REPUBLIC OF KENYA

MINISTRY OF EDUCATION

STATE DEPARTMENT FOR
BASIC EDUCATION

Internet Connectivity to Schools

EXPERIENCES AND LESSONS LEARNT FROM DIGISCHOOL PROJECT IN KENYA

2023

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FOREWORD

Equitable access to internet connectivity is crucial for achievement of the UN Sustainable Development Goals, particularly SDG4, which provides for inclusive, equitable and quality education and lifelong learning. Internet connectivity enriches teaching and learning by granting access to a diverse range of quality learning content that is both relevant and personalized based on diverse teaching and learning needs aligned to the aspirations of the on-going education reforms in Kenya. Moreover, the connectivity supports inclusion by enabling the use of assistive and adaptive technologies, promoting accessibility for learners living with disabilities. It enhances data collection and utilization, facilitating the integration of education management information systems for more efficient administration at various levels. Additionally, connectivity drives local innovations among young people, fostering solutions that address immediate community needs while providing opportunities for connection amongst young people from all over the world on a common engagement or goal.

School internet connectivity plays a pivotal role in strengthening resilience in education and adaptability to the demands of the digital age. Further, as a means to efficient educational administration, innovative content distribution, as well as the acquisition of essential digital skills, connecting internet to the schools is fundamental in preparing learners for the job market. It also empowers the learners to thrive in ever evolving digital era. However, achieving the full benefits of the internet requires efficient, reliable and sustainable connectivity at the institutional level.

In view of the Government's commitment to continuously integrate ICT in education, internet connectivity to schools remains a key component of this process. The Ministry of Education (MoE), UNESCO and other partners implemented the Digischool Internet Connectivity Project in Kenya leveraging on National Optic Backbone Infrastructure (NOFBI) and Digital Literacy Programme (DLP), with a view to provide sustainable internet access to Kenyan schools. This project was to ensure continuity of teaching and learning and thus presents a model that is worth learning from. This report highlights the process of implementation, key lessons and good practices, as well as some of the challenges that called for continuous mitigation mechanisms.

I recognize the collaborative efforts among line ministries, government agencies and partners in the implementation of this project and look forward to enhancing the support as we upscale the programme. It is my hope that MoE officials, school administrators, teachers and stakeholders will adopt the lessons and good practices contained herein. Particularly, I urge partners implementing programmes on internet connectivity to schools to emulate this approach in terms of collaborations, affordability and sustainability. This would go a long way into bridging the digital divide, fostering equity and equality in education, as well as transforming the lives of Kenyan learners.

Hon. Ezekiel O. Machogu, CBS
CABINET SECRETARY

PREFACE

Kenya's Vision 2030 stipulates the Government of Kenya's goal of transforming the country into a globally competitive and prosperous nation with a high quality of life. The Sessional Paper No. 1 of 2019, states that education shall be transformed to meet the 21st century needs for the country. It is in this context that the government has made efforts to connect schools to the internet. The government has over the years invested heavily in the requisite ICT infrastructure, capacity building, development of digital content and strengthening institutional management. As indicated in NESSP2018-2022, education institutions would use ICT as a pedagogical tool to enhance teaching and learning.

The purpose of this report is to provide experiences and lessons learnt on internet connectivity to schools under the Digischool project. The recommendations of this report are aimed at transforming education that stimulates critical thinking, creativity and innovation to meet the challenges of the 21st Century. The report further presents findings with a view of identifying how the sector can reap the benefits on internet connectivity to schools to enhance provision of quality and inclusive education. This will ensure Kenyan citizens acquire requisite skills and knowledge to meet the demands of the labour market, locally and globally.

This report is organized into six Sections. Section One discusses the background and objectives of the Report. Section Two contains methodology which includes the study design, data collection methods and data analysis. Section Three presents the findings covering demographic information, level of utilization of internet for teaching and learning, good practices for scalability and sustainability of internet connectivity in schools and utilization of internet to strengthen administrative functions in schools. Section Four discusses the lessons learnt while Section Five gives the conclusion. Finally, Section Six gives the recommendations of the study.

It is expected that the findings of this report will inform the education sector on internet connectivity to schools in a sustainable and cost effective manner. In addition, it is anticipated that there will be improved coordination to eliminate duplication and wastage on internet connectivity to schools. I wish to call upon all stakeholders to ensure that the recommendations of this report are fully implemented to transform basic education in Kenya.

Dr. Belio R. Kipsang, CBS
PRINCIPAL SECRETARY

ACKNOWLEDGEMENT

This report was developed based on a review of the Digital Literacy Programme (DLP), also known as the Digischool Project. The report is a product of a rigorous and inclusive process that comprised various stakeholders. The Ministry of Education (MoE) acknowledges and appreciates all stakeholders and partners for their critical inputs and tireless efforts to ensure this report is finalized.

I recognize the Senior Management, Ministry of Education for the leadership and wisdom that guided this process. Similarly, I appreciate all stakeholders in the education sector for their invaluable contributions in the development of this report. Specifically, the contribution of the Digital Literacy Programme (DLP) team in guiding the project implementation and development of this report is commendable.

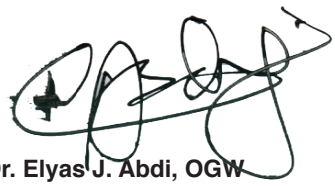
Additionally, MoE is highly indebted to the Ministry of Information, Communications and the Digital Economy, ICT Authority (ICTA), as well as Kenya National Commission for UNESCO (KNATCOM) for providing logistical and technical support. In addition, I wish to sincerely thank Huawei Technologies under its TECH4ALL digital inclusion initiative together with UNESCO for providing financial and technical support towards the project and the development of this report.

My appreciation also goes to the Technical Working Group drawn from MoE Directorates, KNATCOM, ICTA and UNESCO for doing exemplary work in ensuring that this report becomes a reality.

I further extend my gratitude to the school principals, head teachers, Boards of Management (BoMs), parents, teachers and learners from beneficiary primary and secondary schools for their cooperation in the project implementation, as well as participating in the survey.

I also like to thank Dr. Reuben Mutegi and his Research team comprising of Dr. Anastasia Gakuru, Mr. Charles Ouko and Mr. Thomas Muriithi, for providing technical leadership in the survey and authorship of this report.

Finally, I wish to acknowledge other stakeholders for their contribution during the process of developing this report.



Dr. Elyas J. Abdi, OGW
Director General
State Department for Basic Education
MINISTRY OF EDUCATION

LIST OF ABBREVIATIONS AND ACRONYMS

CESA	-	Continental Education Strategy for Africa
CAP	-	Content and Access Point
CBC	-	Competency Based Curriculum
DLP	-	Digital Literacy Programme
FGD	-	Focus Group Discussion
GEC	-	Global Education Coalition
HI	-	Hearing Impaired
ICT	-	Information, Communications and Technology
ICTA	-	ICT Authority
KCSE	-	Kenya Certificate of Secondary Education
KICD	-	Kenya Institute of Curriculum Development
KII	-	Key Informant Interview
KNATCOM	-	Kenya National Commission for UNESCO
LAN	-	Local Area Network
MICDE	-	Ministry of Information, Communications and the Digital Economy
MTP	-	Medium-Term Plan
NEMIS	-	National Education Management Information System
NESSP	-	National Education Sector Strategic Plan
NOFBI	-	National Optic Fibre Network Backbone Infrastructure
MoE	-	Ministry of Education
SAGAs	-	Semi-Autonomous Government Agencies
SPSS	-	Statistical Package for the Social Sciences
STEM	-	Science, Technology, Engineering and Mathematics
TMIS	-	Teacher Management Information System
TSC	-	Teachers Service Commission
TPAD	-	Teachers Performance Appraisal Development

TVET	- Technical and Vocational Education and Training
UNICEF	- United Nations Children's Fund
UNESCO	- United Nations Educational, Scientific and Cultural Organization
UPS	- Uninterruptible Power Supply
VI	- Visually Impaired

DEFINITION OF KEY TERMS

Access to ICT	Right to acquire and use ICTs.
Assistive technology	Hardware and software for persons living with disabilities including the process used in selecting, locating and using them.
Blended learning	A mode of learning delivered via electronic and online media as well as traditional face-to-face teaching.
Digital learning resources	Materials included in the context of a curriculum that support the learner's achievement of the intended learning objectives. These materials include but not limited to graphics, images or photos, audio and videos, simulations, animations and programmed learning modules.
E-learning	A mode of learning where the learner and the instructor interact with each other in real time, from different locations and can complete self-paced online learning asynchronously.
Education administrator	A person who heads a learning institution.
ICT ethics	A set of moral principles that govern an individual or a group on what is acceptable behaviour while using digital devices.
Internet connectivity	Installation of internet in learning institutions.
Remote learning	A mode of learning where the learner and the educator or information source are not physically present in a traditional classroom environment.

EXECUTIVE SUMMARY

Internet connectivity is becoming increasingly important in schools for improving the quality of education and supporting continuity of teaching and learning. It also helps learners and teachers to access online services, enrich the teaching and learning experiences, as well as contribute to improving learning outcomes. As part of its national strategy to spur socio-economic growth through the integration of Information and Communications Technologies (ICTs) in Education, the Government of Kenya, through the Ministry of Education (MoE) initiated the Digital Literacy Programme (DLP), also known as Digischool Project and stated the desire to: provide all public primary schools with digital devices for learners and teachers; build the capacity of teachers; develop digital content/curricula; and connect schools to high-speed internet through various strategies and plans.

The Government has laid the National Optic Fibre Backbone Infrastructure (NOFBI) to provide affordable and quality broadband infrastructure across the country. Currently, NOFBI connects all 47-county headquarters, 290 Constituency headquarters, and is intended to connect all public learning institutions, amongst other goals stated in the Kenya National Digital Masterplan, 2022-2032.

The Global Education Coalition was initiated by UNESCO at the wake of the COVID-19 pandemic and brought together IT and non-IT partners to offer pro-bono services to support governments in ensuring continuity of teaching and learning. The coalition has over 200 members among them Huawei who through its TECH4ALL digital inclusion initiative collaborated with UNESCO Multi-sectoral Regional Office for Eastern Africa, the Ministry of Education, the Ministry of Information, Communications and the Digital Economy (MICDE), as well as ICT Authority to initiate the Digischool Internet Connectivity Project in Kenya. Through the project, 13 schools were connected to the internet through NOFBI. These comprised 9 Primary and 4 Secondary schools benefiting an estimated 6,000 learners and 200 teachers.

The project aimed to provide sustainable internet access to Kenyan schools with the goal of enhancing the quality of education through improved access and effective utilization, as well as development of online teaching and learning content. Additionally, the internet would assist school administrators in carrying out administrative duties such as communicating with parents and other stakeholders, filling Teacher Performance Appraisal and Development (TPAD) appraisal forms, and managing learners' data in the National Education Management Information System (NEMIS). It was also to provide low-cost support for teaching and learning through delivery of online classes, downloading online instructional materials, handling class assignments and management.

This report has been developed from qualitative and quantitative research at 6 of the beneficiary schools 18 months after being connected to the internet. In each school, 20 learners completed a questionnaire while another 10 participated in a Focus Group Discussion (FGD). 5 parents/community members participated in a separate FGD. Interviews were conducted with two teachers (1 ICT and any other teacher) and one school administrator. Online questionnaires were also sent to key informants and project partners including Teachers Service Commission (TSC), Information Communication and Technology (ICT) Authority, Kenya Institute of Curriculum Development (KICD), and United Nations Educational, Scientific and Cultural Organization (UNESCO). The key informants were also interviewed.

The objectives of the study were to: (i) Ascertain how internet connectivity enhances teaching and learning in the benefiting schools; (ii) Determine good practices for scalability and sustainability of internet connectivity in schools; and (iii) Establish how internet connectivity strengthens administrative functions of the schools.

Key Findings

The study established that internet connectivity through the National Optic Fibre Backbone Infrastructure (NOFBI) was stable and reliable enough to meet the needs of learners, teachers, and school administrators for activities requiring the internet. Despite this, there were occasional interruptions in connectivity.

The study revealed that teachers used internet for lesson preparation, online lessons, internet-based teaching in class, online meetings, uploading learners' grades into the school assessment system, accessing online training materials, using online quizzes to monitor learner understanding of the class, and using online content such as videos, animations and games.

Learners reported that using the internet makes learning experiences more exciting, interactive and helps them make complex content easy to conceptualise hence improving learning experiences and outcomes, communication and writing skills, self-study and obtaining relevant current information.

Further, the connectivity transformed the administrative activities such as communication, data management, preparation of professional documents and research whilst also significantly reducing administrative costs in schools.

The study made the following recommendations:

Building the capacity of teachers and learners

- For effective utilization of the internet, teachers, school administrators and learners need training to improve their digital skills, particularly on the effective use of the internet in the classroom, basic troubleshooting skills to resolve minor connectivity issues, and ethical use of internet (to limit access to inappropriate content or inappropriate interactions online) by all stakeholders in the learning institution.

Connecting schools to internet through NOFBI

- There is need to connect schools to internet through NOFBI, as it has proven to be affordable, and reliable for teaching and learning, as well as for administrative duties in schools. This is the most sustainable model despite the high initial installation costs, which include laying of fibre cable from NOFBI terminal to the school and acquisition of several active devices.
- To achieve optimum utilization of internet in schools' classrooms, the connection available in the school (through Wi-Fi Access Points) should be aligned with the students' population, numbers of classrooms and distance from one class to the other. This will address cases of internet buffering and unavailability of signal.
- The expansion of internet to schools should be rapidly implemented to enhance education quality, accessibility and equity.

Ethical issues and security

- Schools should develop school-based guidelines, which are critical to regulate the use of the internet and ICT devices at school.
- Parents/guardians/care givers, teachers, learners and school administrators should be sensitized on responsible use of the internet.

Partnerships for sustainability

- In order to provide sustainable internet to all schools within the shortest time, concerted effort is required amongst the Government and its agencies; Telecommunication companies; development partners and other stakeholders so as to minimize the initial connectivity costs and reduce recurrent expenditures, which cannot be sustained by the schools.
- There is also need to advocate for the establishment of community internet (hubs) to facilitate the community surrounding the schools to have access to the internet. This will reduce interruption of schools' activities by community members streaming into the school to access the internet.

Content and devices

- There is need to establish a mechanism for repairing broken devices and e-waste management system for the disposal of un-repairable devices.

In conclusion, the Digischool Internet Connectivity project met its goals of providing fast, reliable and stable internet connectivity to support teaching and learning. It also enhanced access to and quality of education, as well as learning outcomes. The project reliably supported administrative duties in the 13 beneficiary primary and secondary schools in Kenya.

SECTION 1

BACKGROUND AND OBJECTIVES OF THE REPORT

1.1 Introduction

The purpose of this report is to highlight the experiences, lessons learnt and best practices from providing internet connectivity to the Digischool project, which promotes ICT integration in teaching and learning in selected public schools in Kenya. Through the Digischool Internet Connectivity Project, schools were connected to the internet in order to improve the quality of education through access to and utilization of online content. Primarily, the study focused on the impact of internet connectivity on beneficiaries in select primary and secondary learning institutions. The themes on digital skills/literacy and digital content were addressed in terms of (a) how useful the connectivity is, (b) how it is used, and (c) whether learners and teachers used the connectivity.

SCAN TO WATCH A VIDEO OF DIGISCHOOL PROJECT

1.2 Status of ICT Integration in Basic Education

At the international level, ICT is considered critical for the realization of SGD 4 on Inclusive and Equitable Quality Education and SDG 9 on Industry, Innovation and Infrastructure. Both the Africa Agenda, 2063 and the Continental Education Strategy for Africa (CESA), 2016-2025 emphasize the importance of ICT in achieving quality education. CESA strategic objective three emphasizes using ICT to improve access, quality and management of education and training systems, all of which are issues that this study seeks to address. It also guides African countries to develop policies for ICT integration in education and training, building capacity for ICT integration, developing mobile education and training platforms, and making ICT accessible to all learners.

In light of the aforementioned, the Government of Kenya (GoK) developed the 2019 National ICT Policy, which encourages integration of digital technologies into the educational and vocational system at all levels to ensure that the current and future workforce is prepared for the changing needs of the economy and employers. The policy seeks to create innovation hubs to be associated with a nearby university or Technical and Vocational Education and Training (TVET) institution. It also provides an opportunity for the community to access knowledge, create local solutions to problems, and then innovatively develop the solutions into enterprises. The policy further seeks to integrate ICT into the curriculum at all levels of education; develop and deploy a nationwide e-Education system that supports basic and higher education/training facilities across the country through linking them with each other and with relevant knowledge centres; and utilize data to better shape policies, strategic plans and tactical decisions for developing education and vocational training in Kenya. This is also anchored in the Third Medium-Term Plan (MTP III), 2018-2022, which guides on integration of ICT into teaching and learning, implementation of Competence Based Curriculum (CBC) and expanding the Digital Literacy Programme; a critical aspect of content delivery.

The 2021 Policy on Information and Communication Technology in Education and Training aims at increasing access to appropriate ICT infrastructure in education and training for all; ensuring inclusive use of ICTs in education and training; as well as supporting the adoption of blended, remote, open, distance and e-learning approaches at all levels of education and training. It also provides for the improvement of e-waste management in education and training; strengthening the use of appropriate ICTs in curriculum development and implementation, and the promotion and regulation of the development, accessibility, and use of digital learning resources; as well as the promotion of the use of ICTs in the

curriculum assessment process among other provisions.

The National Education Sector Strategic Plan (NESSP), 2018–2022, depicted the role of technology in a modern, vibrant and successful society. This plan envisioned a strong technological foundation through ICT that would be reflected in the curriculum at all levels, its delivery, and the system support mechanisms. Since then, the government has implemented a Competency Based Curriculum (CBC) that emphasizes the development of skills and knowledge, as well as the application of competencies to real-world situations, with digital literacy being a core competency. According to the Government's MTP III, 2018-2022, integrating ICT into teaching and learning is critical for content delivery.

In the 2013/14 financial year, the Government began to integrate ICT in all public primary schools through initiating the Digital Literacy Programme (DLP), also known as Digischool, whilst the Computers for Schools programme was implemented in secondary education, and over three thousand schools were equipped with ICT devices (MoE, 2019). By January 2020, the device-to-pupil ratio in primary schools was approximately 1:8 (ICTA, 2020). Through the DLP or Digischool, the Government distributed over 1.1 million learner devices to 22,468 public primary schools, benefiting over 3 million learners in Grade 1 – 3. All public primary schools with DLP devices have been connected to electricity. Over 228,000 teachers have been trained in the use of technology in learning, and over 47,000 teacher devices have been distributed in primary schools along with a Projector, as well as a Content and Access Point (CAP) for each primary school. To ensure inclusivity in this programme, assistive technologies and specialized laptops were provided to assist in teaching and learning for the Visually Impaired (VI) and Hearing Impaired (HI).

To maximise utilization of the ICT devices provided to schools through the DLP programme, the Government of Kenya committed via the Kenya Digital Masterplan, 2022-2032 to have 100% broadband connectivity across the country by 2032, which will include 100% connectivity of all schools and other educational institutions. This will facilitate internet-based teaching and learning in all schools in Kenya, effectively revolutionizing the education sector.

1.3 ICT in Education Emergency Context in Kenya

The COVID-19 pandemic brought to light many of the world's inequalities, including the digital divide between and within countries. Countries with strong digital ecosystems were found to be more resilient to shocks and emergencies and responded better to the COVID-19 pandemic. School closures impacted the learning of an entire generation of young people and impacted 1.6 billion children in 188 countries (UNICEF, 2021). However, not all children were equally affected. Children in poorer countries were more disadvantaged than those in richer countries. This was due to a lack of inclusive digital infrastructure and comprehensive digital learning practices. Many developing countries globally, relied on low tech distance learning solutions due to lack of connectivity hence inequality and exclusion in access to education for most learners (Digital Resilience against Covid-19, 2020).

In Kenya, the Government's effort to mitigate the effects of COVID-19 pandemic on education accelerated ICT integration in education. In particular, the Government collaborated with partners to make online learning accessible, including those in underserved and unserved areas to ensure no learner is left behind. The Kenya Institute of Curriculum Development (KICD) strengthened the Kenya Education Cloud to enable teachers and learners to access digital content online. Streaming of model lessons for peer learning and continuous improvement in content delivery was also introduced.

1.4 Internet Connectivity to the Digischool Project in Kenya

The UNESCO Global Education Coalition (GEC) was formed in the year 2020 bringing together partners from a range of sectors to mobilize support and coordinate local, national, regional and global responses to ensure the continuity of learning during the COVID-19 pandemic. In 2023 and beyond, the Coalition is "moving from the pandemic response to the transformation agenda by facilitating bold, new, scalable and sustainable partnerships. These collaborations aim to help realize the power of digital transformation, close educational divides and support actions, as well as investments for pilot projects to be brought to scale at a national level and in a sustainable way".

As part of their commitment to the Coalition, in 2020 Huawei Technologies under its TECH4ALL digital inclusion initiative began collaborating with UNESCO Multi-sectoral Regional Office for Eastern Africa, the Ministry of Education, the

Ministry of Information Communications and the Digital Economy Internet Connectivity to Schools (MICDE), and the ICT Authority (ICTA) so that together, they would connect 13 schools (9 primary and 4 secondary schools) to high-speed internet connectivity as a pilot project in 2021. This was meant to inform subsequent scaling up efforts. The project benefited an estimated 6,000 learners and 200 teachers. In the project, partners pooled resources to connect schools with appropriate technology aimed at supporting the teaching and learning process and create a sustainable solution that takes advantage of the Government's more than 9,000-kilometer National Optic Fibre Backbone Infrastructure (NOFBI) - fibre network. The connectivity was also to enhance school administration through adoption of online management systems.

During the launch ceremony held on December 17, 2021, the internet connection was tested by hosting a virtual meeting that allowed participants from the 13 beneficiary schools to interact virtually. The deployment of internet connectivity directly targeted public primary schools and considered the distance between the school, and the NOFBI network: where the school was within one Kilometre of NOFBI, fibre was laid from the nearest NOFBI connection to the school and where the distance was more than one Kilometre, a point-to-point microwave link was used to connect the school to NOFBI. Four secondary schools neighbouring the benefiting primary schools were also connected for purposes of efficiency and extended reach. The schools that benefited were all in rural areas and spread across seven regions of the country including in marginalized areas such as Mandera County in North-Eastern Kenya.

The lessons learnt from this initiative will inform the on-going efforts by the Government and other partners to scale up provision of internet connectivity to schools. The project may also be useful for other jurisdictions and demonstrate how partnerships can bring sustainable connectivity to underserved and un-served communities.

1.5 Aim/Purpose of the Report

The purpose of this report is to highlight the experiences and lessons learnt from the Digischool Internet (Digischool) Connectivity Project in Kenya.

1.6 Specific Objectives of the Report

The specific objectives of this report are to:

1. Ascertain how internet connectivity enhances teaching and learning in the benefiting schools;
2. Determine good practices for scalability and sustainability of internet connectivity in schools; and
3. Establish how internet connectivity strengthens administrative functions in schools.

1.7 Report Focus Areas

The study focused on the following six areas through which internet may lead to improved access and learning outcomes as presented in Figure 1: (a) Effective utilization of internet usage in both teaching and learning, as well as administrative purposes; (b) Reliability of the internet; (c) Stakeholder support systems for internet usage in schools; (d) Good practices; (e) Ethical use of the internet; and (f) Connectivity sustainability mechanisms. The content in Figure 1 also guided the study objectives.

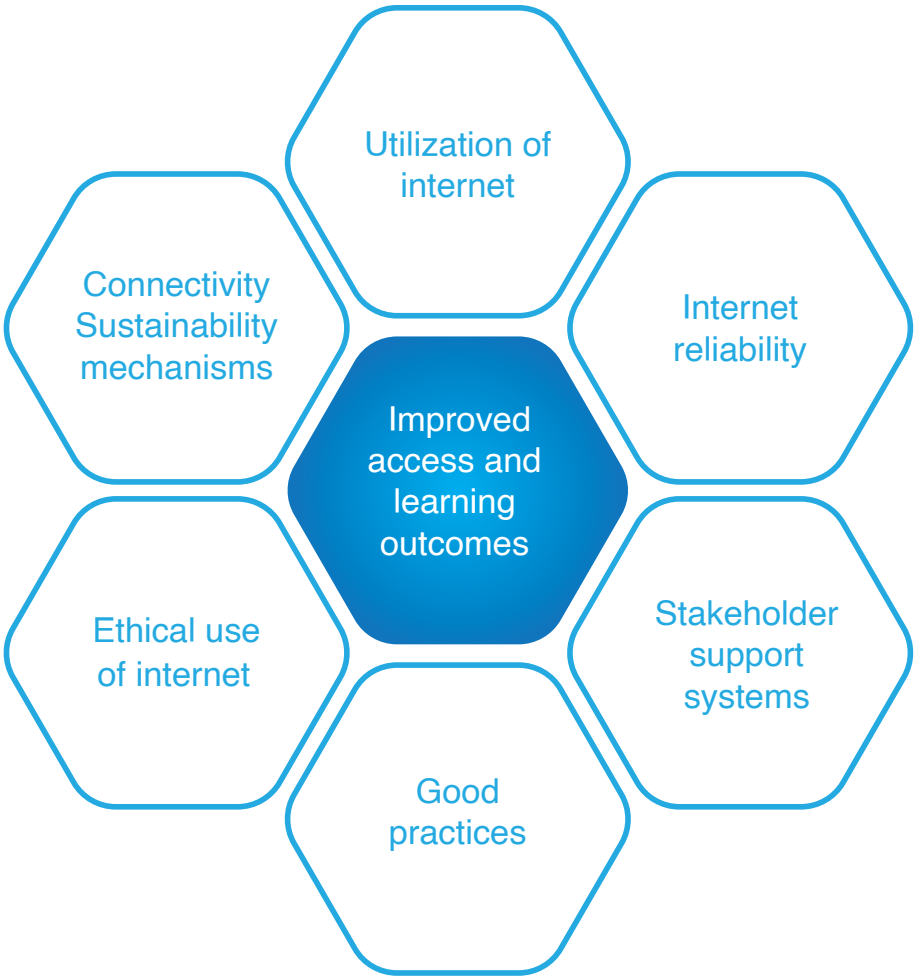


Figure 1.1: The Study Focus Areas

SECTION 2
METHODOLOGY

2.1 Study Design

A mixed methods case study design was employed to gather both quantitative and qualitative data to help establish whether the internet connectivity in the selected schools improved quality of teaching and learning. A case study design is recommended for social studies, which seek to get in-depth information in a case. In this case, it was useful to establish in great depth how schools use the internet, the stability of the internet and the sustainability of the internet among other variables.

2.2 Target Population and Sample Size

The target population included all learners, teachers and school administrators from 13 schools (9 primary and 4 secondary). It also included parents/guardians/caregivers who represented the community within the school locality, as well as partners such as Teachers Service Commission (TSC), ICT Authority, Kenya Institute of Curriculum Development (KICD) and UNESCO. The sample size comprised 30 students from each of the six schools (4 primary and 2 secondary), 5 parents/community members, 26 teachers (1 ICT and any other teacher from each school), 13 school administrators, and 4 key informants (TSC, ICT Authority, KICD and UNESCO).

2.3 Data Collection Methods

Data were collected using the following methods: 20 students completed a questionnaire, 10 learners participated in a Focus Group Discussion (FGD) and 5 parents/community members participated in a separate FGD. In each school, two teachers (1 ICT and any other teacher) and one school administrator were interviewed. Data from key informants including MoE, TSC, KICD, ICT Authority and UNESCO were collected through online questionnaires and interviews. The data collection methods are summarised in Figure 2.1.

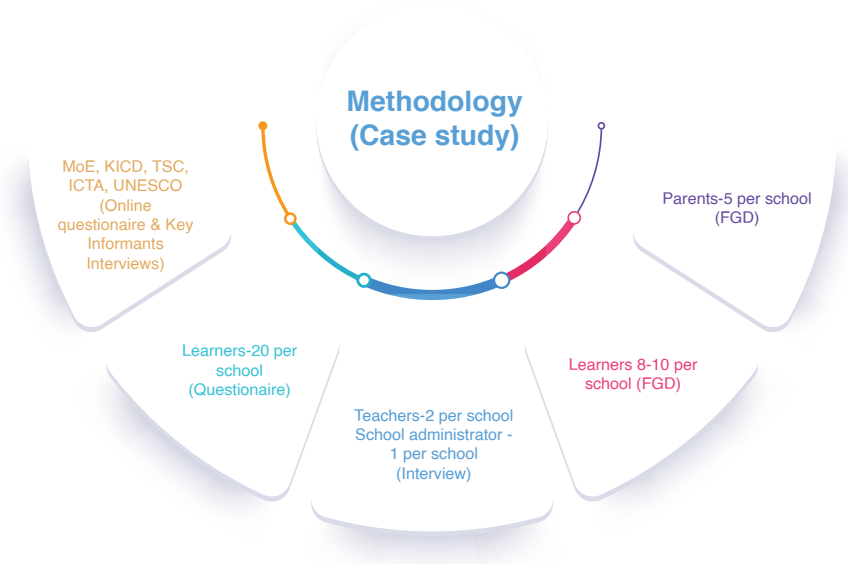


Figure 2.1: Sample Size and Research Tools

2.3.1 Questionnaires

Two types of questionnaires were used; a physical one for the learners and an online one for the Key Informants. The learners' questionnaire sought to establish the usage, stability, sustainability, support system and ethical use of the internet in schools, whereas the Key Informant's questionnaire sought to gain insights from other existing internet connectivity projects in schools and the role of the partners in the project.

Figure 2.2: Learners Filling in a Questionnaire

2.3.2 Interviews

The interviews were scheduled for teachers and school administrators to better understand internet usage, stability, sustainability, support systems, and ethical internet use in schools. Key Informants Interviews (KII) were also conducted with MoE, TSC, KICD, ICT Authority and UNESCO.

2.3.3 Focus Group Discussions (FGDs)

The FGDs were important so as to capture in-depth qualitative data to complement quantitative data from the questionnaires. It sought to probe the learners and parents on usage, stability, support systems and ethical use of the internet in schools.

2.3.4 Observation Schedule

The observation schedule was designed to determine how the internet infrastructure was installed, the access points and usage in classroom, as well as by community members.

2.3.5 Audio-Visual Recordings

Audio-visual recordings were taken from learners, teachers, school managers and parents to capture the voices of the internet users in relation to experiences, lessons learnt and challenges.

2.3.6 Document Review (Secondary Data)

In order to complement the findings of this study, documents from MoE, MICDE, KNATCOM, UNESCO, ICTA and other stakeholders supporting internet connectivity and online learning were reviewed.

2.4 Data Collection Procedure

The Ministry of Education (MoE) provided the required leadership in accessing the sampled schools on the date for data collection. The school administrators invited 2–5 parents/community members and organized learners and teachers to participate in discussions (a whole school approach). The data collection exercise was carried out by a team from MoE, MICDE, KNATCOM, UNESCO, ICTA and three researchers. The data collection exercise took two days per school in May-June 2023, which is 18 months after the project began. This was adequate time for the schools to have been using the internet. An online questionnaire was administered to Key Informant respondents from the government ministries and relevant Semi-Autonomous Government Agencies (SAGAs) comprising MoE, KICD, TSC and ICTA.

2.5 Data Analysis

The quantitative data from questionnaires were coded and analysed using Statistical Package for the Social Sciences (SPSS) and presented using graphs, figures and tables while the qualitative data from interviews and Key Informant Interviews (KII) were transcribed and organised thematically to complement the quantitative data and presented through direct quotations.

SECTION 3

PRESENTATION OF FINDINGS

3.1 Demographic Information

The learners were asked to indicate their gender and disability status and the results are presented in Table 3.1.

		Primary %	Secondary %
Learners Gender	Male	40	25
	Female	60	75
Total		**100**	**100**
Disability status	No disability	79	95
	Have disability	21	5
Total		**100**	**100**

Table 3.1: Gender and Disability Status of Learners

Table 3.1 indicates that there was representation of male and female learners in the study. It also indicates that 21% of primary school learners had mild disabilities while only 5% of learners in secondary school have various forms of mild disability. These findings corroborated with teachers' during interviews. The teachers revealed:

> *"Yes, we have learners living with disability like visual or physical but at mild level. They can read and do other activities like the students without disability. We organise for some to sit in front or make large prints for assessments." Teacher, Kitivo primary 2023.*

> *"We have few learners living with disabilities but the ones who are visually short sited, they sit near the board, the computer print for them it is enlarged." Teacher, Amatu secondary school 2023.*

This information is crucial for teachers to embrace learners' assimilation and processing of information using the universal design of learning principles. The learners were also asked to indicate their age. Figure 3.1 presents the results of the age of the learners.

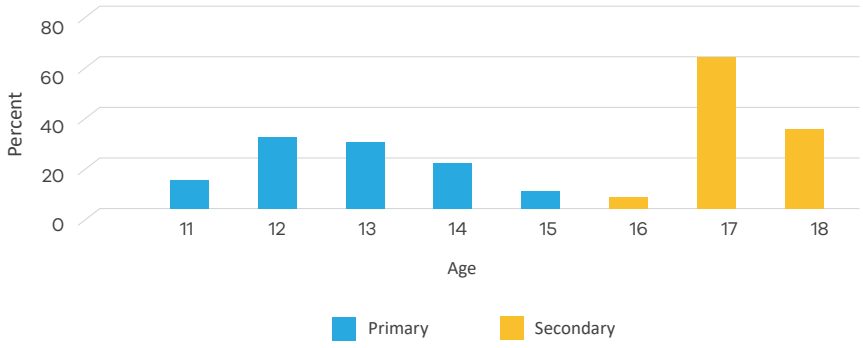


Figure 3.1: Age of the respondents

Figure 3.1 indicates that the learners' age ranged from 11 to 18 years where learners in primary schools were of age 11 to 15 and secondary schools of age 16 to 18. The age of the learners is also key for the choice of online content to use in class. Regarding the Grade, Class and Form, the learners were asked to indicate the current level. This is as presented in Figure 3.2.

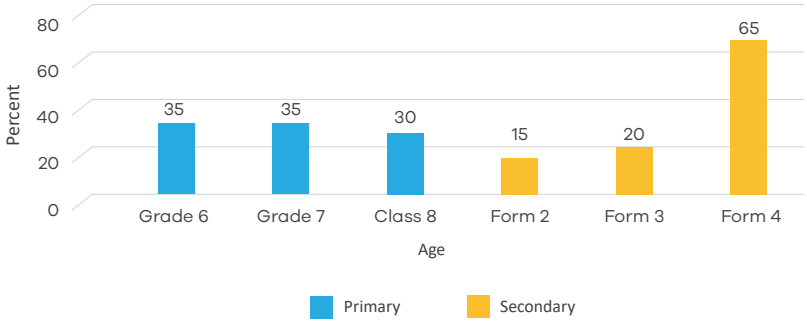


Figure 3.2: Grade/Class/Form of Respondents

The learners who took part in the study were from Grades 6 and 7, Standard 8 in primary schools, and Forms 2 to 4 in secondary schools. The reason for selecting Grades 6 and 7, and Standard 8 is because they were the first learners to be introduced to the DLP in 2013 and pioneers of CBC while in Grade 1 in primary schools, and thus had institutional memory. Forms 2, 3 and 4 were selected because they were in school for a long time as opposed to Form 1 who had just reported to school by the time of data collection.

3.2 Level of Utilization of Internet for Teaching and Learning

This section focuses on internet connectivity, reliability, usage for teaching and learning and the extent to which learners benefit from the internet at schools.

3.2.1 Internet reliability and usage

Figure 3.3: A School Server

Schools were connected to the National Optic Fibre Backbone Infrastructure (NOFBI) internet, which has high bandwidth and very fast speeds at no cost. One Wi-Fi Access Point was provided at each school for internet access, whist some primary schools also extended the internet to the CAP, which acted as a second Access Point. Similarly, some secondary schools extended the internet through the local area network (LAN) to other computers, which required the service. This section gives insights on the network connectivity, reliability and usage at schools based on users' experiences and the context of costs vs benefits of providing internet connectivity to schools.

3.2.2 Status of internet in meeting the needs of education stakeholders at schools

The study sought to establish whether the internet connectivity met the needs of various stakeholders. To this effect, the learners, teachers and school administrators were asked to indicate whether the internet met their needs. The results are presented in Table 3.2.

	Primary		Secondary	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Yes	78	98	39	98
No	2	2	1	2
Total	**80**	**100.0**	**40**	**100.0**

Table 3.2: Learners' Responses on whether Internet meets their Needs

The results indicate that the internet connection at school met the needs of 98% of the learners in primary schools and the same percentage for the learners in secondary school. This implies that it solved the problem of online access to learning materials. For the teachers and the school managers, they all (100%) indicated the internet at school met their needs.

3.2.3 Internet stability

It was critical to establish whether internet connectivity in schools was stable. The learners and teachers were asked to rate the stability of the internet using the scale of poor, good and excellent. The responses were categorised as fibre and microwave connected schools as presented in Table 3.3.

	Microwave Connected		Fiber Connected	
	Primary		Primary and Secondary	
	Frequency	Percent	Frequency	Percent
Poor	1	2	8	10
Good	26	65	46	57
Excellent	13	33	26	33
Total	**40**	**100**	**80**	**100**

Table 3.3: The rating of Internet Stability by Learners

The results indicate that microwave connected schools rated internet stability higher at 98% (good and excellent) compared to the fibre optic connected schools, that rated it at 90% (good and excellent). This suggests that microwave internet connectivity is more stable than those connected by fibre.

All (100%) teachers and school administrators indicated that internet connectivity was excellent except when it is down or when the school experiences power outage. A teacher said:

> *"I have always checked the speed while downloading items; when making a comparison downloading using my mobile phone bundles and the school internet is faster". Teacher, Amatu secondary 2023.*

The students were asked to indicate whether they experience buffering (interruptions) when using internet to carry out some activities at school. The results are presented in Table 3.4.

	Microwave Connected schools		Fibre connected schools (primary and secondary)	
	Frequency	Percent	Frequency	Percent
Yes	25	69	57	71
No	11	31	23	29
Total	**36**	**100**	**80**	**100**

Table 3.4: Responses on whether Users Experience Buffering when using Internet

The results indicate that 69% of primary school learners using microwave connected schools experienced buffering when using the internet while 71% of learners in fibre connected schools experienced buffering. Through interviews with teachers, head teachers and learners, all (100%) indicate that they experience buffering occasionally. This was common shortly after power outages.

The learners were asked to indicate the activities where they experienced buffering and the findings were as presented in Table 3.5.

Activities where buffering is experienced	Secondary school				Primary school			
	Yes		No		Yes		No	
	F	%	F	%	F	%	F	%
Downloading online document	15	41	21	58	38	48	42	52
Downloading online academic videos	15	50	15	50	41	52	38	48
Attending online class	16	55	13	45	45	56	35	44
Answering online quiz	14	56	11	44	42	54	35	46
Sending completed assignment to the teacher	13	52	12	48	39	50	39	50

Table 3.5: Areas where Buffering is experienced

According to the findings, buffering was experienced when learners were answering online quizzes (56% for primary school learners) and downloading online academic materials (48% for secondary school learners). It was also established that when downloading online academic videos, 50% of primary school learners and 52% of secondary school learners experience buffering.

During interviews, teachers indicated that they experience buffering when streaming online videos in class, downloading academic video clips and when attending online classes. However, it was noted that this only occurs occasionally. A teacher reported:

> *"I test internet speed using fast.com and sometimes it is low. For instance, on 29/5/2023 around 12 noon the speed was 0.38 Mbps Download and 2.31Mbps Upload". Teacher, Amatu secondary school 2023.*

This implies that sometimes, the internet is low. For instance, the following is a test result for Amatu Secondary School in Meru at different dates. The school is connected to Fibre.

Figure 3.4: Internet Speed Test Results during Data Collection Time

Figure 3.5: Internet Speed Test Results Collected in 2021

3.2.4 Changes in Learner Engagement with Technology

To determine whether the internet connectivity benefited learners and teachers, learners were asked to indicate whether they used the internet for teaching and learning.

Figure 3.6: Students from Sironga Girls, Nyamira County using Internet for Learning

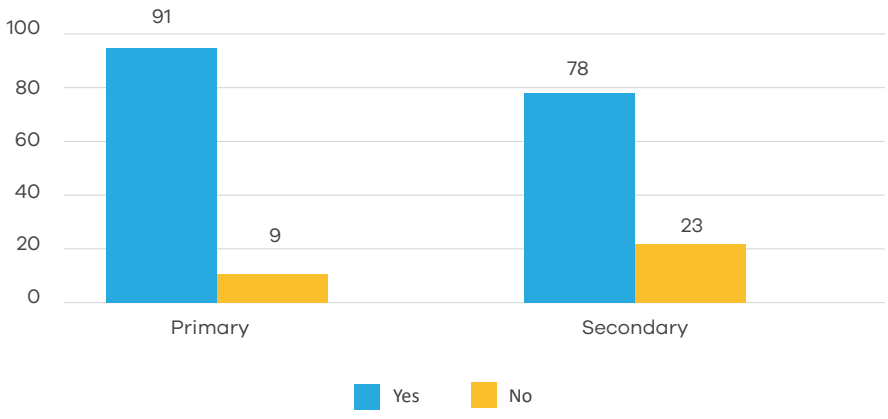


Figure 3.7: The Use of Internet by Learners for Studies

The findings indicate that 91% and 78% of learners in primary and secondary schools respectively, use the internet for personal studies (See Figure 3.7). On the other hand, 9% and 23% of the learners in primary and secondary schools do not use the internet. The reasons for not using the internet for personal studies was inadequate number of ICT devices such as computers at school, not all devices were working, fear of damaging devices and stringent regulations on use of ICT devices by the schools.

According to the findings, learners have been accessing online digital content since the installation of the internet. The learners acquired skills on how to connect their devices to the internet and search for content online from various educational sites. At the same time, teachers learnt how to access various sites online to download teaching and instructional materials for learners and lesson preparation.

In order to establish the level of ICT integration in the classroom by teachers, learners were asked to indicate the total number of teachers in their class and those that use the internet. The results were as presented in Table 3.6.

	Primary	Secondary
	Average number	Average number
Total number of teachers teaching a class	5	8
Number of teachers using internet in class	3	6

Table 3.6: Number of Teachers using Internet in the Classroom

Results in Table 3.6 show that, on average, of 5 teachers who taught a class in primary school, 3 (60%) used the internet in class while in secondary schools, of a total of 8 teachers who taught a class, 6 (75%) taught using internet.

Teachers also indicated in interviews that they use the internet in class. However, there are some who do not use internet in class. Teachers revealed:

> *"We use the internet to access the available schemes of work, and lesson plans from the internet, this helps us improve on our teaching methods". Teacher, Kitivo primary school 2023.*

> *"We download materials from the internet and use them to enhance our teaching, for example, while teaching English, we download plays available online and let our learners watch them. This leads to better understanding of the set books. Also in English, they are able to hear the correct pronunciation of some of the words. Subjects like Biology, are able to see clear and even live images of different body parts and how they function, for example, blood circulation." Teacher, Sironga Secondary School 2023*

Head teachers indicated that after each lesson, the learners are provided with a link which they use to do class assignments. One of them said: "The learners have now learnt a lot and they keep on visiting the same site." Head Teacher, Kitivo Primary School 2023.

To find out subjects that were taught using the internet, learners in secondary school were asked to indicate the subjects, which were taught by teachers using internet in class. This is shown in Table 3.7.

	Yes		No	
	Frequency	Percent	Frequency	Percent
Computer	21	100	0	0
STEM	27	70	11	30
Humanities	21	61	13	39
Languages	**23**	**61**	**15**	39

Table 3.7: Subjects Taught Using Internet in Secondary Schools

Findings in Table 3.7 show that teachers use the internet more in teaching Science Technology, Engineering and Mathematics (STEM) related subjects than in Humanities and Technical subjects. For example, 70% of STEM teachers used internet in class compared to 61% of Humanity teachers. The findings also show that 62% of language teachers used internet in class, while 100% of computer teachers used internet in class. This is significant in education since the use of internet makes; learning more exciting, complicated ideas easier to understand and learning more engaging. Teachers use the internet for lesson preparation, online meetings, online lessons, internet-based teaching in the classroom, uploading learners' scores into the school examination system, and accessing internet training materials (e.g., on YouTube).

Teachers were asked to indicate the average time they spent in each of the tasks related to teaching, learning and their professional development. This is presented in Table 3.8.

Activity	Time Allocated
Uploading learners' marks in school examination system	12 Hours
Content creation by teachers	3 Hours
Lesson preparation	2 Hours
Assessing internet training materials (YouTube)	50 Minutes
Online lesson	35 Minutes
Online meetings	30 Minutes
Teaching in class using the internet.	10 Minutes

Table 3.8: Average Time spent by Teachers on Teaching-related Activities

Results in Table 3.8 show that teachers spent an average of 2 hours for lesson preparation using the internet and an average of 35 minutes for online lesson. However, when teaching in class using the internet, they spent an average 10 minutes per lesson and the rest of the time (30 minutes) for note taking, discussions and other classroom activities. It is worth noting that the teachers take 12 hours on average to upload learners' marks on termly basis. This implies that a whole day is set for each of the teachers to upload students' marks.

Through interviews with teachers, one affirmed that during lessons, for example on the solar system, he searches for videos to show the learners in class to make it easier for the learners to understand. Through FGD with learners, one of them said:

"Through watching video games, we internalize and understand better".

The teachers also indicated that they use the internet for real-time quizzes, learners' feedback and more interactive online activities such as computer games in class. One of the teachers explained:

"The assignments are given through software where the learners are examined through online platform where they work out problems and they are marked before moving to the next questions". Teacher, Rarieda Primary School 2023.

These findings imply that the real-time online assignments helped learners to reflect on the question and raise issues with the teachers especially if there is something they do not understand.

To establish whether the internet improved learning, learners were asked to indicate whether internet use in school improved their learning. The results are indicated in Table 3.9.

	Primary		Secondary	
	Frequency	Percent	Frequency	Percent
Yes	78	98	39	98
No	2	2	1	2
Total	**80**	**100.0**	**40**	**100**

Table 3.9: Learners' Response on whether Internet Improved Learning

According to the findings, 98% of learners in both primary and secondary schools affirmed that the internet improved their learning. This is manifested through self-reported improved academic performance, improved communication and improved self-study as summarised in Table 3.10.

Areas of improvement	Primary school		Secondary school	
	Frequency	%	Frequency	%
Good performance in exams	64	80	25	62
Discovering various sources to get the latest information	28	35	12	29
Improved communication	34	43	11	27
Improved self-study	45	57	24	71

Table 3.10: Ways in which the Internet improves Learning among Learners

The report also sought to establish whether learners benefited from the online content in class. This is presented in Box 1.

Box 1: Learners' achievements, A case of Maragima Primary School

A teacher in Maragima Primary school said:

"The internet connectivity has really assisted and boosted my teaching because there are some topics in CBC that requires the teacher to engage the learners physically. One topic is where the learners are to make a 'Kiondo' local basket. Initially we used to go look for a resources person within the community who would come to train the learners on how to make the 'Kiondo'. Getting a resource person used to be very tedious and sometimes we would not even get one. But now with the internet connectivity, I just go to YouTube whereby I am able to

show learners real videos of people making 'Kiondo'. My work has become much easier and we really appreciate the connectivity."

Another teacher in Maragima Primary School said:

"In CBC we have topics whereby learners are to discuss different types of shops including a supermarket. In our region, we don't have a supermarket, where people enter and pick items then pay at the end. My teaching has become easy because I can download videos of people in a supermarket and learners are able to see how the supermarket operates. This makes my work easier and the learners enjoy as they watch and still learn from watching the videos."

In conclusion, I can say that the internet connectivity in our school, has really upgraded and improved our teaching and learning process. Our learners are able to watch real videos from different platforms that are relevant to their study. This has really enhanced the learner's performance in the continuous assessments that we do. Our learners are now getting better scores; learning has become more real and relevant to the learners. Even us as teachers we now enjoy teaching some of the various topics that seemed initially difficult to explain have now been simplified. Thanks to our internet providers.

We highly recommend the internet to be connected to other schools so that they can also enjoy the internet facilities like we do.

In general, the study indicates that internet use in school improved learning outcomes as indicated in Box 1.

To establish whether there was any statistical difference between learner achievement by level of students' disability status in integrated schools, cross-tabulation was carried out between learners' disability status and whether learners benefited from online content in classroom. A chi-square test was carried out to establish statistical significance. This is presented in Table 3.11.

		Have you benefited from the online content in class?					
Disability status	**Count**	**Primary**			**No**		
	Yes %	**No %**	**Total**	**Yes %**	**No**	**Total**	**%**
No, disability	Count	60	3	63	34	1	35
	% within Disability status	95	5	100	97	23	100
Have disability	Count	15	2	17	2	0	2
	% within Disability status	88	12	100	100	0	100
	Count	75	5	80	36	1	37
	% within Disability status	94	6	100	97	23	100
					Value	df	Asymp. Sig. (2-sided)
				Pearson Chi-Square	.552a	2	.759

Table 3.11: Benefit of Internet in Class by Disability Status of the Learners

The results indicate that 95% of the learners with no disability benefited from the internet and only 5% do not while 88% of the learners living with disability benefited from the internet. It is worth noting that these are learners living with mild disabilities who are in integrated schools, not those with severe or multiple disabilities in special needs schools. The Chi-square results indicate that even though there are leaners with mild disabilities, they are not disadvantaged in benefiting from the use of internet in class as shown by p-value = 0.759.

A cross-tabulation was carried out between gender of learner and whether learners benefited from online content in the classroom. A chi-square test was carried out to establish statistical significance. This is presented in Table 3.12.

Gender	County	**Have you benefited from the online content in class?**					
		Primary			**Secondary**		
		Yes %	**No %**	**Total**	**Yes %**	**No %**	**Total**
Male		31	1	32	10	0	10
	% within gender	97	3	100	100	0	100
Female	count	44	4	48	29	1	30
	% within gender	92	8	100	97	3	100
Total	count	75	5	80	39	1	40
	% within gender	94	6	100	98	2	100
					value	df	asymp. sig. (2-sided)
				Pearson chi-square	.562a	2	.876

Table 3.12: Benefit of Internet in Class by Gender of the Learners

The findings show that there is no statistically significant relationship between gender and the benefit of using the internet in class. This implies that both male and female learners benefit from using the internet in class, as evidenced by the p-value = 0.876.

In order to establish whether there are certain classes that benefited more from the internet, a cross tabulation was carried out between the different level of class and whether learners benefited from internet use. A chi-square test was carried out to establish statistical significance as presented in Table 3.13.

Primary		Have you benefited from the online content in class		Total	Secondary		In your opinion does the internet at school improve learning		Total
		Yes %	No %				No %	Yes %	
Grade 6	Count	24	4	28	Form 2	Count	6	0	6
	% within class	86	14	100		% within Form	100	0	100
Grade 7	Count	27	1	28	Form 3	Count	8	0	8
	% within class	96	4	100		% within Form	100	0	100
Class 8	Count	24	0	24	Form 4	Count	25	1	26
	% within class	100	0	100		% within Form	96	4	100
	Count	75	5	80		Count	39	1	40
	% within class	94	6	100		% within Form	97	3	100

Table 3.13: Internet benefit by Learners' Level of Class

The results show that learners in all class levels benefited from internet use in class. The study also sought to establish whether learners benefited from internet use in class by improving the teaching. The results are presented in Table 3.14.

Benefit of internet use in class by teachers	Frequency	Percent
Make learning more exciting	63	84
Make complicated ideas easier to understand	46	71
Make learning more engaging	32	54
Make learning more fun	12	23
Increase class attendance	10	13

Table 3.14: Benefit of Internet to the Learners in Class

According to the findings, using the internet in class makes learning more exciting for 63% of primary school and 84% of secondary school learners. Similarly, it makes complicated ideas easier to understand, learning more engaging and learning more fun, as well as increasing class attendance. This is according to the learners who answered the questionnaire; but it was not checked with actual attendance data or other variables that affect attendance.

This was also indicated by teachers and head teachers in an interview. One of the head teachers said, "The number of learners has increased in our school since the internet was installed. The transfers from other schools are overwhelming." Head Teacher, Maragima primary school 2023.

Furthermore, learners were asked to indicate how they utilize internet in class. This is presented in Figure 3.8.

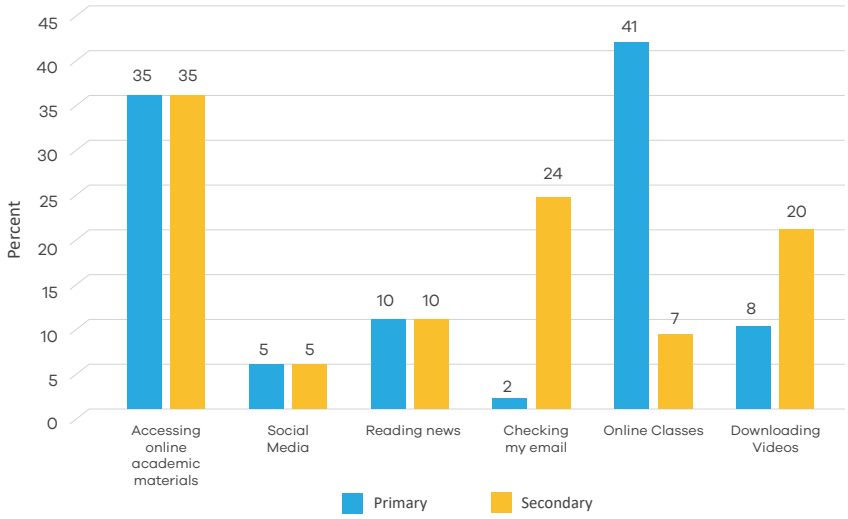


Figure 3.8: Ways in which Learners Use Internet in Class

The results reveal that the use of the internet in school has made learning easier. Learners are able to access online academic materials with ease, attend online classes and download academic videos.

3.3 Good Practices for Scalability and Sustainability of Internet Connectivity in Schools

3.3.1 The good and innovative practices adopted by schools

This section documents good practices observed at the school level.

1. **Participation of learners in online academic and co-curricular contest:** With the support of teachers, learners engaged in online contests in science, games, sports, research and information access.

   For instance, learners from Sironga Girls participated in Interswitch SPAK, a Pan - African Science competition designed to empower African learners in STEM. The initiative was introduced for high school learners to develop, ignite and chart a career path in STEM education and drive them towards fully optimizing their potential to make Africa a better place for all. After doing well in the online competition, the school then sent a team to participate physically in the 2023 final in Nigeria and emerged number one in Africa. These contests help to diversify learning outcomes and inculcate the culture of innovativeness.

Box 2: Case One

One learner from Sironga watched a video on YouTube regarding a method of solving water shortage in a novel and effective way. She developed an automated water level management device to help farmers save water. The system maintains tank water level by automatically turning on and off the water pump. This saves farmers from overwatering crops and water shortages since climate change worsens water shortages in Kenya. Solar electricity makes the system eco-friendly. The technology is straightforward to install and maintain for small-scale farmers. She participated in Interswitch SPAK 2023 in Nigeria and won. In the interview, the learner said, *"Were it not for Digischool internet connectivity in our school, I wouldn't come up with such a concept that made me tour the world at my youthful age. It is a dream come true for me."* Learners 2023

A team of five students organised themselves and joined a competition to participate in a TV show for STEM. In preparation for the competition, they used the internet at school to improve their knowledge in the STEM area. This is summarised in Box 3.

Box 3: Case 2

The team, "The Brainiacs," took home the grand prize. The team won the science quiz category after correctly answering 90% of the questions and completing all the problem-solving challenges. The team was able to answer a wide range of STEM-related questions. They were also able to demonstrate their understanding of STEM concepts by participating in a series of problem-solving challenges. They were given a scholarship to study STEM at a prestigious Kenyan university. They also received a laptop and other prizes. They used the internet at their school to read widely on general STEM issues, helping them have a broad range of knowledge on the subject. One of the learners said, *"It's incredible how the internet can make STEM so simple and enjoyable. I am extremely pleased and grateful for internet connectivity in our school. It provided us with international exposure."* Learner 2023.

2. **Revamping guidance and counselling in schools:** For instance, a teacher at Maragima primary school downloads motivational/inspirational movies for learners to watch after classes. This motivates learners after watching videos of successful people from humble backgrounds. It helps learners to relate to their own situation and motivates them to put more effort into education. The teacher noted that absenteeism reduced after taking learners through such life changing counselling sessions.
3. **Diversification of teaching and assessment methods in class:** For instance, all schools indicated that they gave learners interactive online quizzes to enhance their knowledge and skills in various subjects.
4. **Resource sharing:** One of the teachers in Kitivo primary school in Taita Taveta county prepared online classes and invited learners from neighbouring schools to join. This is a critical step towards building communities of practice in learning institutions.
5. **Digital skills development:** A teacher at Maragima primary school leveraged on connectivity to conduct coding lessons for fellow teachers and learners outside class hours.
6. **Support from stakeholders and partners:** Schools got support from government agencies and partners in regard to capacity building, infrastructure, computing devices and technical support. This facilitates optimal utilization and sustainability of connectivity as shown in Box 4.

Box 4: Support from Stakeholders and Partners

With the support from other stakeholders, the teachers and school managers were interviewed on whether they obtained any support from other key strategic partners and the responses were as follows:

'I have attended several short training courses both at school and outside the school. These trainings have been very useful. Now I can be able to prepare lessons using the internet, teach in class using internet and give assignments through online platforms." Teacher's Rarienda Primary school 2023.

"I have attended numerous trainings in the use of online quiz administration. This has really improved how we administer quizzes." Head teacher, Kitivo Primary School 2023.

It was widely reported that there were several ICT training courses where two teachers from each of the samples

school attended, particularly ICT clinics and then trained others at the school level. This has improved teachers' ability to use ICT devices and integrate ICT into teaching and learning.

3.3.2 Ethical issues on use of the internet

The teachers, parents and school administrators were asked if they discuss internet use with learners to promote responsible internet use. According to the findings, some parents discuss the dangers of visiting inappropriate sites with their children and instruct them on how to use the internet. At the school level, ICT teachers use logfiles to track what a learner has accessed and to filter what is accessible to learners. The students also stated that they are guided on responsible internet use by ICT teachers, school administrators, guidance and counselling teachers, and some parents. Despite these efforts, there were isolated cases of students watching video clips during lessons, accessing inappropriate content, using the internet for betting, and students accessing social media platforms, exposing them to online bullying.

3.3.3 School internet sustainability mechanisms

Sustainability mechanisms are critical to the project's long-term viability. In an interview with all the school heads, they stated that they had not initiated any sustainability plan because they believed the project would continue to be supported by MoE and partners. However, they noted that the trainings that have already been completed will be critical for managing internet facilities, and that training will be critical for maintaining the skills acquired in line with power bills, security costs, device maintenance and repairs, physical infrastructure improvements, and any other related costs.

> *"We do not have anything in place, we had thought that this project will be there forever but because we have known how useful this is to both the staff and our learners, we would look for money through the Board of Management (BoM) to ensure continuity". Head teacher, Irichelo Primary School.*

One important sustainability mechanism is determining the cost of running internet in schools. This would aid in determining the required amount and allowing the school to devise a mechanism for obtaining such funds. This is as presented in Table 3.15.

OFFICE	**Using mobile phone Bundles before the project**		**Using the internet provided by the project at school**	
Activity	**Per term**	**Yearly**	**Per term**	**Yearly**
Principal Office – Circulars/letters/Reports download; NEMIS updates; Data uploads	40GB @ 8000	120 GB @ 24,000	Nil	Nil
Deputy Principal Office - TPAD UPLOAD	20GB @ 4,000	60GB @ 12,000	Nil	Nil
ICT Teacher Office – Exam Reg/results download/ Projects upload	50GB @ 10,000	150GB @ 30,000	Nil	Nil
Curriculum Co-ordinator Office - Download Exams	10GB @ 2000	30GB @ 6000	Nil	Nil
Teaching Staff – Teaching aids/ materials download	80GB @ 16000	240GB @ 48000	Nil	Nil
Total	**200GB @ 40,000**	**6000GB @ 120,000**	**Nil**	**Nil**
Electricity	9000	27,000	12,000	36,000
Security	24,000	96,000	24,000	96,000

Table 3.15: Cost Benefit Analysis of Internet Connectivity in Schools

The results indicate that after the internet was installed, the electricity bill went up by KSh 3,000 from KSh 9,000 to KSh 12,000 per term. However, there was a saving of KSh 40,000 a term in internet costs.

After the Digischool project was launched at one (17%) of the six schools, parents contributed KSh 20 extra per term towards electricity to cover the additional cost. It was also critical to establish the amount of data (GBs) used to carry out any administrative and teaching activity. This is key to estimate the amount needed every year for the purpose of installing internet that will meets the needs of the schools. This is as presented in Box 5.

Lesson preparation - 2 GB

Online meetings – 3 GB

Online lesson -4 GB

Teaching in class using the internet -4 GB

Uploading students' marks in the school examination system -4 GB

Downloading student's exam-3GB

Assessing internet training materials (YouTube) for content creation by teachers 4- GB

Registration of students for national examination -6 GB

Box 5: Average amount of Data (GB) activity

The results indicate that in average, teachers require at least 2 GB per lesson preparation, 3 GB per online meeting and 4 GB per online lesson as shown in Box 5.

3.3.4 Challenges

The teachers, parents and school administrators were asked to give the challenges they face in the use of internet at school. This is presented in Figure 3.9 and Table 3.16.

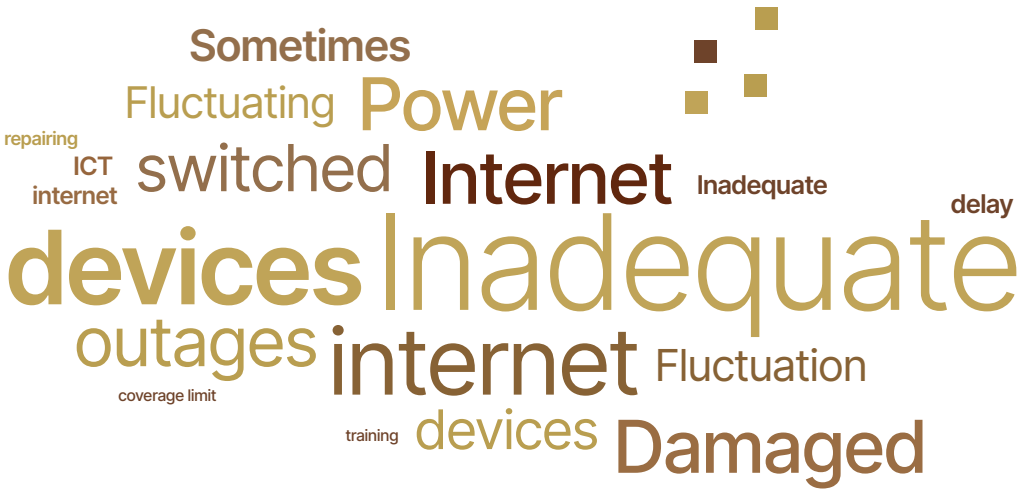


Figure 3.9: Internet Connectivity Challenges

Focus areas	Challenges
Access to internet	• Inadequate devices • Insufficient rooms • Non repaired devices • Power switched off
Internet stability	• Limited internet coverage • Power outage • Slow internet speed
Outcomes/quality	• Delayed learning process • Access to non-educational contents • Inadequate internet • Maintenance cost
Cost	• Maintenance cost of devices • Increased cost of electricity

Table 3.16: Challenges faced by Schools on Internet Use

3.4 Utilization of Internet to Strengthen Administrative Functions in Schools

ne of the areas of focus of the study was to establish how the internet is utilised in schools for administrative purposes. This is summarised in Box 6 and 7.

- Online registration for the KCSE candidates.
- Data management.
- Communication to the parents (through WhatsApp, emails etc).
- Communication to local MoE and TSC offices.
- Online Appraisals.
- Online application for transfers.
- Online leave application by teachers through TSC Teacher Management Information System (TMIS) portal.
- Proposals development for funding.
- Strategic plans development.

Box 6: Administrative use of internet

This information was emphasised by a Head teacher who said *"90% of all our official communications are now done on WhatsApp and this is a big advantage to the administration, and it even reduces expense from* ***Ksh. 70,000*** *on the same to Zero Ksh. I have also created a social media platform for the parents, again this has really worked very well'.* (Head teacher, Kitivo Primary school teacher 2023

"We are aware the school is connected to internet and the head teachers uses internet to communicate to us. Personally, I get all information from school through the internet. Including my child's report form before we get the (physical one" **Parent 2023.**

Box 7: Quotes in internet use

The findings revealed that in some schools, members of the local community would come to the school fence to access internet, whereas in others, community members and parents walk into the school compound to use internet. On parent revealed:

> *"I usually go to the school fence in the evenings to check my social media and send messages to my friends. The internet bundles for other internet providers are very expensive for me." Parent, Irichelo Primary School 2023.*

One principal said:

> *"I am always on the internet; I spend half of my day on the internet every day. I file returns and review circulars from TSC and other higher-level offices. I also upload the exams. This has saved the school around Ksh70,000 per term that we used to spend in cyber cafes. I also purchased a printer so that whatever I download can be printed here at school and saved over KSh 400,000 that we used to spend on printing downloaded exams. However, our power bills have slightly increased, but we can live with it; the amount is not comparable to what we used to pay at cyber cafés. We complete our returns on time, avoiding the last-minute rush." Head teacher Irichelo primary school 2023.*

Generally, parents agreed that they received information online such as notices of school meetings, learners' assessment reports and newsletters. However, some of the parents did not have smartphones and the schools used SMS, phone calls and letters to reach them. One parent said, "Yes, I receive online information from the school, like learners' results, class clinic, and school fees, through the school's Facebook page and WhatsApp." Parent 2023.

The school administrators were asked to indicate the total amount of time they spend in carrying out administrative task at a time. This is presented in Table 3.17.

S/No.	Activity	Average Amount of time
A	Digital registration of learners	4 hours
B	Uploading exams	1 hour
C	Downloading exams	2 hours
D	Filling online appraisal forms	2 hours
E	Reading/responding to administrative emails	Continuous
F	Assessing internet training materials (workshops)	1-2 hours

Table 3.17: Average Time taken for Administrative Tasks

The results indicated that on average, to upload exams, school administrators take 1 hour to complete the task while digital registration of learners for national examinations takes four hours per exercise. However, it is worth noting that this depends on the number of learners. The results also indicated that filling the TSC appraisal forms takes a total of 2 hours per exercise.

The schools' administrators were asked to indicate their level of satisfaction with internet stability whilst using the internet for administration on a scale from 1-5 where 1 represented Very unsatisfied, 2 Unsatisfied, 3 Neutral, 4 Satisfied and 5 Very satisfied. The results are presented in Table 3.18.

S/No.	Activity	Average rating
A	Digital registration of learners	4
B	Uploading exams	4
C	Downloading exams	4
D	Filling online appraisal forms	5
E	Reading/responding to administrative emails	4
F	Assessing internet training materials (workshops)	5

Table 3.18: Rating of Internet Stability for Administrative Tasks

According to the findings, all the school administrators were satisfied with the internet's stability when performing administrative tasks such as digital registration of learners and uploading, as well as downloading exams, filling out online evaluation forms, responding to administrative emails, and evaluating online training materials.

SECTION 4

LESSONS LEARNT

The study identified key lessons of the project:

- Teachers already used the internet a lot before this project, mostly for administrative purposes, but sometimes for teaching, by using mobile broadband and buying data bundles. The low speed and high cost of the internet limited the benefit of it in schools. Therefore, it is important for schools to have high-speed internet (ideally 40-100 Mbps) that is affordable and sustainable, such as through NOFBI (paid for by the national government);
- Internet benefits for schools may be limited due to the lack of enough devices, meaning that at any one time only one class may be able to use the devices to access internet, and classes must take it in turns. For teachers, though the lack of laptops is also a limiting factor, they could use other devices (the IT lab in a secondary schools, the student tablets in primary school, or their own devices) for lesson preparation and administration. Therefore, it is important to increase the number of devices available in schools;
- The benefits of the internet were not just directly in improving education quality, but also in the overall education environment and attitude for learners and teachers. This indicates much wider benefits than may otherwise be considered;
- The teachers and learners used a variety of online platforms and tools, not just the official Kenya Education Cloud content, particularly videos on YouTube and various interactive quiz systems. Therefore, it is important to consider these in planning for content and use of the internet, when considering which software or platforms schools can/ should use and what training to provide teachers;
- The internet opens up a whole range of possibilities that are not usually planned for, such as schools supporting other schools, students entering international competitions etc. This is very promising and such local innovation should be encouraged;
- Administrative benefits of the internet were very significant and included communication with parents, and this must not be under-estimated;
- The economic value of the internet provided in this project (high speed, free of charge) was high with significant savings (from not buying data bundles or going to cyber cafes, as well as time savings) to be made compared to the minor additional power costs;
- Internet in schools can benefit parents and local communities but this could cause risks for the safety of the school compound and could affect the internet speeds for the students. Therefore, schools should develop appropriate policies for this;
- Providers of internet must provide suitable Uninterruptible Power Supplies (UPS) or battery backups so that internet does not cut out from power outages and enough Wi-Fi Access Points for full school coverage, including all the classrooms for learners and also for the grounds if the parents are also to benefit; and
- The rapid and localised technical support available from ICT Officers was very important in supporting the schools; though this may not be possible at a scale of tens of thousands of schools. This is an issue that must be considered.

SECTION 5

CONCLUSION

Based on the findings and lessons learnt in this project, it can be concluded as follows:

- The internet connectivity was highly utilized and enhanced integration of ICT in teaching and learning where complex concepts were simplified through online content such as games, videos, among others and the learning became more exciting and interesting;
- Internet connectivity in schools enhanced real time assessments for learning, as well as diversification of learning outcomes to promote the culture of innovativeness. It also enhanced guidance and counselling programmes in schools among the learners. However, there were isolated cases of unethical use of the internet by teachers and learners;
- Proper utilization of internet promotes access, quality education outcomes while addressing inclusivity and equity in education, therefore benefiting all learners;
- All the learners in integrated schools benefitted from internet connectivity through access to digital content and classroom experiences. However, teachers require continuous capacity building on inclusive use of online content;
- Internet connectivity through NOFBI was available and reliable and reduced operation cost in activities that require internet connectivity. This notwithstanding, there were occasional interruptions of the connectivity, usually due to power outages;
- Internet connectivity in schools transformed administrative activities such as communication, data management, preparation of professional documents and research. This has significantly reduced administrative costs in schools; and
- Internet connectivity promotes the culture of sharing education online resources to enhance access to online resources, promote collaboration and networking among teachers and learners for optimal utilization of educational resources.

SECTION 6

RECOMMENDATIONS

Based on the aforementioned findings and conclusions, the following recommendations are made:

1. **Capacity building for teachers and learners**

   - For effective utilization of the internet, teachers, school administrators and learners need training to improve their digital skills, particularly on the effective use of the internet in the classroom, basic trouble-shooting skills to resolve minor connectivity issues, and ethical use of internet (to limit access of inappropriate content or inappropriate interactions online) by all stakeholders in the learning institution.

2. **Connecting schools to internet through the NOFBI**

   - There is need to connect schools to internet through NOFBI for it is the most effective, affordable and reliable for teaching and learning, as well as for administrative duties in schools. This is the most sustainable model despite the high initial installation costs, which include laying of fibre cable from NOFBI terminal to the school and acquisition of several active devices.
   - To achieve optimum utilization of internet in schools' classrooms, the connection available in the school (through Wi-Fi Access Points) should be aligned with the students' population, numbers of classrooms and distance from one class to the other. This will address cases of internet buffering and unavailability of signal.
   - The expansion of internet to schools should be rapidly implemented to enhance education quality, accessibility and equity.

3. **Ethical issues and security**

   - Schools should develop school-based guidelines, which are critical to regulate the use of the internet and ICT devices.
   - Parents/guardians/care givers, teachers, learners and school administrators should be sensitized on responsible use of the internet.

4. **Partnerships for sustainability**

   - In order to provide sustainable internet to all schools within the shortest time, there is need for concerted efforts in the Government and its Agencies; Telecommunication companies, Development partners and other stakeholders; so as to minimize the initial connectivity costs and avoid recurrent expenditures, which cannot be sustained by the schools.
   - There is need to advocate for the establishment of community internet (hubs) to facilitate the community surrounding the schools to have access to the internet. This will reduce interruption of school activities by community members streaming into school to access the internet.

5. **Content and devices**

   - Establish a mechanism for repairing broken devices and e-waste management system for the disposal of un-repairable devices.

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Annex I: List of Technical Working Group

S/No.	Name	Department
1.	Stephen O. Barongo	Ag. Director, Primary Education
2.	Martin Kungania	Directorate of Primary Education
3.	Francis Karanja	Director General's Office
4.	Benson Omondi	ICT Unit, Basic Education
5.	Dauglas Namunane	Public Communication Office, MOE
6.	Nelly Kosgey	Public Communications Office, MOE
7.	Eric Shilenje	Public Communications Office, MOE
8.	Duncan Sikoyo	Public Communications Office, MOE
9.	Mary Kang'ethe	KNATCOM
10.	Tony Onani	KNATCOM
11.	Joshua Opondo	ICT Authority
12.	Washington Onyango	ICT Authority
13.	Virginia Ntheketha	UNESCO
14.	Felix Rop	UNESCO
15.	Adam Lane	Huawei Kenya
16.	Maureen Mwaniki	Huawei Kenya
17.	Winnie Chepkonga	Huawei Kenya
18.	Dr. Reuben Mutegi	University of Nairobi
19.	Dr. Anastacia Gakuru	University of Nairobi
20.	Charles Ouko	University of Nairobi
21.	Thomas Muriithi	Researcher

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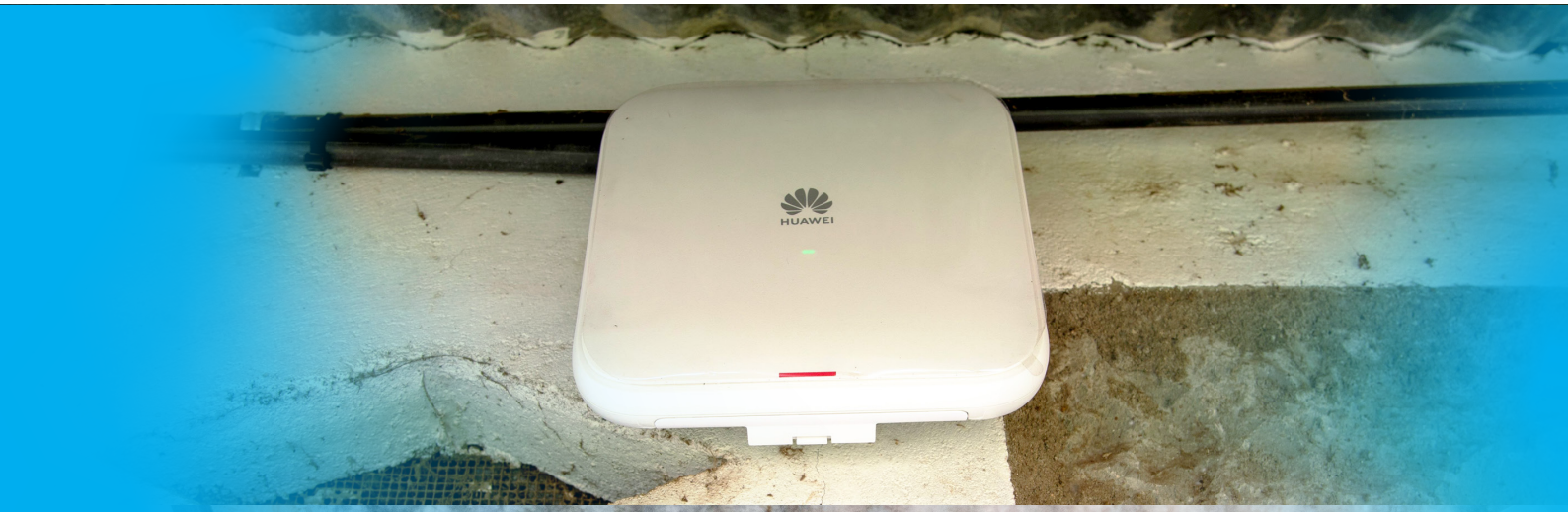

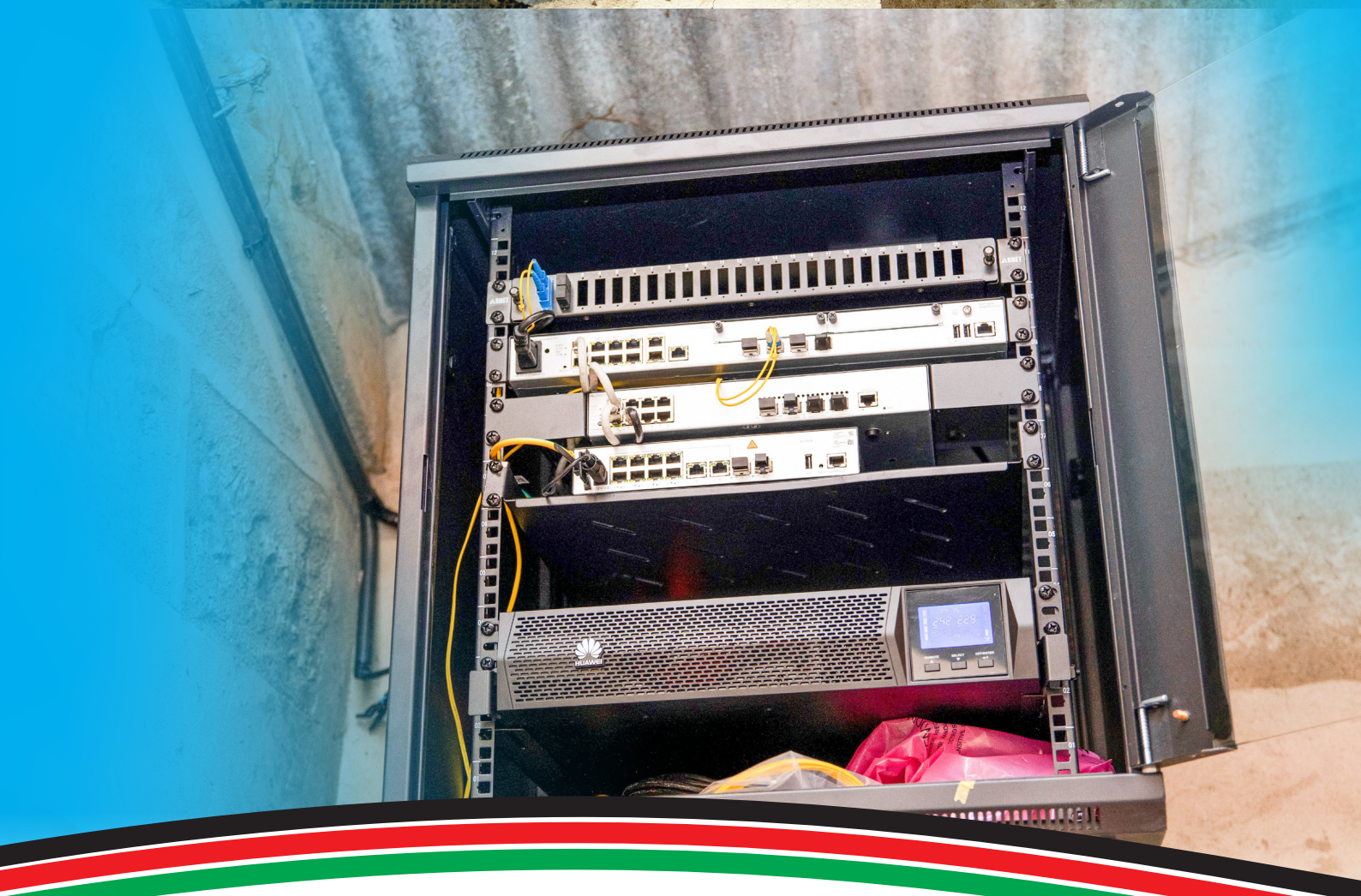

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