research and education networks, and several others are in the process of doing so. The goal of the Kenya Education Network (KENET) is to "establish sustainable communication and networking among educational institutions in Kenya that will facilitate wide use of Internet technology in teaching, research, and sharing of other information resources to the general populace at affordable cost." This initiative was driven by Kenya's higher learning learning institutions to build a high-speed, reliable and sustainable network for all learning institutions to interconnect (Farrel, 2007).

As evidenced by the recent publication of the National ICT Strategy for Education and Training, Kenya has placed considerable emphasis on the importance of ICT in its Education Sector Support Programme. The Ministry of Education took steps to support the strategy's implementation either through direct action or through the various institutions and agencies it deals with. However, there are many other organisations that are not directly involved with the Ministry of Education that continue to be engaged in the implementation and support of ICT projects in education (Farrel, 2007).

2.3 ICT Tools in Education in Kenya

A key objective of the education policy of the Government of Kenya is to encourage ICT as a learning tool. The government tried to incorporate ICT into the education system under the 2006 National Information and Communication Technology Strategy for Education and Training, improving its accessibility and fostering proficiency of the youth. This was meant to fall in line with a wider framework of economic development, wealth and employment creation, and the attainment of the Millennium Development Goals (MOE - ICT in Education, 2006). However, progress on the ICT for education front has fallen short of expectations (Kanorio, 2015).

In the Ministry of Education's Strategic Plan for 2008-2012, the slow integration of ICT in operations and programs is specifically identified as one of the Ministry's key weaknesses. Meaningful ICT incorporation is not easy to achieve - it must include aspects of stakeholder buy in, quality training and efficient systems (Ministry of Information Communications and Technology, 2013) . Within Kenya's education sector, however, there are already a range of creative e-learning platforms that illustrate possible methods of using ICT effectively to improve education. Due to their understanding of the challenges of implementing new technologies, many of the programs implementing e-learning focus on providing support for teachers (Kombo, 2013).

Kenya Teacher Education and Professional Development (TEPD) Program was implemented by FHI360. The program seeks to tackle the capacity of educators when it comes to ICT. Facilitating a partnership between the Government of Kenya, Intel, Microsoft, and Cisco, the program has provided laptops, digital cameras, scanners, printers, wireless access points and other equipment and training to 20 primary schools, 3 secondary schools and 3 teacher training colleges. TEPD helps public teacher training colleges integrate HIV/AIDS prevention and treatment into teacher instruction and provides training in strategies to combat the spread of HIV/AIDS. TEPD is directly training 1,320 tutors and indirectly training another 16,000 teacher trainees on critical HIV/AIDS awareness topics (Williman, 2017).

Eneza Education was founded by Kenyan teachers. Eneza Education (formerly known as MPrep) uses technology that is already commonly available to students — mobile phones — to enhance learning outcomes in remote schools, providing students with research resources and teachers with the means to collect performance and learning data. A mobile quiz program enables students to strengthen learning concepts from the national curriculum, while teachers can track the progress

of students and collect performance data, identify their strengths and weaknesses (Eneza Education, 2017).

The goal of the iMlango project was to boost the enrolment, retention and learning outcomes of 56,561 disadvantaged girls across 205 Kenyan primary schools. The iMlango primary schools are spread across four counties (Kilifi, Kajiado, Makueni and Uasin Gishu) that were selected based on marginalisation factors (poverty rates, attendance statistics and learning achievements for girls) as well as availability of electricity, safety and accessibility (iMlango, 2019). The project offered internet connectivity to schools, digital literacy learning content, continuous teacher training and support, real-time tracking and evaluation of projects, among others (iMlango, 2019). iMlango has shown that a complex educational technology system can be successfully implemented in rural Kenya's primary school environment, producing positive results in its key target areas and laying the foundation for long-term sustainable development. (Avanti Communications, 2017). 67.5% of all the teachers from treatment schools who were interviewed at endline said that the use of new interactive and engaging learning materials has made the girls more interested in attending school. Results from the girls interviewed at the endline showed that the use of digital learning tools had helped to change the girls ' view of school positively, with 60.5% saying they were more interested in attending school now, while 67.8% said they found school more exciting (Avanti Communications, 2017).

2.4 ICT Technologies Used for Implementation of Tusome Literacy Program

2.4.1 Tangerine: Tutor

Figure 1 Log In Screen of Tangerine

Tangerine is an open-source electronic data collection software for use on mobile devices running Android. Its primary use is to enable student responses to be recorded in early-grade oral reading and assessment of mathematics skills. Tangerine is also used to capture interview responses from students, teachers and headteachers.

Using customizable, logic-driven forms, Tangerine:Tutor can combine and analyze results from classroom observations, mini assessments and classroom inventories to generate (offline) a coaching feedback report that can be used to guide and inform conversations with teachers (Kip S, Strigel C, Pouezevara S, 2015).

2.4.2 Nexus 7 Tablets

Tangerine requires the following minimum features for use as a data collection tool: Capacitive touch screen, Android OS [v. 2.3 or higher], HTML 5-capable browser (standards, such as Chrome or Opera Mini preferred), Wi-Fi (b/g/n), 4GB HDD (8GB preferred), 512MB Memory, 7 hours battery life (without Internet turned on) and ability to install third-party Android application. Additionally, the following are desired features: 3G connectivity, GPS, mini-/USB port, mini-/HD slot and Capacitive touch-screen.

The following is recommended: 7 inch screen, Ideally below 1lb. in weight

Tusome program mainly uses the Google Nexus 7 tablet (2012 and 2013). It is designed for use on smartphones and tablets in low-resource environments without the Internet and is also GPS enabled. Results are used offline for immediate teacher feedback and online for progress reports.

2.5 Theoretical Frameworks for Evaluation of ICT Usage and Impact

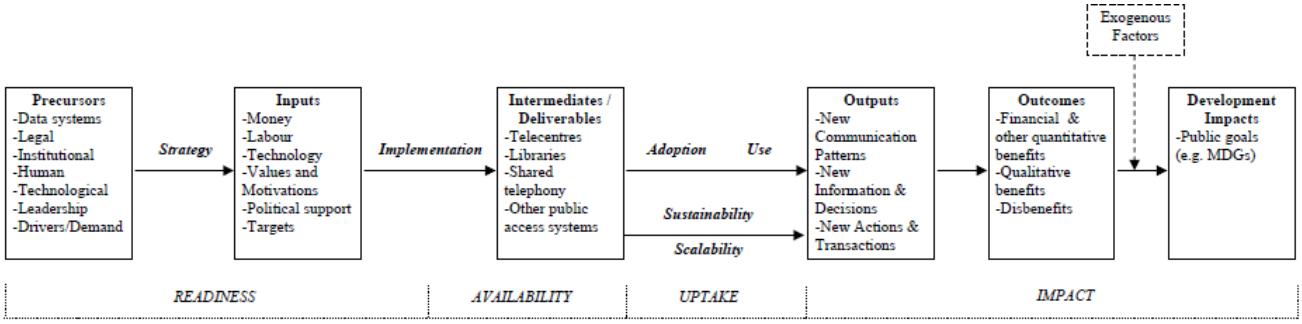
2.5.1 An Overview of Impact Assessment for ICT4D

Two questions guide how ICT4D impact assessment is done, according to Heeks and Molla (2009):

- What should we know?
- How do we figure it out?

The basis for understanding the assessment of ICT4D projects is the ICT4D value chain:

Figure 2 ICT4D Value Chain



This builds on a standard input — process — output model to create a sequence of related ICT4D resources and processes. It is divided into four main targets for assessment:

- • Readiness: "e-readiness" assessment usually tests the functional prerequisites for any ICT4D program, such as ICT infrastructure, ICT expertise and ICT policies. The approach that transforms project precursors into project-specific inputs and the presence / absence of those inputs could also be evaluated.
- Availability: ICT4D project implementation transforms inputs into a series of concrete intermediate ICT deliverables; the role and availability of such intermediate assets can be assessed.

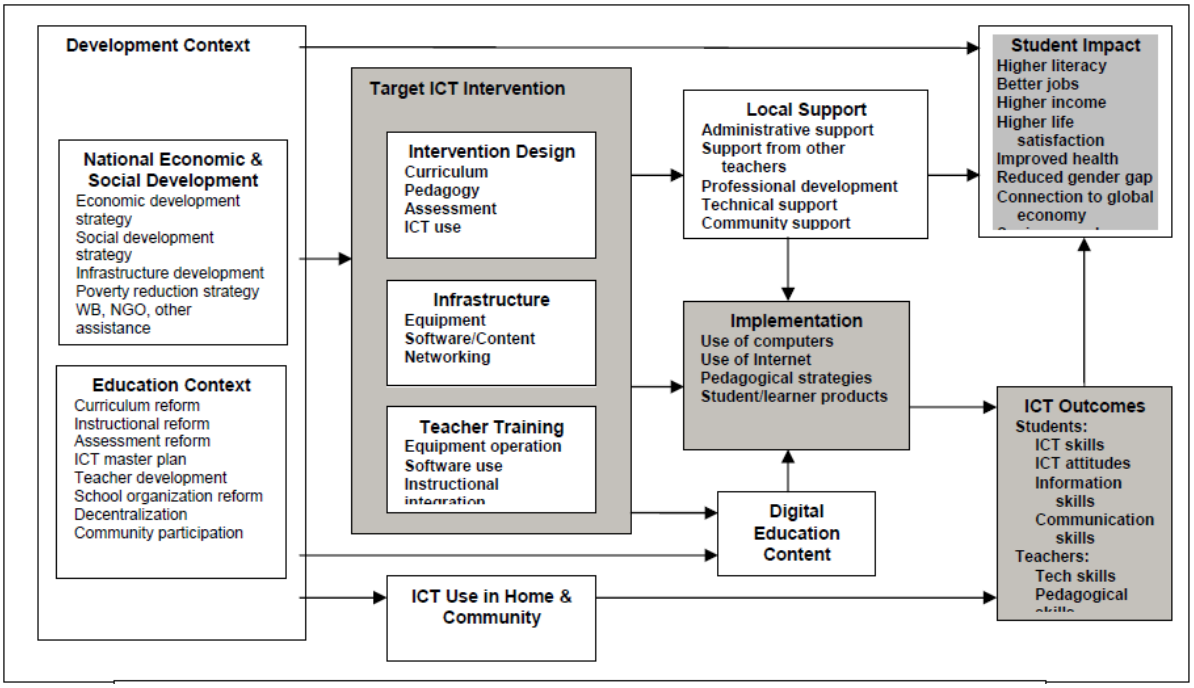
- Uptake: assessment typically measures the degree to which its target population uses the ICT results of the program. Over time, broader assessment could examine the sustainability of this use and the potential or actuality of scaling-up.
- Impact: this focus, as the name suggests, assesses the project's impact and can be divided into three sub-elements:Outputs: the micro-level behavioral changes associated with the ICT4D project.
    - Outcome: the actual ICT4D project costs and benefits.
    - Development Impacts: the ICT4D project's contribution to wider technical objectives

An ICT4D project's overall impacts can be categorized into one of five performance levels:

- Total failure: the program has never been implemented, has been implemented, has been abandoned immediately or has been implemented but has not accomplished any of its objectives.
- Largely unsuccessful: certain goals have been accomplished but most stakeholder groups have not achieved their main goals and/or have had major undesirable results.
- Partial success / partial failure: some major goals have been achieved for the initiative, but some have not been achieved and/or some significant undesirable results have been achieved.
- Largely successful: most stakeholder groups have achieved their main objectives and have not had significant undesirable results.
- Total success: all stakeholder groups have accomplished their main goals and have not had major undesirable results.

2.5.2 Monitoring and Evaluation of ICT in Education Projects

Figure 3 Theoretical Framework for ICT monitoring and evaluation



A theoretical framework as shown in Figure 3 for any specific ICT intervention context, which takes into account the layers and interactions of a number of inputs into the development process was developed by Daniel A. Wagner et al. This study's conceptual framework has been heavily borrowed from the theoretical framework for ICT monitoring and evaluation because once the context is established and the role of ICT is specified, a monitoring and evaluation plan can then be developed The components of the intervention, the role of ICT and how it is incorporated into the curriculum, pedagogy, and assessment are defined in the framework. It also incorporates the infrastructure needed to implement the intervention – the equipment, software, communications, and networking. It also puts emphasis on human resources required (such as teacher training) that are needed, including training in equipment operation, software use, and instructional integration. The framework stresses that, it would not make sense to evaluate the outcomes of the intervention without first assessing the extent to which these intervention components were implemented (Daniel, et al., 2005).

2.6 Empirical Literature

2.6.1 Link between ICT infrastructure and implementation (or use)

A report on ' Technological Infrastructure and Use of ICT in Education in Africa ' revealed that while the choice of ICT should also take into account the widely used ' older ' technologies such as print, radio and television, it is becoming increasingly apparent that ' leapfrogging ' technologies remain the primary alternative, wherever possible, to respond more quickly to the daunting challenge of access and equity. For example, the level of 26% of secondary enrollment and 3.9% of tertiary participation in Africa is very unfavorable relative to that of most non-African developing countries where it has reached 51% and 10.9% respectively (Institute for Statistics UNESCO, 2019). For both technological and pedagogical purposes, most African countries are willing to consider the implementation of state-of - the-art technology to leapfrog into the future. Complementary and convergent use of technologies like Working Group on Distance Education and Open Learning Technological Infrastructure and Use of ICT in Education in Africa; an overview for what each can do best should be advocated (Mukhari, 2016). The key constraint of most African countries, however, is limited access to new technology due to the high cost of setting up, using and maintaining the necessary infrastructure, lack of adequate local expertise and low computer literacy among user groups (Brown Onguko, 2010). In view of these impeding factors, African initiatives to promote the use of ICT in education will, to a large extent, depend on creative partnerships between public and private as well as local and regional organizations, particularly to reduce operating costs. For example, it is considered that Africa will meet the challenge of improving the quality of secondary and tertiary education in mathematics, science and technology, on the one hand, and improve access to primary teacher education by subsidizing equipment costs and increasing educational institutions ' communications tariffs through such collaborative undertakings. Success and sustainability of projects will, however, be subject to in-country policy development and institutions' legislative framework (Brown Onguko, 2010).

2.6.2 Link between ICT skills and Implementation

Everyday use of digital technology involves using a laptop, tablet or mobile phone, sending email, browsing the internet, making a video call-all these are examples of basic ICT skills and communication technology (Griffith College, 2019). The study concluded that undergraduates of Library and Information Science departments in Delta and Edo States possess ICT skills and make

effective use of the internet, according to a study conducted by Israel and Edesiri. However the study revealed that undergraduate ICT skills do not really influence or forecast the actual use of the internet. The study also suggests that universities need to promote and allow students to develop a set of specific attributes through their academic study. ICT skills are one of those attributes in this day and age (Odede & Enakerakpo, 2014).

2.6.3 Link between local support and implementation (or use)

Some studies have shown that digital technologies (ICTs) can reshape the quality of teaching and learning in institutions of higher education if the teachers accept and use it (Odhiambo, 2013)A pilot study was conducted at Jos University, Nigeria, and it was discovered that although ICT usage is compulsory, there is still a low level of adoption among academic staff at the university. The drawbacks of ICT use among academic staff range from underfunding, lack of training opportunities, lack of school management support, inability to obtain personal ICT facilities, lack of workplace ICT facilities, inadequate electricity supply, lack of ICT expertise, lack of time due to workload, lack of interest in learning and lack of time to study (N.D.Oye, N.A.Iahad, & Rabin, 2011).

On the issue of barriers to the use of ICT, most respondents (38 percent) said their problem was time, (32 percent) said there were no opportunities for training. It was proposed that all working teachers at federal, state and private universities undergo mandatory ICT training and retraining. This is to give them practical and functional knowledge of computers, internet and related areas of ICT to improve efficiency and effectiveness (N.D.Oye, N.A.Iahad, & Rabin, 2011). The government should develop ICT policies and practices that would support lecturers in their academic work and students in their learning. ICT tools should be made more accessible to both academic staff and students.

2.6.4 Link between Implementation and ICT outcomes

The World Links program offered 200 hours of teacher training including introduction to ICT, use of the Internet for teaching and learning, use of tele-collaborative learning activities, incorporation of ICT into curriculum and teaching, and innovative pedagogical approaches. The World Links program evaluation found that a large majority of teachers and their administrators reported that teachers had learned new computing and teaching skills and had gained more positive attitudes about technology and teaching (Husain, 2011). The use of ICT has often been thought to bring

significant changes into classroom practice. This was evident from school surveys conducted in 26 countries and a series of case studies conducted in 27 countries in Europe, Asia, North America, South America, and Africa (Kozma, 2015). These and other studies show that creative use of computers in the classroom depends not only on the availability of computers in classrooms, but also on other factors such as administrative support, teacher training and support plans and policies (Agbo, 2015). Technology introduction promotes organizational change in schools, and transformed organization of schools can increase the use and impact of ICT. Coordinating computers with national policies and programs on education, pedagogy, assessment and teacher training improvements is likely to result in widespread use and learning (Kozma, 2015).

2.6.5 Link between Level of Lesson observation and Literacy Score

The purpose of the study done by African Population and Health Research Centre (APHRC) was to examine what happens in classrooms of low and high performing schools. We find that the way teachers teach and how learners are exposed to learning opportunities leads to learner achievement from the literature of the studied classroom-based studiesThe monitoring of lessons by the head teacher was very critical. What is assessed will be achieved. Head teachers are the school level's immediate quality assurance officers and are responsible for conducting the class. You also have a professional responsibility to advise and mentor teachers and properly direct them. The practice of observing the lesson was more common in high-performing schools than in low-performing schools. Head teachers should enhance lesson assessments, mentoring, training, and professional guidance in order to improve the teaching practice of classroom teachers as part of tracking curriculum development and providing feedback. Since head teachers are also entrusted with many other duties in the management of schools, they need help from deputy head teachers and senior teachers in the observation of lessons. Peer assessment from members of the subject team is also a strategy that can be used to improve teaching practice effectiveness. Therefore, there needs to be a policy that encourages the institutionalization of lesson observation at school level (Ngware, Oketch, Mutisya, & Abuya, 2010).

2.7 Conceptual Framework

The purpose of the conceptual framework is to explain the interrelationships between variables (Orodho, 2005). According to Mugenda and Mugenda (2003), a conceptual framework shows graphical relationship between variables in the study. Figure 6 shows the relationship between the

independent dependent variables in this proposed study. In this framework, the independent variables are:

- ICT Infrastructure
- ICT Skills of CSO and County Directors of Education
- Local Support

ICT Infrastructure

ICT Infrastructure encompasses the software, hardware and networking that are employed in the system. Proper installation and set-up of ICT infrastructure affects the level of use of the Tangerine assessment tool by the CSOs in the field. With proper ICT infrastructure they would be able to visit the schools and carry out lesson observations using the tablets and later upload the data to the cloud server.

ICT Skills of CSO and County Directors of Education

Basic ICT skills on use of smartphones, tablets and computers is paramount to the level of use of the assessment tool. This encompasses basic ICT training to CSOs and County Directors of Education on equipment operation and software use. The CSOs should be able to use the tablets to fill an assessment and later tether to the smartphone for uploading. The County Directors of Education should be able to access the Tangerine dashboard on their computers inorder to receive the reports for decision-making.

Local Support

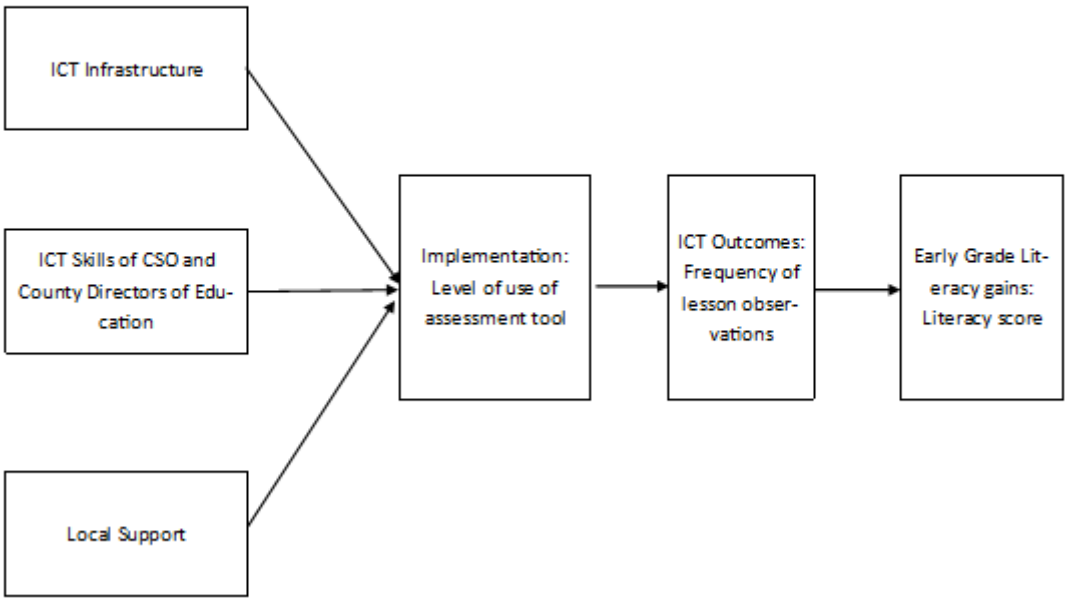
Local support from the school administration, headteachers, teachers and parents is important for successful implementation of the program. This is enabled by sensitization of the 'locals' inorder to get the support needed for effective implementation of the tool.

In this framework, the dependent variables are:

- Implementation: Level of Use of the Assessment tool
- ICT Outcomes: Level of Lesson Observation
- Early Grade Literacy Gains: Literacy score

The implementation i.e the level of use of the assessment tool is dependent on the success of the independent variables. These are ICT infrastructure, ICT skills and local support. The ICT outcomes which includes the level of lesson observation as shown on the Tangerine dashboard analysed by the County Directors of Education for decision-making is dependent on the level of use of the assessment tool by the CSOs. The Early Grade Literacy gains as indicated by the literacy score of the early grade learners is dependent on the ICT outcomes.

Figure 4 Conceptual Framework: Relationship between the variables



The conceptual framework as shown in figure 4 of this study has been heavily borrowed from the theoretical framework of ICT monitoring and evaluation in education projects. Despite the framework being used at county or national level ICT interventions, this framework is seemingly useful in the ICT intervention in Tusome Literacy Program because it takes into account the layers and interactions of a number of inputs into the development process such as the ICT infrastructure, ICT skills of the CSO and County Directors of Education and the Local Support. The framework has appropriate, realistic and measurable variables that could easily be modified for the level of one instance of ICT for education projects being studied in the context of this study. The dependent variables have also been heavily borrowed from the theoretical framework of ICT monitoring and

evaluation in education projects. It clearly defines the relationship between the implementation and the ICT outcomes and the literacy score.

2.6 Conclusion

The chapter looked at the whole idea of use of ICT to assess program gains. The chapter that follows will look at the research methodology.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Overview

This study is set to develop an evaluation framework for assessing the use of ICT and its impact on early grade literacy. This chapter will explore the philosophical paradigm underpinning the research approach chosen, the research method, design, sampling techniques, instrumentation as well as data analysis techniques and ethical consideration of the study.

3.1 Philosophical Paradigm

Philosophically, researchers claim what understanding (ontology) is, how we learn it (epistemology), what principles it includes (axiology), how we write about it (rhetoric) and how we research it (methodology), (Creswell, Plano Clark, & Guttmann, 2003). Johnson and Christensen (2012) explained these claims (paradigms) as "a research perspective held by a research community based on a set of shared hypotheses, concepts, values and practices" (p. 31).

3.2 Research Design

The study has used a survey design. Survey research is the collection of data obtained by asking questions from individuals either in person, on paper, by phone or online. Surveys are one type of primary research, which is the collection of data from its origin (Haughn, 2019). A survey of Curriculum Support Officers (CSO) and County Directors of Education from Ministry of Education was conducted in 3 counties in Kenya. Survey design was used in this study due to its versatility, efficiency, and generalizability. It works best with a large population thus ensuring development of a representative picture of use of ICT to improve early grade literacy in public schools in Kenya.

3.2.1 Target Population

(Hair et al., 2007and Sekaran & Bougie 2010) Defined target population as the entire group of individuals or firms to be studied by the researcher. The target population will be CSOs and County

Directors of Education from three counties that have successfully implemented the Tusome programme.

3.2.2 Sampling Techniques

The sample consisted of three counties in Kenya. Namely: Bungoma, Busia, Uasin These counties have successfully implemented Tusome in their public primary schools run by the Ministry of Education.

The sample size determination for the CSOs was equal to the population. Bungoma has 30 CSOs, Busia has 14 CSOs and Uasin Gishu has 17 CSOs. A total of 59 CSOs were sampled.

Purposive sampling was used in selecting the sample size for County Directors of Education. The County Directors are the supervisors of the CSOs within the education sector in Kenya and they manage education matters within the counties. They were therefore the most suitable group to interview and find out the implementation of Tusome and how the information gathered is used for decision making.

3.3 Data Generation Techniques

Instruments for data collection are methods, techniques or tools to produce thoughtful techniques or approaches to manipulate the data (Tashakhori & Teddlie, 2003). In this study the researcher has used both the primary and secondary sources of data.

3.3.1 Structured Questionnaires

The first phase of the study has used structured questionnaires for generating quantitative data. The questionnaire has been designed according to the rules for questionnaire construction, layout and question content (Sarantakos, 2005). This instrument has been used to elicit data which has provided insight into the use of ICT in assessing early grade literacy. These questionnaires were given to CSOs in all the three counties.

3.3.2 Interviews

Interviews are one of the most important sources of information about case studies (Yin, 2009). Their organization and execution are considered easy and inexpensive, flexible and analyzed

relatively quickly (Sekeran 2000). It has been used to collect data from the County Directors of Education, while observing non-verbal behavior, and guiding and probing them so that quality data could be uncovered (Stokes and Bergin 2006). Through interviews it was possible to get a clear and wide picture of the County Directors' thoughts and how the use of ICT tools have enabled improved literacy within the early grade learners.

3.3.3 Secondary Data

The researcher obtained the secondary data from reviewing data collected by CSOs using Tangerine Dashboard. Tangerine dashboard-based data is used in decision making by the County Directors of Education. The dashboard landing page shows observations, number of schools visited and schools served by Tusome monthly. A user can filter the data by specifying the month/year. Observations are further viewed by county per month and fluency rate is reported per subject. The notes besides each table are very helpful to the user to help them understand what the data is showing. An observation map is displayed showing the distribution of observations geographically. The URL for the dashboard is:

http://tools.tusome.tangerinecentral.org/dashboard/literacy.html

3.4 Data Analysis

There are three phases involved in data analysis leading to hypotheses and conclusions, namely data reduction, data display and drawing, and finally verification (Sekaran & Bougie, 2010).

Quantitative data have been scored from the questionnaires. A descriptive statistics diagram was created. In this analysis, descriptive statistics was used by providing the results description in the form of bar charts, pie charts, graphs, tables and statistical measurements. This enabled the interpretation and analysis of the raw data. Factor analysis and Regression analysis were applied on the data in order to analyse the relationships of the variables as indicated in the research objectives.

Qualitative data was analysed in the following steps: documentation of data and data collection procedures, organization / categorization of data into concepts, relation of data to show how one concept can affect another, corroboration / legitimization, analysis

of alternative explanations, disconfirmation of facts, quest for negative cases and finally representation of the account (report and findings).

The study used the model to assess the objectives of the study $Y= \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \varepsilon$

Where;

Y = Implementation

β_0 = (constant)

X_1 = ICT Infrastructure, β_1 = coefficient of X_1

X_2 = ICT Skills, β_2 = coefficient of X_2

X_3 = Local support, β_3 = coefficient of X_3

ε = Error term.

3.5 Reliability and Validity of the Instruments

Validity and reliability are two essential processes that need to be observed while conducting research. A pilot study was conducted by distributing questionnaires to respondents to check the instruments' quality in terms of the response's suitability and how they captured the content. The pilot study was an eye opener for the author as it helped to recognize problems and corrective actions prior to the actual process of data collection. This helped the researcher to determine if the results are replicable, accurate and whether the research actually measured what it was intended to measure (Golafshani, 2003). The validity was measured by the design of questionnaires in accordance with the research goals. This helped the researcher see if they were addressing or capturing each research goal.

In this study, the reliability of all the variables under investigation were projected using Cronbach's Alpha coefficient for the internal consistency of the scale.

3.6 Ethical Considerations

As recommended by Creswell, (2003), ethical consideration procedures were followed. In addition to that, permission to conduct research was sought and obtained from National Commission of Science, Technology and Innovation (NACOSTI). The study was guided by the following ethical guidelines;

a) Integrity: thorough and professional conduct of the study.
b) Plagiarism – the proper recognition of the origin of data and ideas has been given.
c) Data handling – that there was effective record keeping, proper storage with regards to confidentiality and data protection.
d) Ethical procedures – that proper consideration was given to these and appropriate approval was sought; conformed to professional codes of conduct where appropriate.
e) Confidentiality and anonymity-where no identifying information was ever recorded to link respondents with their responses

3.9 Conclusion

This chapter has discussed the research methodologies that were used by the researcher to conduct the study.

CHAPTER 4

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.0 Overview

This chapter deals with interpretation and presentation of the findings. The responses were obtained through the use of questionnaires, the research instrument in the study.

4.1 Response Rate Analysis

Table 1 Response Rate Analysis

Response	**Questionnaires**	**Response Rate (%)**
Returned	59	89
Not Returned	5	8
Spoilt	2	3
Total	66	100

Table 2 Response Rate per County

County	Frequency	Percent %
Bungoma	30	50.85
Uasin Gishu	17	28.81
Busia	12	20.34
Total	59	100.0

Majority of the respondents came from Bungoma county (50.85%), followed by Uasin Gishu (28.81%) and the least were from Busia County had (20.34%).

4.2 Demographics Characteristics of the Respondents

The population of those interviewed comprised of Ministry of Education officials who were given questionnaires to fill. These were Curriculum Support Officers (CSO) and County Directors of Education (SCDE) from 3 counties in Kenya. Namely: Uasin Gishu, Bungoma and Busia counties.

Table 3 Gender and Duration in service

Gender	Years you have worked in your station	N
Male	< 1yr	2
	1-5yrs	16
	>5yrs	14
	Total	32
Female	1-5yrs	4
	>5yrs	8
	Total	12
Total	< 1yr	2
	1-5yrs	20
	>5yrs	22
	Total	44

On the gender basis the majority were male who were 32(72.7%), female were 12(27.3%) and they 14(31.8%) of the male had worked for more than 5years in their stations, while 16(36.4%) had worked for 1 to 5 years only 2(4.5%) had worked for less than a year in their stations. On the other hand female who had worked for 1 to 5 years were 4(9.1%) people and 8(18.2%) had taken more than 5years. In overall, 22(50%) of the CSOs and SCDES had worked for more than 5 years, 20(45.5%) and 2(4.5%) had worked for 1 to 5 and less than a year respectively.

Table 4 Age

Job title	Age of respondents	N
CSO	>45	1
	Total	1
	30-44	4
	>45	37
	Total	41

SODE	>45	2
	Total	2
Total	30-44	4
	>45	40
	Total	44

Majority of the respondents were CSOS, most of them, 37(84.1%) were above 45 years old, while between 30 and 40 years were 4(9.1%). The SCDEs were only 2(4.5%) and they were above 45 years of age.

Table 4.2 1 Duration of service

Job title	Years you have worked in your station	N
CSO	1-5yrs	1
	Total	1
	< 1yr	2
	1-5yrs	18
	>5yrs	21
	Total	41
SODE	1-5yrs	1
	>5yrs	1
	Total	2
Total	< 1yr	2
	1-5yrs	20
	>5yrs	22
	Total	44

Majority of the CSOs 21(47.7%) had worked for 5 years and above, CSOs who worked between 1-5years were 18(40.1%) and less than 1 years was 2(4.5%) while SCDEs who had worked for 1 to more than 5years was 1(2.3%) of the respondents which was equal to those who had worked for >5years.

4.3 Analysis of Measurement Model

In the measurement model constructs were created by computing the item questions under each construct. Convergent validity and Discriminant validity were checked. Cronbach's validity testing was used to test convergent validity. Convergent validity ensures that items that should be related are in reality related. A high value for Cronbach's alpha indicates a high level of internal consistency for a construct. Cronbach's (alpha) is a coefficient of reliability. It is commonly used as a measure of the internal consistency or reliability of a psychometric test score for a sample of examinees.

Theoretically, alpha varies from zero to 1, since it is the ratio of two variances. Empirically, however, alpha can take on any value less than or equal to 1, including negative values, although only positive values make sense. Higher values of alpha are more desirable. As a rule of thumb, a reliability of 0.70 or higher is considered desirable.

Cronbach's alpha will generally increase as the inter-correlations among test items increase, and is thus known as an internal consistency estimate of reliability of test scores. Because inter-correlations among test items are maximized when all items measure the same construct, Cronbach's alpha is widely believed to indirectly indicate the degree to which a set of items measures a single unidimensional latent construct.

Table 4.3.1 below summarizes Cronbach's alpha of the scale.

Table 5 Cronbach's Alpha

Cronbach's alpha	**Internal consistency**
a> .9	Excellent
.9>a> .8	Good
•8 >a> .7	Acceptable
•7> a> .6	Questionable
•6>a> .5	Poor
.5 > a	Unacceptable

Table **6** below shows results of reliability test.

Table 6 Reliability Test

Construct	**Measurement Instrument**	**Cronbach's Reliability**

ICT Infrastructure	Are the computers connected to the internet?	.173
	How do you primarily use the internet?	
	What type of mobile phone do you use or have access to?	
	Have you undergone any Tusome program training?	
ICT Skills	State your level of proficiency in basic tablet operations	.908
	State your level of proficiency using Tutor (Tangerine) in the Tusome tablet	
	State your level of proficiency using Papaya in the Tusome tablet	
	State your level of proficiency accessing instructional videos in the Tusome tablet	
	State your level of proficiency in basic computer skills	
	State your level of proficiency in using the internet/emails	
Local Support	Extent in which head-teachers support classroom visits using tablets	.789
	The extent to which teachers support classroom visits using tablets.	
Implementation of Assessment Tools	Which applications have you utilized in supporting teachers?	.818
	What is your level of usage for Tangerine Tutor?	
	What is your level of usage for Papaya?	
	What is your level of usage for Instructional Videos?	
	What is your level of usage for Accessing PDF books?	
	The Tusome tablet makes it easier to demonstrate appropriate teaching of skill to teachers.	

These items in the questionnaires were the indicators for the validity of the information that the researcher investigated the correlation between ICT infrastructure and the level of use of the assessment tools. The indicators are the internet, type of phone, computers training and primary use of internet measured the level of association which means how infrastructure positively affect the level of use of the assessment tool. Reliability analysis conducted on the relationship between

ICT infrastructure and the level of use of assessment tools on a scale of 4 items, Cronbach's Alpha showed reliability was poor α=0.173.

Reliability analysis was carried out on the Relationship between ICT skills and level of using Tusome devices comprising of 10 items. However, 4 of these items were worthy deletion and 6 were good enough to be retained to improve the reliability on the scale. When these items were removed α=0.908 which is perfect these items were, level of proficiency in the use of Tablet, tutor, Papaya, processing institutional videos in Tusome, level of proficiency in basic computer skills, and level of proficiency in using internet/email.

The two items in Local Support showed a strong correlation r=0.686. This is a strong association, hence, both questions addressed effectively the objective of the study. Visiting classrooms by head-teachers to teach pupils has been very important.

Reliability analysis was carried out on the scale for Implementation of Assessment Tools which had 6 items. Cronbach's alpha showed that 5 of these items were worthy of retention on the scale to reach good reliability of α=0.818 deleting these 5 items would result in a decrease in alpha value. However, one of the 6 items was worthy deletion to improve reliability α=0.9. The tools on the tablet are the key components of Tusome support of the CSOs, SCDEs and CDEs support to the teachers. With enhanced trainings and active field support, the education officers have obtained the right ICT skills to operate the tools and applications on the tablet.

4.4 Descriptive Statistics

Descriptive statistics is the term given to the analysis of data that helps describe, show or summarize data in a meaningful way such that, for example, patterns might emerge from the data. Descriptive statistics are very important because if we simply presented our raw data it would be hard to visualize what the data was showing, especially if there was a lot of it. Descriptive statistics therefore enables us to present the data in a more meaningful way, which allows simpler interpretation of the data (Lund Research Ltd, 2012). This section summarises the data collected from the questionnaires in visual form.

4.4.1 ICT Infrastructure

Table 7 Descriptive Statistic for ICT Infrastructure

	No of Respondents	Yes %	No %
Do you have computers in your office?	44	6.6	91.1
How many are currently operating?	45	13.3	86.7
Are the computers connected to the internet?	43	6.7	88.9
Have you undergone any Tusome program training?	45	95.6	4.4
Has Tusome program issued you with a tablet?	45	91.1	8.9

Access to internet is still wanting as only 6.7% have internet connection, 6.6% have computer in their offices, and 13.3% of the computers are working. Conversely, 95.6% had gone for training and 91.1% issued with tablets.

4.4.2 ICT Skills

Table 8 Descriptive Analysis of ICT Skills

	Tablet	**Tangerine**	**Papaya**	**Pdf book**	**Institutional Videos**	**Computer Skills**	**Use of internet**
Mean	1.93	1.95	2.02	1.85	1.74	1.36	1.81

Mode	Very good	Very good	Very good	Weekly	Moderate	Moderate	Moderate

From Table 8 the researcher wanted to determine degree of use of the gadgets. The mode was used to show frequency. Proficiency in ICT skills showed that, majority were very good at using the Tablet, Tangerine, Papaya and use of internet, majority accessed pdf books weekly. However experience in use of instruction video and computer skills were moderate.

Figure 5 Proficiency in tablet operations

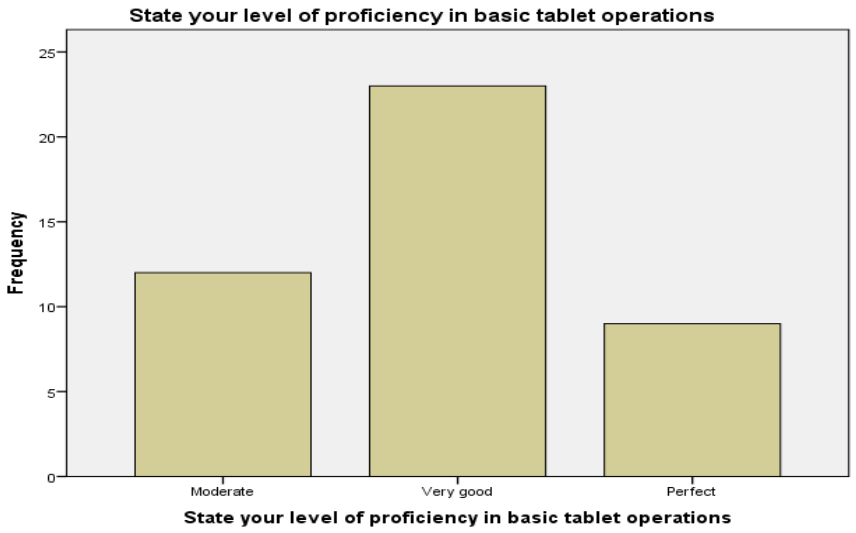
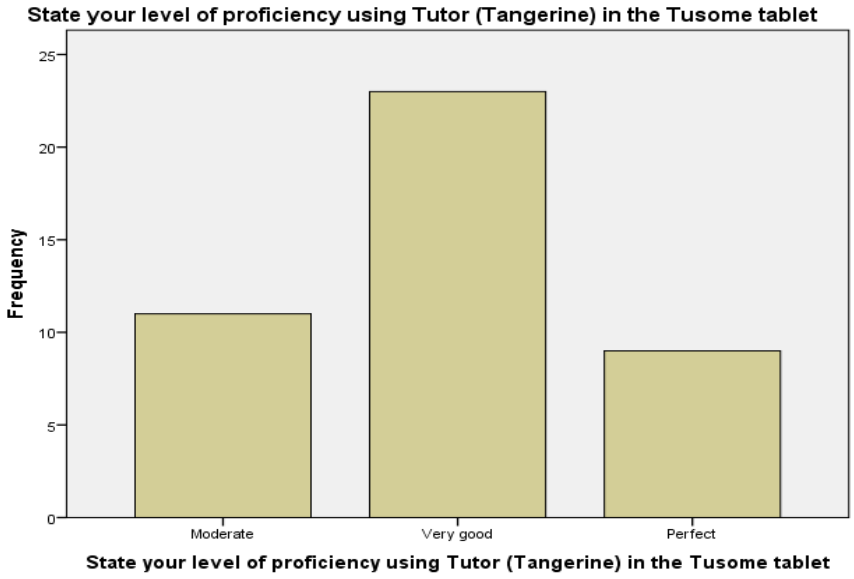


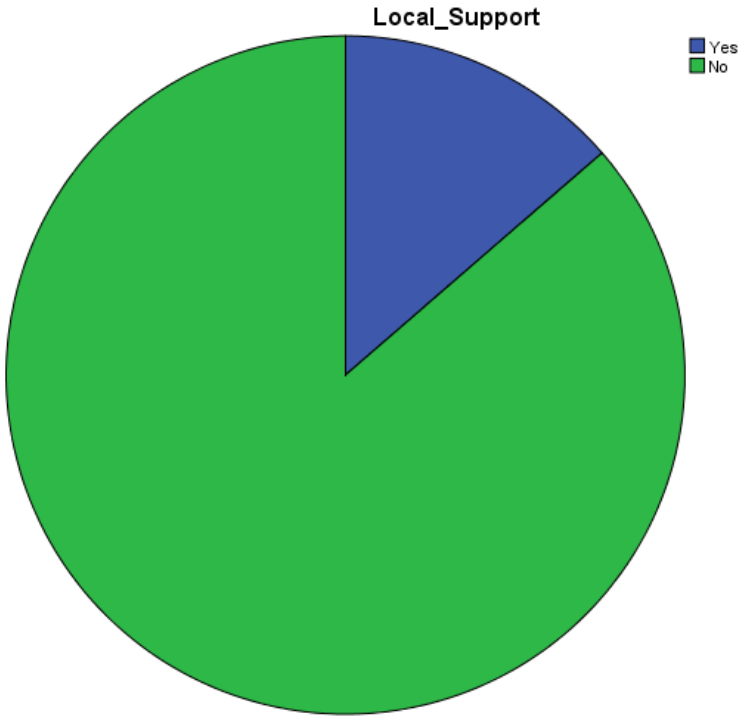
Figure 6 Proficiency in using tangerine



Quite a good number were found to be good at using the tutor device. However, some are still struggling to use the device these were the lot who stated they moderately having proficient in use of tangerine.

4.4.3 Local Support

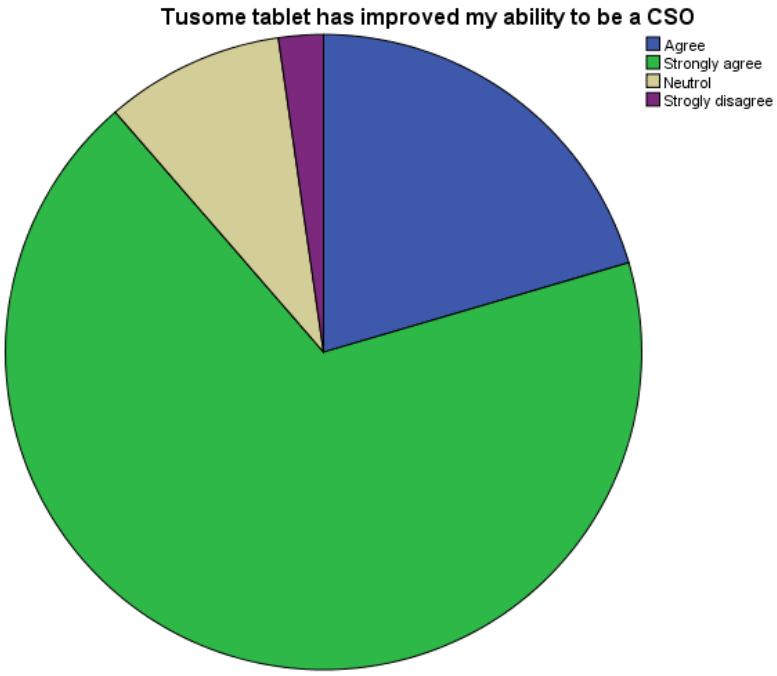
Figure 7 Local Support



86.4% of the CSOs interviewed answered Yes to the question ‘Does your immediate supervisor support you in Tusome activities?’. The immediate supervisors of the CSOs are the subcounty directors of both TSC and MOE. The supervisors are expected to support the CSOs to carry out lesson observations by facilitating their movements to all the schools within their zones. Most directors have been involved in the program.

4.4.4 Implementation: Level of Use of Assessment Tool

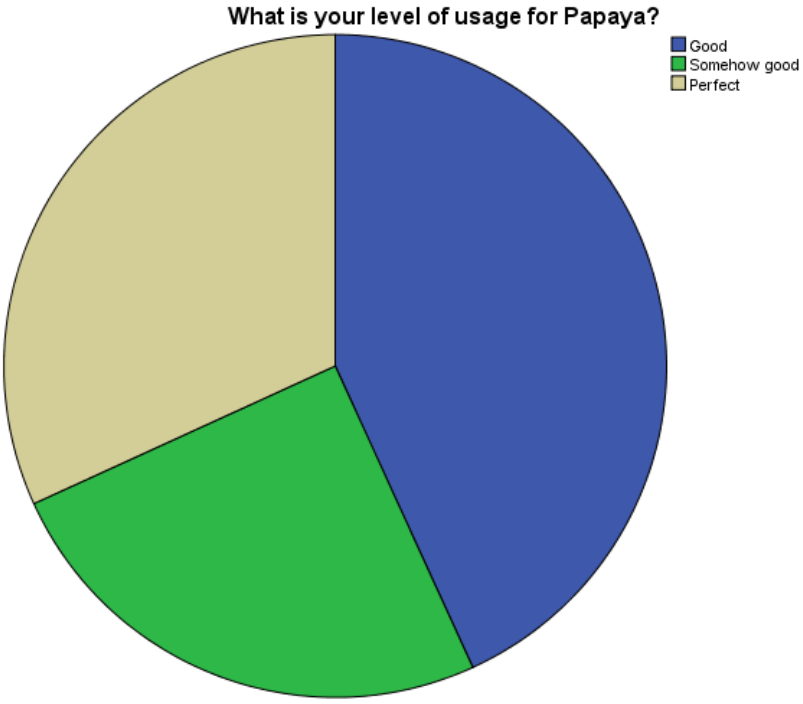
Figure 8 Implementation



68.2% of the CSOs interviewed strongly agreed that the tablet improved their ability to be a CSO. This involves using the tablet to perform activities such as supporting the teacher in class, giving quality feedback to the teacher after observations, assessing the literacy levels of the students and using the tablet to plan for lesson observations.

4.4.5 ICT Outcomes: Frequency of Lesson Observation

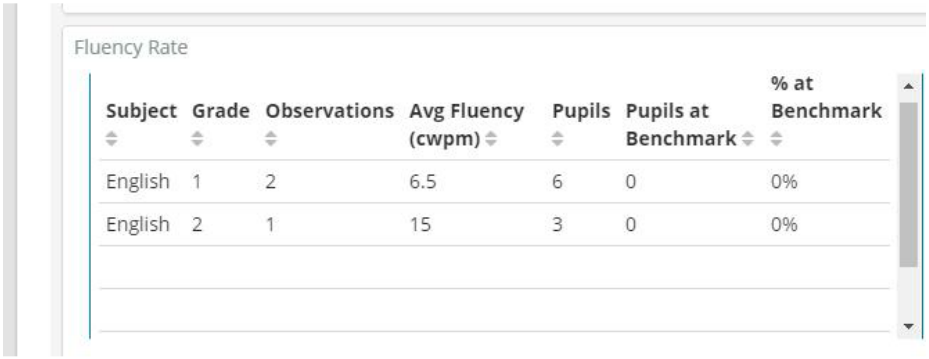
Figure 9 ICT Outcomes



Papaya is a reference tool used for letter names and sounds. The tool is installed in the Tusome tablet for reference especially when the CSO wants to clarify a letter name or sound to the teacher during feedback after a lesson observation. 43.2% of the CSOs responded that their level of usage of Papaya is Good. This could be case because it is not necessary for the CSO to use the tool every time they do an observation because the teacher perform well in that secion and not need negative feedback in that area.

4.4.6 Early Grade Literacy Gains: Literacy Score

Table 9 Uasin Gishu - Moiben: Average Fluency rate

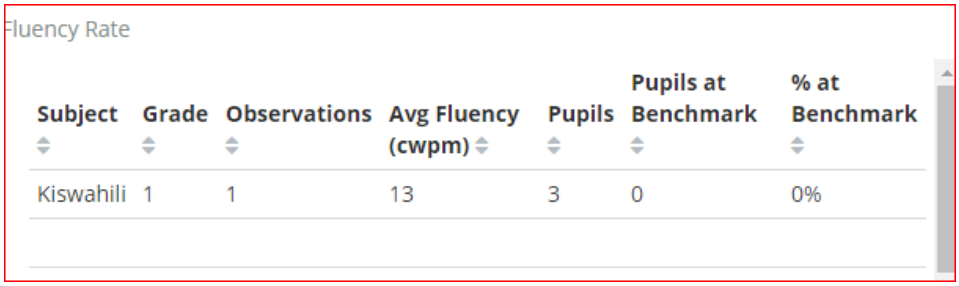


Fluency Rate

Subject	Grade	Observations	Avg Fluency (cwpm)	Pupils	Pupils at Benchmark	% at Benchmark
English	1	2	6.5	6	0	0%
English	2	1	15	3	0	0%

Table 4.4.3 shows average fluency rate for Moiben zone Uasin Gishu county no pupils are reading at benchmark both grade 1 and 2 which depicted by 0% for both cases. Average fluency rate for grade 1 and 2 were 6.5 and 15 respectively; and number of pupils were AVF= 6 for grade 1 and 3 for grade 2 observations AVF = 2 and AVF= 1 for English grade 1 and 2 respectively

Table 10 Bungoma Average Fluency Rate



Fluency Rate

Subject	Grade	Observations	Avg Fluency (cwpm)	Pupils	Pupils at Benchmark	% at Benchmark
Kiswahili	1	1	13	3	0	0%

From Bungoma County average fluency rate was measured in Kiswahili for grade 1 pupil's only one observation was made for 3 pupils which yield average fluency rate of 13 no pupil read at bench mark.

Table 11 Busia Angurai Average Fluency Rate

Fluency Rate

Subject	Grade	Observations	Avg Fluency (cwpm)	Pupils	Benchmark	Benchmark
English	1	1	4	3	0	0%
Kiswahili	1	1	14	3	0	0%
English	2	1	41	3	0	0%

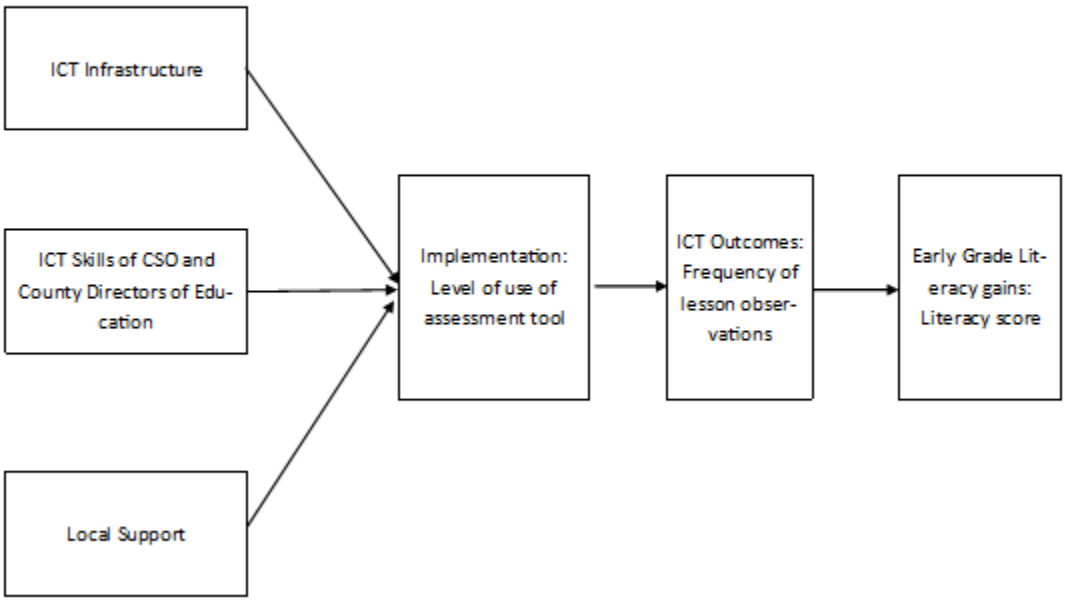
Data was collected from Angurai Busia County instead of Amogoro since personnel had not recorded any observation on the average rate of fluency on Tusome dashboard. The study then employed the use of K-Nearest Neighbor model to compare the population from the nearby sub-county (Angurai) whose average fluency rate was used. Grade 1 English and Kiswahili was observed once, number of pupils assessed was 3 in cases the average fluency rate showed. English was 14 and Kiswahili was 4 for grade two English observed was 1 and average fluency rate was 41. However, no pupil read at bench mark for both grade 1 and 2.

In conclusion, of the selected counties for this study Average Fluency Rate (AFR) for grade two English was highest in Busia AFR= 41 while Uasin Gishu came a distance last with AFR=15 for Kiswahili Busia and Bungoma were almost equal with ARF of 14 and 13 respectively.

4.5 Inferential Analysis

Inferential analysis uses statistical tests to see whether a pattern we observe is due to chance or due to the program or intervention effects (University of Minnesota, 2019). In this research, we have used inferential analysis to determine if there is a relationship between an intervention and an outcome as well as the strength of that relationship. This is guided by the research objectives and the conceptual framework as seen the figure 9 below.

Figure 10 Conceptual Framework



4.5.1 Relationship between ICT infrastructure, ICT Skills and Local Support with Implementation: Level of Use of Assessment Tool

Table 12 Regression Analysis of ICT Infrastructure, ICT Skills and Local Support with Implementation

	Coefficient	OR	95%	p-value
Constant	1.915			0.001
ICT infrastructure	14.675	4.233E-007	(1.408E-008, 1.272E-005)	<0.001
ICT Skills	14.070	1289415.125	(<0.000, 1.121)	0.993
Local support	0.203	0.816	(0.001, 807.305)	0.954

Regression was employed to determine the implementation of the level of use of the assessment tools and ICT infrastructure, ICT skills and local support. The results showed that the implementation of the use of the assessment tools is strongly associated with the ICT infrastructure; OR=4.233E-007, $p<0.001$. For the Tusome policy to be implemented first tablets have to be made available, skills and the local support comes second. ICT skills and local support was found to be not so significantly associated with the implementation of assessment tools. ICT skills; OR= 1289415.125, p=0.993 and the local support OR=0.816, p=0.954. A unit increase in the ICT skills would result in the increase of implementation by 14.070 and local support affect the implementation by -0.203. From the discussion above there was enough evidence to conclude that, ICT infrastructure is most important in the implementation of the Tusome literacy skills the decision was taken at 95% CI.

Modeling the predictors of implementation of the level of use of assessment tools

The model is expressed as follows;

$$Y= \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

Where;

Y = Implementation

β_0 = (constant)

X_1 = ICT Infrastructure

X_2 = ICT Skills

X_3 = Local support

ε = Error term.

Implementation =1.915+14.675ICT Infrastructure+14.070ICT Skills+0.203Local support

4.5.2 Relationship between Implementation and ICT Outcomes: Level of Lesson Observations

Table 13 Regression Analysis of ICT outcomes against Implementation

	Coefficient	OR	95%	p-value
Constant	2.038			0.007
Implementation	1.599	4.950	(1.657, 14.786)	0.004

The relationship between the ICT outcomes: frequency of lessons observed and the implementation: use of the assessment tools was significantly related as the OR=1.599, p=0.004. This clearly depict that the ICT outcome in the study highly depend on the implementation of the program. The Model showed that a unit increase in the implementation results in increase of the ICT outcome by 1.599 plus 2.038 the modelling the equation would be as shown below.

ICT Outcome = 2038 + 1.599Implementation

4.5.3 Relationship between ICT Outcomes and Early Grade Literacy gains: Literacy Score

Table 14 Regression Analysis of Literacy score against lessons observed

	Coefficient	OR	95%	p-value
Constant	62.260			0.001
ICT outcome	41.453	9.531E-019	(3.396E-019, 2.904E-018)	0.001

When the study compared the literacy score and the ICT outcome the result showed that, the ICT outcome significantly relates to the literacy score the odds ratio (OR=9.531E-019, p=0.001). Coefficient of the ICT outcome depicted that a unit increase in would result in an increase of the literacy score by 41.453. Therefore there was enough evidence to conclude that there is association between the literacy score and the ICT outcome. The decision was taken at 95%CI.

Model: **Literacy score = 62.260 +41.453ICT outcome**

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

5.0 Overview

This chapter presents a summary conclusion and recommendation based on the findings of the study.

5.1 Summary of Findings per Research Objective

5.1.1 The relationship between the ICT infrastructure and the level of use of the assessment tool

Most CSOs and County Directors of Education (93.2%) indicated to own personal smart phones. 95.5% of the respondents have indicated that they have attended a Tusome training which is conducted three times a year where they are practically guided on how to use the tablets and the tools pre-installed in the tablets. 90.5% have been issued with an Android based tablet by Tusome.

The results showed that the implementation of the use of the assessment tools is strongly associated with the ICT infrastructure; OR=4.233E-007, $p<0.001$. The CSOs and the County Directors needed to have the proper ICT infrastructure for the implementation of Tusome to be successful. This means that they need to have working tablets with pre-installed tools and applications. They need a source of internet either by tethering to their smartphones, WI-FI connection or using a nearby cyber café. They also need user training and support on the tablets and tools used in Tusome.

5.1.2 The relationship between the ICT skills of the CSO/County Director of Education and the level of use of the assessment tool.

The descriptive statistical analysis results indicates that 50% of the CSOs and County Directors of Education have a 'Good' level of proficiency in basic tablet operations. 27.3% of the respondents indicated that they were 'Perfect' in their level of proficiency in using Tutor: Tangerine which is the main observation tool used by the CSOs to capture data in classrooms and during feedback to the teachers. 68.2% of the CSOs and County Directors had a 'Moderate' level of proficiency of basic computer skills. The basic computer skills include fundamental computer skills such as use

of internet and emails, basic hardware and software concepts, word processing formatting, presentations, spreadsheets and multimedia.

The results showed that ICT skills was found to be not so significantly associated with the implementation of assessment tools. ICT skills had an; OR= 1289415.125, p=0.993 A unit increase in the ICT skills would result in the increase of implementation by 14.070. Proper training and support of users of the tools and the dashboard has proven to be an effective technique of ensuring that the CSOs and the County Directors use the tablets as prescribed. Continuous training and support involves practical mentoring and coaching of the CSOs and the County Directors both at the workshops and at the school as they carry out their observations.

5.1.3 The relationship between Local Support and the level of use of the assessment tool.

Most CSOs (70.5%) under study indicated to have support from their immediate supervisors. 97.7% of the CSOs under the study responded that they support headteachers during the program implementation. The County Directors are based at the County Head Quarters and basically oversee activities in the whole County, while Sub County based handle Sub Counties in their respective Counties. They are the immediate supervisors to the CSOs and provide a support function for the CSOs. They are expected to facilitate the movement of the CSOs to the various schools and also assist the CSOs with issues of underperformance in zones, preparation of work plans for support, recommendation for promotion of officers, holding meetings with CSOs to come up with solutions and monitoring of CSOs support to schools. The CSOs are also expected to support the headteachers who are in close contact with the teachers and can therefore help the teacher to always deliver quality lessons following the instructional models of Tusome.

Local support was found to be not so significantly associated with the implementation of assessment tools. The local support had an OR=0.816, p=0.954. This is possibly because if the CSO is efficient in supporting the teacher during training, support school visits and cluster meetings, then the over reliance on headteachers and county directors would be minimal for the implementation of Tusome.

5.1.4 The relationship between the level of use of the assessment tool and the frequency of the lessons observed.

61.4% of the CSOs indicated that the software on the tablet facilitates their ability to have an engaging feedback session with the teacher. 68.2% of the CSOs in the study strongly agree that Tusome tablet has improved their ability to be a CSO. Some of the functions of the CSO within the school level include: using Tangerine tool to plan their work while observing the teacher, giving teachers feedback after observing a lesson and assessing learner's literacy levels at the early grade.

63.6% of the CSOs agree that the tablets help them visit more teachers regularly. The relationship between the ICT outcomes: frequency of lessons observed and the implementation: use of the assessment tools was significantly related as the OR=1.599, p=0.004. This clearly depict that the ICT outcome: frequency of the lessons observed in the study highly depend on the implementation of the program. It is clear that CSOs refer to these applications in supporting teachers' pedagogical skills. 63.6% of the CSOs strongly agree that they use the tablet during every classroom observation. The popularity of Tangerine assessment tool is due to its functions and usage in relation to lesson observation.

5.1.5 The relationship between the frequency of lessons observed and the literacy score of the learners.

86% of the CSOs and the County Directors of Education in the study agree that the tablets help them track teachers and students progress. 95.5% of the CSOs and the County Directors of Education in the study indicated that Tusome tablet helps them assess learner competencies in literacy. The Tangerine Dashboard is a tool developed by Tusome and can be accessed by anyone who has access to the link and internet connectivity. The Dashboard contains processed data in regards to classroom level support and fluency levels for learners in grade 1, 2 and 3. The Tangerine dashboard link is shared out on monthly basis via email to Directors. County Directors who have used Tangerine dashboard data in decision making pointed out that the system had enabled them easily tackle issues such as: underperformance in zones, preparation of work plans for support, recommendation for promotion of officers, holding meetings with CSOs to come up with solutions, monitoring of CSOs support to schools.

When the study compared the literacy score and the ICT outcome the result showed that, the ICT outcome significantly relates to the literacy score the odds ratio (OR=9.531E-019, p=0.001). For there to be literacy gains in the learners then it can be concluded that the CSOs need to frequently go to schools to perform classroom observations using the tablets. Close supervision of the teachers ensures that they deliver quality lessons adhering to the methodologies that are to be used.

5.2 Conclusion

Tusome Literacy Programme has enabled improved literacy on early grade learners in public schools. CSOs and County Directors of Education have implemented use of ICT tools to monitor and support teachers and learners in the early grade i.e grade 1, 2 and 3. This has depended on the education officers being issued with Android based tablets that had pre-installed tools and applications. Availability of an internet connection was made possible through tethering the tablet to a smartphone for internet connectivity, WIFI connection available in offices and hotels or use of nearby cyber café. With internet connectivity the CSOs were able to upload the data gathered to a cloud-based national database. In this regard, the County Directors of Education supported and observed the CSOs, the CSOs in turn supported the teachers and the pupils through classroom teacher support and continuous learner assessment. The learner's fluency was assessed. This was evidenced by the validity of the items on the scale. With proper implementation then the CSOs are able to carry out more school visits. It is seen that as CSOs go out to the schools to assess the learners and support the teachers, gains are seen in the literacy score of the learners. The ultimate goal of the program is therefore achieved which is to have the learners able to read.

Basic ICT skills of the CSO and County Director was not as significant to the implementation of the program because use of basic ICT skills such as use of word processing software, spreadsheets, emails etc does not directly translate to ability to use of Tangerine software for monitoring. Termly training on use of the tablet and the monitoring tool, and consistent field support by the Tusome team had an impact on the CSO's ability to use Tangerine software in the tablet. Local Support from the headteachers and county directors of education was not as significant mainly because the they had limited time during termly trainings and also did not interact frequently with the monitoring tool due to other competing tasks in their work schedules.

5.3 Recommendation

I. Local support by the supervisors of the teachers and the CSOs is key for the continuity and sustainability of Tusome. The County Directors of Education and primary school headteachers need to have clearly laid out roles in implementation of Tusome. They need to be sensitized on the importance of their roles and expectations in the implementation of Tusome. They need to be trained continuously and their reports scrutinized by stakeholders of Ministry of Education. Misreporting and non-performance should have consequences. ICT solutions should be employed to reduce the administrative burden of County Directors of Education and headteachers to constantly consolidate and manage data.

II. Data obtained from the CSOs through Tangerine (monitoring tool) needs to be used for decision-making by the Ministry of Education. The Tangerine reporting tool (dashboard) is capable of assisting MOE detect issues within the early grade literacy levels and help in coming up with innovations to improve literacy levels in the country further. Integrating Tangerine to other existing systems such as NEMIS within MOE would be a great stride in ensuring that the data is put to use within the entire education sector.

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APPENDIX

Appendix 1 Questionnaire

Tusome Early Grade Literacy Programme is a Ministry of Education (MoE) intervention whose goal is to improve literacy outcomes for class one, two and three pupils in Kenya. This questionnaire is for the purpose of conducting a research on how use of ICT can have an impact on Early Grade Literacy.

SECTION A: INTRODUCTION

Please provide the following information:

1	Date of Interview	
2	Name of Employer	
3	Job Title	
4	County (Workstation)	
5	Zone/Sub County (Workstation) (If applicable)	

SECTION B: DEMOGRAPHIC QUESTIONS

1	Gender: Male [ ] Female [ ]
2	Age: Below 29 years [ ] 30 – 44 years [ ] 45 years and above [ ]
3	How long have you worked in that position? Less than a year […] 1-5 years […] 5 years and above […]
4	What is your responsibility in that position in relation to Early Grade Literacy?

SECTION B: ICT INFRASTRUCTURE

To be filled by All:

1. How many computers do you have in that office? *(indicate)*

   ……..

2. How many are currently operating? *(choose option or indicate)*

   [1] All [2] None [3]…….

3. Are the computers connected to the internet? *(choose one option)*

   [1] Yes [2] No

4. How do you primarily use the internet? *(choose one option)*

   [1] Educational resources [2] News [3] Social media

5. What type of mobile phone do you use or have access to? *(choose one option)*

   [1] Basic phone [2] Smartphone

6. Have you undergone any Tusome program training? *(choose one option)*

   [1] Yes [2] No

7. Has Tusome program issued you with a tablet? *(choose one option)*

   [1] Yes [2] No

SECTION C: ICT SKILLS

To be filled by All:

1. How many Tusome trainings have you attended in the last 2 years? *(choose one option)*

   [1] One [2] Two [3] Three [4] >Three

2. State your level of proficiency in basic tablet operations *(choose one option)*

   [1] Moderate [2] Very good [3] Perfect

3. State your level of proficiency using Tutor(Tangerine) in the Tusome tablet *(choose one option)*

   [1] Moderate [2] Very good [3] Perfect

4. State your level of proficiency using Papaya in the Tusome tablet *(choose one option)*

   [1] Moderate [2] Very good [3] Perfect

5. State your level of proficiency accessing PDF books in the Tusome tablet *(choose one option)*

[1] Daily [2] Weekly [3] Monthly [4] After three months [5] Twice a year [6] Once a year

6. State your level of proficiency accessing instructional videos in the Tusome tablet *(choose one option)*

   [1] Moderate [2] Very good [3] Perfect

7. State your level of proficiency in basic computer skills *(choose one option)*

   [1] Moderate [2] Very good [3] Perfect

8. State your level of proficiency in using the internet/emails *(choose one option)*

   [1] Moderate [2] Very good [3] Perfect

9. Do you have ICT Assistants in the office *(choose one option)*

   [1] Yes [2] No

10. If Yes, How often do they assist you in operating the Tusome tablet *(choose one option)*

    [1] Quite often [2] Often [3] Rarely

SECTION D: LOCAL SUPPORT

To be filled by All:

1. Does your immediate supervisor support you in Tusome activities? *(choose one option)*

   [1] Yes [2] No

2. Do you support headteachers/teachers in classrooms?

   [1] Yes [2] No

3. Do the schools that you visit have tablets or ICT gadgets?

   [1] Yes [2] No

4. If Yes, what is the source of their ICT gadgets?

   ……

5. Approximately what is the percentage of schools in your area which have ICT gadgets?

   ……

6. In your view, what type of ICT gadgets mentioned above can be used in supporting Tusome activities?

   ……

7. Extent in which head-teachers support classroom visits using tablets *(choose one option)*

   [1] Daily [2] Twice a week [3] Thrice a week [4] Never

8. Extent in which teachers support classroom visits using tablets *(choose one option)*

   [1] Daily [2] Twice a week [3] Thrice a week [4] Never

SECTION E: IMPLEMENTATION - LEVEL OF USE OF ASSESSMENT TOOL

For County Directors and Sub-county Directors:

1. Do you receive monthly email notifications for Tusome data? *(choose one option)*

   [1] Yes [2] No

2. How frequently do you access data from CSOs on the dashboard? *(choose one option)*

   [1] Daily [2] Weekly [3] Monthly [4] After three months [5] Twice a year [6] Once a year

3. Has access to the data from CSOs on the dashboard affected your county/department/ministry's activities or decisions? *(choose one option)*

   [1] Yes [2] No

   If yes briefly explain

   ……

   ……

   ……

For CSOs:

1. Which applications have you utilized in supporting teachers? *(you can choose more than one of the options)*

   [1]Papaya [2] Tangerine Tutor [3] Instructional Videos [4] Accessing PDF materials

2. What is your level of usage for Tangerine Tutor? *(choose one option)*

   [1] Good [2] Somehow good [3] Perfect

3. What is your level of usage for Papaya? *(choose one option)*

   [1] Good [2] Somehow good [3] Perfect

4. What is your level of usage for Instructional Videos? *(choose one option)*

   [1] Good [2] Somehow good [3] Perfect

5. What is your level of usage for Accessing PDF books? *(choose one option)*

   [1] Good [2] Somehow good [3] Perfect

6. Tusome tablet makes it easier to demonstrate appropriate teaching of a skill to teachers *(choose one option)*

   [1] Agree [2] Strongly Agree [3] Neutral [4] Disagree [5] Strongly disagree

7. Tusome tablet helps me assess learner competencies in literacy *(choose one option)*

   [1] Agree [2] Strongly agree [3] Neutral [4] Disagree [5] Strongly disagree

8. Tusome has helpful sound applications to help teachers *(choose one option)*

   [1] Agree [2] Strongly Agree [3] Neutral [4] Disagree [5] Strongly disagree

9. The software on the tablet facilitates my ability to have an engaging feedback session with the teacher *(choose one option)*

   [1] Agree [2] Strongly Agree [3] Neutral [4] Disagree [5] Strongly disagree

10. I am comfortable using the tablet *(choose one option)*

    [1] Agree [2] Strongly Agree [3] Neutral [4] Disagree [5] Strongly disagree

11. I use the tablet during every classroom observation *(choose one option)*

[1] Agree [2] Strongly Agree [3] Neutral [4] Disagree [5] Strongly disagree

12. Tusome tablet has improved my ability to be a CSO *(choose one option)*

    [1] Agree [2] Strongly Agree [3] Neutral [4] Disagree [5] Strongly disagree

13. The tablets help me visit more teachers regularly *(choose one option)*

    [1] Agree [2] Strongly Agree [3] Neutral [4] Disagree [5] Strongly disagree

14. The tablets help me track teachers and students progress *(choose one option)*

    [1] Agree [2] Strongly Agree [3] Neutral [4] Disagree [5] Strongly disagree