DIGITAL LEARNING MATERIALS IN TEACHING AND THEIR INFLUENCE ON LEARNERS' PERFORMANCE IN BIOLOGY: CASE OF KALAWA SECONDARY, KITUI COUNTY, KENYA

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DECLARATION

This thesis is my own work and has not been submitted for a degree award to any other university. No part of this thesis should be reproduced or photocopied without prior permission from the author and / or Kenyatta University.

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DEDICATION

It is my opportune moment to dedicate this research thesis to my wife Dorcas Nduku, sons; Samuel Mwendwa, Lazarus Kyalo and Joseph Matheka and daughter Victoria Mwende for their perseverance during the many times I was away doing a degree on Masters of Science Education at Kenyatta University.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

BTQ	Biology Teacher Questionnaire
CQAS	County Quality Assurance and Standard
CDE	County Director of Education
NG-CDF	National Government-Constituencies Development Fund
ESP	Economic Stimulus Package
ICT	Information Communication Technology
KS	Kalawa Secondary
KCDE	Kitui Central Director of Education
KCSE	Kenya Certificate of Secondary Education
KICD	Kenya Institute of Curriculum Development
KNEC	Kenya National Examinations Council
LCA	Learner- Centered Approach
LCIA	Learner- Centered Instructional Approach
LOS	Lesson Observation Sheet
MOE	Ministry of Education
NACOSTI	National Commission for Science, Technology& Innovation
PIS	Principal Interview Schedule
QASE	Quality Assurance and Standard of Education
RCL	Resource Check List
SCLT	Social Constructivist Learning Theory
SCQASO	Sub-County Quality Assurance and Standards Officer
SMASSE	Strengthening Mathematics and Sciences in Secondary Education
SPSS	Statistical Package for Social Sciences
TCA	Teacher- Centered Approach

TPACK	Technological, Pedagogical and Content Knowledge
TTC	Teacher Training College

ABSTRACT

Use of technology has influenced education sector by enabling teachers to allow repetition and variation in presentation of complex content in class easily. Other than motivation, use of Digital learning materials ensures high content retention. Kalawa Secondary (KS) had been recording consistent low performance in Biology between year 2014 and 2022. The school benefited from equipped computer laboratory through Economic Stimulus Package (ESP) by the government. Science teachers were taken through in-service training for ICT skills. This study investigated use of digital learning materials in teaching and its influence on learners' performance in Kalawa Secondary. The study objectives were: (a) to identify available digital learning resources for the use in teaching Biology; (b) to explore challenges facing teachers of Biology during integration of technology; and (c) to establish influence of digital learning materials integration on learners' performance. The research used descriptive research design. Qualitative and quantitative data was collected using checklists, Biology teacher questionnaires, Principal interview schedule and Lesson observation sheets research instruments. The study was grounded on Vygotsky social constructivist learning theory. A target population of eight (8) teachers of Biology and 750 students taking Biology was used. Purposive sampling was done to pick six (6) teachers of Biology, four (4) Form II Biology classes and the principal. Piloting was done with two (2) teachers of Biology at neighboring school of equal status. Statistical package for social sciences (SPSS) was used in data analysis based on study objectives. The study revealed that the school had insufficient Biology ICT resources. In addition, 75% of teachers of Biology used technology in at least a single lesson per week while 25% never did. The study revealed a strong positive relationship between use of digital learning materials and students' performance in Biology ($r=0.652$). The findings will benefit curriculum developers at the Kenya Institute of Curriculum Development (KICD), ICT and QAS departments in MOE to evaluate the significance of technology use in secondary schools.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Study by Aslan and Zhu (2016) on the factors influencing ICT use into teaching practices among pre-service and new teachers in the profession noted that education is one of the sectors highly influenced by technological evolution in the world. A study on use of ICT in education in Malaysia reported that curriculum designers have tried to accommodate technology use in classroom teaching (Ghavifekr, S.,Razak, A. Z.A., Ghani, M. F. A.,Ran, N. Y.,Meixi, Y.,and Tengyue, Z. , 2014). It was observed that the effort faced challenges of inadequate resources, low confidence and inadequate skills among the teachers in Australia (Khalid, 2009). Study by Aladejana (2008) on improved Biology teaching and blended learning in Nigeria secondary schools reported other ICT integration blocks such as low power connectivity and limited internet connectivity in most of African countries.

A study by Elisha (2011) on the challenges facing ICT integration in Kenya secondary schools showed that there were challenges such as few trained personnel for ICT teaching and most of teachers in most schools are technophobic to handling of ICT resources. A study by Gakime (2016) on viable factors influencing use of digital resources in science teaching and learning in Kenyan secondary schools indicated that ICT use promotes good performance in examinations.

In Kenya, research indicated general low performance in Biology KCSE results between the year 2013 to 2022 as illustrated in Table 1.1

Table 1.1: KCSE Sciences performance between 2013 to 2022 nationally

Subject / Year	Biology (231)	Chemistry (233)	Physics (232)
2013	31.63	24.50	36.71
2014	31.82	32.15	31.31
2015	34.79	34.23	35.11
2016	29.18	23.71	39.76
2017	18.92	24.04	35.04
2018	25.69	26.88	34.27
2019	51.38	52.17	65.18
2020	53.03	45.01	71.03
2021	57.01	42.02	59.39
2022	57.37	48.05	66.12

Source: KNEC (2019-2022)

The table shows that performance in Biology nationally, was relatively low compared to other science subjects, except in years 2016, 2020, 2021 and 2022 where its performance was relatively better compared to Chemistry but worse than Physics.

Use of digital learning materials has been encouraged by international organizations and Kenya Government with aim of improving teaching pedagogies and performance in science subjects. When integrated with other learner-centered instructional approach (LCA), higher content retention and better performance in Biology examinations would be realized in both formative and summative tests. Table 1.2 shows trend in KCSE performance in Biology vis-à-vis other science subjects at Kalawa Secondary for a period between 2014 and 2022, Kitui County, Kenya.

Table 1.2: KCSE Science subjects school performance for the last ten years

Subject / Year	Biology		Chemistry		Physics	
	Enrolment	Mean	Enrolment	Mean	Enrolment	Mean
2014	122	5.36	138	4.84	16	7.23
2015	121	6.87	144	4.83	23	7.23
2016	115	4.83	136	4.20	21	9.22
2017	127	2.2	156	3.43	29	4.91
2018	128	3.33	154	3.43	26	9.79
2019	141	3.81	162	4.03	23	6.01
2020	109	4.11	132	4.0	31	7.84
2021	110	3.91	160	3.15	53	5.74
2022 **2023**	92 142	4.18 5.10	114 168	3.9 4.17	24 38	9.0 7.39
Average		4.37		3.998		7.436

SOURCE Examination Department Kalawa Secondary.

Biology performance average index is 4.37 compared to that of Physics whose index is 7.436. This was far below the expectation because the subject was elective and with use of available digital learning resources, its performance was expected to be better in general.

From the data in the table, it can also be deduced that most of the students scored poor grades in Biology.

This research investigated use of digital learning materials in teaching of Biology and their influence on learners' performance in Kalawa Secondary

1.2 Statement of the research problem

Kalawa Secondary is in a rural setting in Kitui county and was identified as a centre of excellence by the Kenya government in the year 2005 and equipped with I

CT resources to enhance teaching. However, the performance in Biology remained relatively low for the period between 2014 and 2022. Biology teachers of the school were of the view that the problem was emanating from the school level and this became an area of concern.

In addition science teachers were further taken to in-service training in the SMASSE programme for technological skills in teaching using audio- visual tutorial software and computer simulations for topics identified as difficult. Later, WIFI was installed in the school for teachers to access teaching and learning materials online. Despite this effort, Biology performance in KCSE remained relatively low at Kalawa Secondary.

1.3 Purpose of the study

The goal of this study was to investigate use of digital learning materials in teaching of Biology and their influence on learners' performance in Biology in Kalawa Secondary (KS), Kitui County.

1.4 Objectives of the study

The research was guided by three (3) objectives:

i. To identify available digital learning resources for use in teaching of Biology at KS;
ii. To explore challenges teachers of Biology face on use of technology during teaching at KS; and
iii. To establish the level of influence of digital learning materials integration on students' performance in Biology.

1.5 The research questions

This study was guided by the questions stated below:

i. What digital learning resources are available for use in teaching of Biology at KS?
ii. What challenges do teachers of Biology face during technology integration at KS?
iii. How does use of digital learning materials in teaching of Biology influence student' performance in Biology at KS?

1.6 Significance of the study

This research provides important information that can be used by the MOE to review the significance of ICT resources in schools for use in teaching of Biology. In addition, its findings will guide MOE on need to take newly employed science teachers to in-service training to equip them with relevant ICT skills for the 21st Century learners digital literacy.

The findings are also of great importance to high school's curriculum developers such as KICD, QASE, CDE, CQAS, SCQASO, TTC. The school administrators and Biology educators will benefit from the findings and make informed decision on the significance of technology in classroom teaching.

Government officials from different ministries will find this research beneficial in making policies that will make Kenya realize her vision 2030 through allocation of enough resources for monitoring how technology integration is being implemented in all school levels.

The findings will guide in the identification also of further areas of academic research in related subjects such as Mathematics, Physics and Chemistry in secondary schools.

The findings of this study will also expand knowledge related to use of digital learning materials in teaching and their influence on learners' performance in Biology.

1.7 Scope of the study

This research was done at Kalawa Secondary located at County of Kitui, Lower Eastern Region; Kenya. The school is an extra-county centre of excellence with students' population of 840 and teachers' population of 42 .The study was limited to Biology as a subject only. Data was collected from the institution, the school principal, teachers' of Biology and from 4 form II Classes of Biology with 225 students taking Biology.

1.8 Limitations of the study

a) Research focused on use digital learning materials in teaching Biology at KS and thus the target population was not enough to make generalization of the results.

b) In addition, the study relied partly on the respondents' opinions about ICT integration in teaching of Biology. People's views should not be taken as an absolute truth and therefore it was advisable for one to consider generalizations of this study carefully.

c) This study was faced by the challenge of time to do lesson observations by the researcher since was regular employee of TSC and block timetable could not always allow. However, KS is a boarding school and therefore the researcher created time to compensate for the lessons not taught over the weekends.

d) The study was also faced by limitations of finance to cater for printing expenses. However, researcher sourced emergency loan from Mwalimu National Sacco to cater for the same.

e) This study used descriptive research design which had some weakness for this study. For instance, there were no manipulations of variables directly and therefore detailed statically analyzed results was not possible. In addition, results based on observation field work are not repeatable and therefore generalization of this study findings should be carefully considered.

1.9 Delimitations of the Study

Despite the limitations stated above, the MOE allowed the researcher to conduct this study at KS. This was because its findings will be beneficial to the school and other education stake holders in the departments of ICT and quality assurance and standards.

1.10 Assumptions of the study

These were the assumptions made during this study:

i. Respondents' were honest enough and gave the required information.
ii. Teachers had necessary ICT skills for use in handling Biology.
iii. Teachers' of Biology were integrating technology in the school by using digital learning materials in classes.
iv. The school had digital learning resources for use in teaching of Biology.
v. Digital learning materials use influences learners' performance in KCSE examinations.

1.11 Theoretical framework

The study was guided by the Social Constructivist Learning Theory (SCLT) put forward by (Vygotsky, Amineh and Asl, 2015). The theory stresses that knowledge is constructed by individuals as they interact with the environment and other people. According to this theory, learners exposed to technological learning environment with adequate integration of technology develop collaborative model of learning in problem solving. Biology areas of difficult can be demonstrated by use of simulation software in class. For students to effectively gain knowledge, teachers must create and promote interactive learning environment during teaching in classes. Prior knowledge always influences new learning experiences in the mind of the learner (Dimov, 2007).

From this theory, it can be deduced that what is in the mind of the learner creates an impact on the new experiences given and learning can be done better in an interactive session by use of digital learning materials. Also, the use of ICT plays significance role in promoting constructivism theory of learning (Chaudhary,2018). The complexity and considerations required in reference to technology, content and pedagogy knowledge can be indicated as illustrated below:

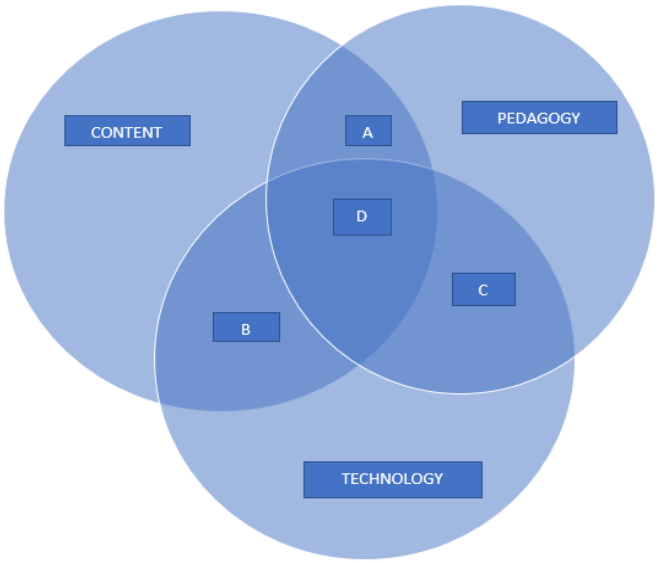

Figure 1.1: The relationship between content, technology and pedagogy

Source – adopted from the component of the topic framework graphic (from http/tpack.org) retrieved 1st March, 2012.

Key

A- Content/pedagogical knowledge

B- Content/technology knowledge

C- Technology/pedagogy knowledge

D- Content/pedagogy/technology knowledge

Part D represents the best ICT involvement in teaching for effective learning.

TPACK is a framework that introduces the relationship between three components that maybe integrated for effective ICT–implementation at school level.

1.12: Conceptual framework

The chart below illustrated how independent and intervening variables influenced the dependent variable

Independent variables

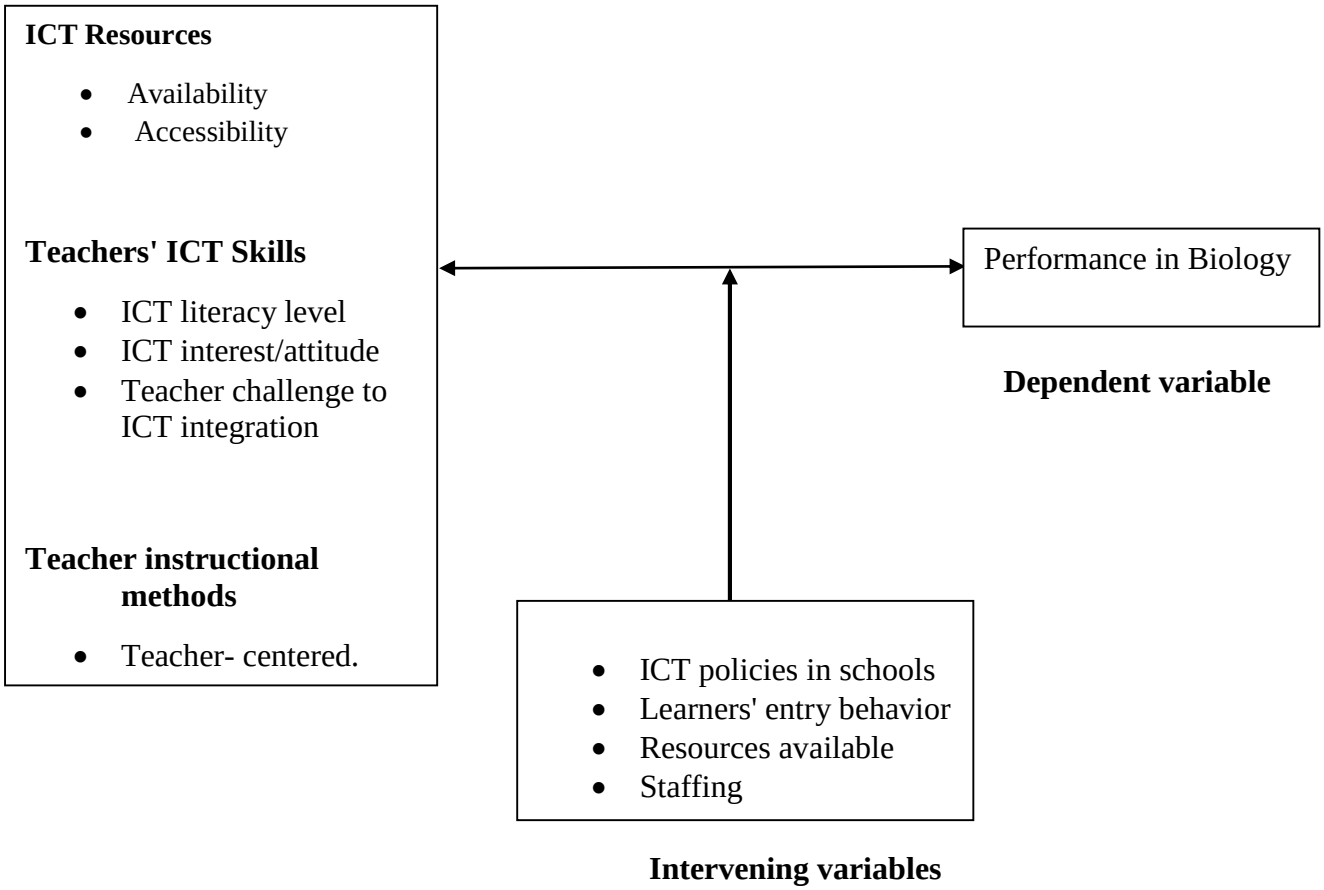

Figure 1.2: Conceptual framework

Source: Researcher, 2025

The independent variable such as ICT resources availability and accessibility, teacher ICT skills as well as teacher instructional method directly affects the dependent variable, that is, performance in Biology. Intervening variables like ICT policy in school, learners' entry behavior, other science resources available and staffing may indirectly affect performance in Biology. The adoption of this conceptual framework guarantees improved performance in biology in schools.

1.13 Operational definitions of terms

Digital learning materials: It is based on information communication technology resources for teaching in class to present information such as computers, projectors, smart phones among others.

Computer simulations software: Learning information presented in class for the learners to view and visualize what the teacher presents for better understanding of difficult concepts.

Summative evaluations: Examinations given to mark the end of study cycle.

In-service training: Programs designed to offer extra professional skills to one already employed**.**

Learner-centered approach: Instructional method where the learner is at the middle of learning process and an active participant of the learning process.

Students Performance: Learning outcome presented through examination results in both formative and summative exams.

Teacher-centered approach: The teacher does the teaching without involvement of the learner in class and learners are passively involved in class.

Tutorial software: Downloaded information for learning reinforcement in class.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter helped the researcher to note up-to-date information about the studies done by others researchers related to technology integration in secondary teaching. Literature review also helped the researcher to avoid repetition of research work already done by others. It further helped researcher in building deeper understanding of the problem of the study and acquired valuable information on research methods and techniques used in the other studies.

The literature under review was based on the study objectives: ICT resources available for teaching Biology in schools, challenges teachers of Biology face when using ICT in schools and ICT influence on students' performance in Biology, case of KS. The literature also guided the study in reviewing the gaps under investigation.

The current changing science landscape demands that learners should be updated and engaged with the new discoveries and the real life demands to better their skills. Today the word Biology is expanding and changing into new frontiers from biotech to bio-medicine to bio-manufacturing and beyond. Luckily, there are available resources that can assist the twenty first century tutors bring out the current biology related research into classrooms for learner consumption, making Biology both engaging and accessible. This in turn improves its performance in evaluations.

Using digital learning materials in teaching Biology enhances teacher's lesson planning, provides an interactive learning experience and inspires future career goals in Biology. Digital learning resources in Biology complement inter-disciplinary hands-on approach in Kenyan curriculum, assisting the preparation of learners for bio-driven future. The resources make teaching and learning easier, engaging while personalizing learning paths, providing instant

feedback and offering access to a wider array of content from different sources for instance, specialized educational platforms, online museums, YouTube, Artificial Intelligence and Google.

2.2 Digital learning resources available in teaching of Biology

Various resources are available for the teaching of Biology. ICT resources are information handling apparatus that are used to distribute, exchange information, produce and store the information (Torruam and Abur, 2013). Some ICT resources according to UNESCO (2006)include: radio, television, video, DVD, phones, computers, satellite systems and network equipment and software among others provided by technologies like video- conference and electronic mails. Research reveals the availability of a variety of ICT resources that can be used in teaching Biology.

Sarkar (2012) study at Agartala defined ICT resources as any media that can collect, store, process, transmit and present information and related services during learning. According to Valasidou (2008), there are various types of ICT implements for learning such as tele-conferencing, video- conferencing and e-learning technology options. Sabina (2012) research on E-learning by secondary schools noted that there is big concern on use of ICT resources more so computers, scanners, multimedia computers, projectors, internet, among others in schools.

According to the recommendations by Kubiatko (2006), schools should be equipped with digital learning materials and hardware discs for learning, in build ICT rooms for Biology teaching among others. Vogt and Johnson (2005) also recommended use of computer programs which involve set of instructions written in a form a computer can read ("machine readable") that tell it how to perform specific tasks. ICT tools can also refer to digital microscopes with sensors and computer laboratory networks for science subjects like Physics, Biology and Chemistry; data display electronic whiteboards with projectors, digital cameras,

audio visual devices and soft-wares to allow channeling of teaching materials amongst networked computers in a room (Osama, 2008).

According to Kingori (2016), teachers and students can interact through web-based portals and access latest Biology content with the help of e-learning platforms through personal laptops and tablets. He further stated that by use of Skype and Zoom, students may share information online and also take examinations in scheduled time from home. Ouma (2015) did point out that use of tablets in school programs can revolutionize learning and was strongly supported by Kingori (2016), stating that with tablets students can be directed to various educational resources such as web links and case studies during class teaching.

This area dealt with a question, what ICT digital learning resources are in schools for teaching? The glaring findings were that there are some ICT digital learning resources which can be used in teaching in most schools. However, there were no specific digital learning resources for use in teaching Biology as a subject. In addition, no such research was done in any school in Kitui County so far and therefore, this study was justified to gather information on the ICT digital learning resources available for teaching Biology, case of Kalawa Secondary.

2.3 Challenges teachers of Biology face in ICT integration in schools.

Teachers of Biology face numerous challenges in the integration of ICT in teaching and learning Biology in most schools in developing countries (Farhana, Khan, and Chowdhury, 2024). Inadequate infrastructure- shortage or lack of ICT related devices, power issues especially in remotely located schools, insufficient technical support and teacher training, lack of related resources and software (Munyemana, Nsanganwimana, andGaparayi, 2022). At times some schools may not have a clear wide vision or strategic plans for integration of ICT in teaching and learning. The curriculum designers may also design a curriculum that is not compatible with ICT not underrating administrative and logistical issues, for instance, insufficient time and finances (Manggopa, Kumampung, and Batmetan, (2025). At times, most

Biology teachers who are young in age or with minimal time in teaching profession find it a waste of time in learning new and the current teaching methods in Biology which includes integration of ICT.

Use of technological resources in teaching profession is necessitated by continuous low performance in Biology despite the use of other conventional methods of teaching. For sure, use of technology alone cannot change much, but when used together with other LC teaching methods, learners' feel motivated and thereafter register a positive improvement in Biology performance (Nii Akai Nettey, Osei Mensah,Asafo-Adjei, and AdizaBabah, 2024). Research shows that there are challenges in integration of ICT in teaching science.

Khalid (2009) study in Australia indicated some of the challenges to ICT integration among teachers as lack of enough resources, confidence and competence skills. Microsoft worldwide education vice-president, Anthony Salcit in his opening statement to a forum once noted that a good number of the present generation of learners worldwide are already exposed to ICT devices and applications giving them due advantage to access different types of information outside learning environments (Wamari, 2014).

Kenya universal call for ICT use was challenging due to lack of adequate resources, poor national ICT infrastructure, low connectivity of electricity particularly in the rural areas (Farrell, 2007).

There are also other problems like poor government policies and projects implementation strategies which works against the efforts of ICT integration in schools (Torruam and Abur, 2013). Study done by Manyindo and Muthini (2014) indicated other challenges like computer illiteracy in most of teachers making it difficult to handle the technological resources; insecurity of the ICT tools and unreliable power supply to run some ICT resources in schools. Buabeng-Andoh (2012), did indicate that incase of teachers view of technological programs as

neither satisfying to themselves nor to the students' needs; then use of technology in schools was impossible.

Findings by Aladejana (2008) indicated that some blocks to ICT use in African schools are lack of electricity in most rural areas, poor infrastructure, epileptic power supply, poverty, untrained personnel, limited funding and inadequate internet access. Study findings by Obijiofor, Inayatulla, and Stevenson (2005) identified challenges to ICT in teaching as issues such as poor infrastructure, access to ICT in service training for skills development and hierarchical social barriers which determine who has access to ICT resources in work places. Elisha (2011) also noted other challenges that face involvement of technology in Kenyan schools as few trained teachers to handle ICT in schools, lack of computers, electricity, expensive nature of computers in Kenya, un repairable computers, burglary, technophobia among teacher, slow internet connectivity, low initiative measures by the community leaders and increased moral degradation among the youth. Therefore, Bitok (2014) did recommend training of teachers who are not in compliant to ICT competencies so as to apply the updated skills for teaching Biology. Poor ICT skills is one of the reason why teachers find it hard to involve ICT in schools (Kubiatko, 2006).

This area dealt with the question: are there challenges teachers' face when integrating ICT in schools? From literature review, several limitations were identified especially computer illiteracy among teachers, lack of enough ICT resources especially computers, electricity connectivity, poor ICT infrastructure in schools, financial constraints to purchase the ICT resources, theft, techno-phobia among teachers and many others. The research has not revealed the exact challenges facing teachers of Biology in schools. It was therefore important to find out whether the same challenges and others affected integration of ICT in teaching of Biology at Kalawa Secondary, Kitui County, Kenya besides other objectives stated.

2.4 Influence of digital learning materials integration in students' performance in Biology.

Mbugua, Gori and Tanui (2015) research indicated that global objective for investing in ICT use in education was to make instructional methods used by teachers better during content delivery in class. This makes lessons more interesting and result to improved students' performance in academics. In addition to this, Abichandani (2012) also indicated that virtual simulation software experiments through online laboratories enhance understanding of abstract concepts, resulting to good performance whenever tested.

Research shows that teaching Biology by involving technology has significant positive impact on students' academic results in general. Findings by Volman and Van Eck (2001) on gender and ICT integration indicated that technological use creates a vivid experience in learning and transforms teaching and learning process into more interactive, active and self-directed activity. Omollo (2013) concurred with this statement and emphasized that use of ICT facilitates effective learning thus enhancing better students understanding of new concepts thus translating into expansion of knowledge and improvement on examination outcomes. Drent (2007) supported this by stating that creative use of technological software in teaching facilitate learner centered learning environment, which again result into good performance in examinations.

Through ICT, ideas are shared regionally and schools in Kenya can get support and through that improved learning and academic performance is realized. Manyindo and Muthini (2014) observed that if adoption of ICT integrated learning is effectively done, most schools may register good performance in examinations. Research has also shown that schools that are already using modern technology in learning through an initiative that seeks to test the viability of using tablets in teaching and learning have recorded improved performance (Merab, 2014).

Inevitably, use of technology is penetrating into classrooms very fast, with teachers in more developed schools taking innovative use of ICT to facilitate improved learning (Wamari, 2014) and recording good performance in examinations. Kenya's technology master plan on ICT project which was put forward the period between 2013 and 2018, encouraged deeper ICT integration in the country's system of education and business processes (Kamunyu, 2014). Ouma (2015) noted that public schools are still waiting for rolling out of computers for schools promised by the government years ago which to date amounts to more than ten years, yet use of technology in some schools has made learning more exciting and thus improved school attendance and academic performance.

To be specific, teachers use technology to teach abstract Biological concepts like in genetics despite insufficient computer hardware and digital learning materials for instruction of Biology in schools (Van Rooy and Wilhemina, 2012). As a matter of fact, software use in the teaching process make students understand difficult concepts which are also problematic in examinations and directly record good academic performance outcome in examinations (Gakime, 2016).

Oyebola (2018) research finding indicated that use of multiple media in class improves learning among learners and influenced their academic performance positively and therefore its use in teaching Biology was inevitable. Basri, Alandejani and Almadani (2018) research finding supported the same and realized existence of a close relationship between ICT integration and academics performance. Ishtiaq, Qaiser, Naseerud Din and Farhan (2017) supported this in their research findings which established that Technological use positively affects students' academic performance and content retention which in turn results to good performance in their examinations. In addition to this, Mbugua, Kiboss and Tanui (2015) in their research concurred with this statement and concluded that ICT integration in teaching is an important component in positive improvement of students' academia.

With the current changes and dynamics in the education sector ICT is slowly becoming one of the basic tolls in teaching and learning making it a key element in the modern technology for successful lives and competition for jobs (Surxonidinovna, and Madrimovich, 2020). ICT integration has landed in different grounds within the education sector some making it to thrive very well while others bringing it to a standstill. Where ICT integration has received warm welcome in teaching and learning Biology, it has not only increased the levels of knowledge but also the learners' attitude towards the subject (Fenni, 2023). Regardless of the various benefits provided by ICT integration in teaching and learning of Biology, full implementation of the same has been affected by the a number of challenges; technical support by schools, competence of teachers in using ICT, attitude towards the same and time.

Teacher attitude and perception affect ICT integration in teaching and learning biology because use of ICT and its integration in teaching and learning Biology begins with the acceptance by the instructors which is directly linked with the attitude and perception of the instructors (Yildirim, 2021). Teacher positive attitude and perception encourage use and adoption of ICT in teaching and learning Biology right from the classroom levels regardless of the challenges associated with the same. A teacher with positive attitude and perception about integration of ICT in teaching and learning Biology will make maximum use of use the available resources maximally compared to teachers who negatively perceive integration of ICT in teaching and learning biology who will complain about shortage of resources in starting the use of ICT in their lessons. Successful implementation of ICT integration in teaching and learning Biology calls for positive attitude and perception among teachers.

Technical and administrative support is also an essential tool in the integration of ICT in teaching and learning Biology and can influence performance as it ensures that teachers are equipped with the relevant skills and knowledge to integrate ICT in their methods of instruction (Volman, Van, Heemskerk, and Kuiper, 2015). Technical training and administrative support also motivates teachers into using ICT in their everyday teaching. The technical support is

likely to affect the willingness of teachers to adopt and use ICT in teaching and learning Biology as it is very essential in troubleshooting issues related to the integration of ICT. For full implementation of ICT in teaching and learning Biology it is essential to train teachers on basic ICT techniques to help them fix simple problems related to the same (Yadap, 2021). In this regard, education and school administrators need to adopt strategies that encourage teachers to gain skills and knowledge on the use of ICT in their daily teaching and learning. School administrators should take lead in setting and discussing with teachers on ICT policies and vision in their schools and how to appropriately share the available resources. Administrators also have a duty to follow up the on the ICT implementation in their schools and encourage teachers to come up with the possible solutions to challenges facing implementation of ICT integration in teaching and learning Biology.

Teacher professional development plays a great role in the effective implementation of all education programmes (Volman, and Van, 2021). Professional development boosts teacher's morale, skills and motivation. In this regard, teachers need to be trained in various aspects of using ICT at classroom level to reduce teacher anxiety and increase both their confidence and willingness to use ICT in Biology. Such teacher training should be based on teacher needs in regard to ICT integration in teaching and learning Biology. The ICT sector is one of the dynamic sectors in the current world and thus teachers should be trained on the currents trends in the integration of ICT in teaching and learning Biology, for instance, the best applications, web platforms and devices to use to make a lesson engaging, learner centered, interactive and captivating. Teachers may also be trained on the best ways to integrate ICT in teaching and learning Biology so as to motivate learners and boost their creativity in class for instance making use of the virtual labs, sorting and treatment of data and video presentations in teaching and learning process (Fenni, 2023). Teacher trainings on ICT integration are few and inadequate especially in most public schools in developing countries. This has resulted to slow rates in implementation of ICT in teaching and learning of Biology. In most teachers training,

general ICT skills rather than specific skills for successful implementation of ICT in teaching and learning Biology are put into consideration.

According to World Economic Forum, 2019, there exists a gap between women and men in various forms of life all over the world. The same gap has been witnessed in ICT where males have dominated the use of ICT. The level and the rate at which male and female teachers use ICT in the teaching differs and consequently the level of using the internet among female teachers has been found to be low compared to male teachers (Miguel, 2017). Female teachers miss some opportunities to access online services and useful information as they are busy with domestic duties. This has resulted to low competencies and lower computer skills among female teachers.

Education institutions need to come up with programs and plans to facilitate and upgrade female teachers' ICT skills and competence to boost implementation of ICT integration in teaching and learning Biology. Age among teachers is another factor that is majorly affecting implementation of ICT in teaching and learning Biology in schools today. The younger generation has shown positive attitude and perception towards use of ICT in teaching and learning biology compared to aged teachers (Prospery, 2018).

Schools in developing countries have also been faced with shortage of ICT resources which is not the case in developed countries and thus Biology performance remains wanting. For successful and effective implementation of ICT integration in teaching and learning biology ICT resources must be available for use by teachers in schools. Schools need both hardware and software resources to ensure effectiveness of ICT in classroom (Tomljenović, and Zovko, 2016). Shortage of computers, connectivity to the internet and electricity facilities are among strong setback in the effective implementation ICT integration in teaching and learning Biology (Catherine, 2018). Administrators should attempt to provide at least the basic materials for implementation of ICT integration for teaching and learning biology.

This section dealt with the question; does integration of technology during teaching of Biology influence academic performance of the learners? Findings from other studies showed that its use has a great influence on students' academic performance. It was therefore necessary to conduct research at Kalawa Secondary, Kitui County to find out whether same use of digital learning materials in teaching of Biology has influence on students' examination results.

2.5 Summary and the existing gaps from the reviewed literature.

To conclude this chapter, it was of great importance to present the summary of the research findings and comments that were reviewed highlighting major gaps that this study intended to bridge.

To begin with, research on ICT resources availability revealed that there are some ICT resources available and already in use in schools, but it was not specific on the available resources for teaching of Biology as a subject. Most of the ICT resources available do not give the learner direct hands-on-experience since the learner is passively involved in their use, this makes it difficult for the students to acquire knowledge and experience. Research was therefore, important to find out what digital learning materials are available in Kalawa Secondary for use in teaching Biology in classes or laboratory.

Research also revealed several challenges teachers face during ICT integration in schools ranging from resources to technological experience. However, the research does not reveal specific challenges facing teachers of Biology in Kitui county. Research was therefore necessary to investigate whether the same challenges and others face teachers of Biology at Kalawa Secondary, Kitui county, Kenya.

Research indicated that technology use in teaching has significant influence on students' academic outcome in examination. However, no similar study was done at Kalawa secondary.

Research was therefore necessary to determine whether digital learning materials integration has significant influence on students' performance in Biology, case of KS.

It was also noted that there is no research so far done at Kalawa Secondary, Kitui County, Kenya on digital learning materials in teaching and their influence on learners' performance and therefore this study was considered relevant to the school.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the method of research used in collection of required data and its analysis for this study. It also presents the design used and locale of the study, population targeted, sampling procedure, instruments used, reliability and validity of the instruments, logical and ethical matters.

3.2 Research design

A descriptive research design was found suitable for this study. This is because the design allowed for the description of events as they were at the time of research. The researcher was interested in identifying which ICT resources were available at KS, exploring challenges facing teachers of Biology at KS and lastly finding out whether use of digital learning materials in classroom teaching had significance influence in performance of Biology. Both qualitative and quantitative data from selected respondents were used in the description of the influence of digital learning materials integration on learners' performance in Biology, case of KS.

Besides, descriptive research design was considered suitable because data from sampled members of the population was used in determining the status of the KS population in variables under investigation (Mugenda and Mugenda 2003). Data collection was done using RCL, LOS, BTQ and PIS research instruments and then used to discuss the characteristics of the school and its population under this study.

3.3 Research variables

Independent variables: These variable included availability and accessibility of ICT resources, and teacher ICT skills such as literacy levels, interest and integration skills, teacher instructional methods used in teaching of Biology as well as technological challenges faced by teachers in ICT integration.

Dependent variable: Performance in Biology.

Intervening variables: These are factors which may indirectly affect biology performance such as ICT policies in the school, learner entry behavior, resources available and staffing if not adequately checked.

3.4 Location of the study

This research was conducted at KS, Kitui Central sub-County, Kitui County, Lower Eastern region of Kenya. Kitui County borders 7 counties: Meru and Tharaka-Nithi to north, north-west to Embu, Makueni and Machakos to west, Tana River to east and Taita-Taveta to south. The school was selected because consistently recorded very low performance in Biology compared to Physics and Chemistry in KCSE examinations between 2014 and 2022 despite benefiting from various ESP for ICT stimulus from the government of Kenya. For that matter, ICT use by teachers of Biology in the school remained an area requiring research. According to Orodho (2012), carrying out a research in an environment the researcher is conversant with is easier compared to doing it in an unfamiliar area.

In the educational context, Kitui Central sub-County has 26 schools: 1 national secondary school, 3 extra-County schools and 22 County and sub-County schools. Despite the efforts made by many schools, low performance in Biology has been noted generally across the Sub-County.

3.5 Target population

The research targeted 750 students taking Biology, eight (8) teachers of Biology and one (1) school principal. Table 3.1 shows the total target population in the school. The school has 4 streams in form II. The researcher purposely selected the 4 form II classes and did lesson observations for a period of 4 weeks. Form III and IV classes were not selected for this study because Biology is an elective subject in upper forms unlike in lower forms. Secondly upper classes are combined into three Biology classes instead of four and hence previous results in form I and II could not be used in doing the comparison.

Table 3.1: The targeted population

Respondents	**School Population**	**Target Sample Size**	**Percentage**
Biology teachers	8	6	75%
Biology students	750	225	30%
Principal	1	1	100%
Total	**759**	**232**	**30.57%**

Six (6) out of eight (8) teachers of Biology were sampled. From student's population, the researcher targeted 225 out of 750 students of Biology to serve as representatives for this study. The School has one (1) principal who was included in this study.

3.6 Sampling procedure and sample sizes

The school has a single principal who was purposely selected for this study. Six (6) teachers of Biology were purposely sampled as well. This was done to ensure a higher sample size and maximize validity and reliability in the study. The researcher targeted form two students of biology instead of form III because the subject remains elective in form III and IV and therefore classes reduce to three. In addition, analyzed results in form I's and II's were to be used in the study which was not possible. Lesson observations were done in form two classes in week I,

IV, VII and X for a period of 4 weeks from a total of 12 teaching weeks in a term. 64 lessons were observed from a total 192. The study looked at teacher use of digital learning materials in teaching visa-vis other conventional methods of teaching. SPSS model was used in the analysis of the collected data.

3.7 Research instrument

The researcher used four instruments namely: RCL, LOS, BTQ and PIS to gather both qualitative and quantitative data from the population under this study.

3.7.1 Resources checklist

This is an inventory record with series of things to be investigated. This study used checklist to identify the available ICT resources for use in the teaching of Biology at KS. The main resources of interest were electricity sockets in classes, desktops & laptops, projectors, display whiteboards, printers, photocopier machines, Wi Fi connectivity in offices and classes, ICT-Rooms in the school, electric extension cables and any other digital learning materials for teaching.

3.7.2 Lesson observation sheet

This instrument collected data from selected classes of Biology. The data collected related to actual and frequency use of any digital learning materials in teaching Biology in classes within a period of four (4) weeks of study.

3.7.3 Biology teachers questionnaire

This instrument was used to gather data from teachers of Biology at KS. Data collected related to challenges of ICT integration in KS, frequency of use of digital learning materials during lesson preparation and presentation in classes, ICT skills in the teacher and teacher' perception towards administration support towards ICT integration in teaching of Biology. Questionnaires were given to six (6) teachers of Biology to fill and later collected by the researcher for analysis.

3.7.4 The Principal interview schedule

Mugenda and Mugenda (2003) emphasized that data can be collected through oral presentation of questions or alternatively involve use of an interview schedule that in many cases require the interviewer to set questions to be asked during the interaction. In this study, the researcher collected information directly from the principal by use of set questions on the aspects related to administrative support for ICT integration in KS.

3.8 Pilot study

Before the real research, pilot study was conducted in St. Charles Lwanga secondary of equal status as KS. BTQ were given to two teachers of Biology to fill. The school principal was then subjected to mock interview by the researcher using the set of questions for the study. The researcher also visited the school and did lesson observation in form II classes. This was of importance in testing validity and reliability of the instruments. Ambiguous statements were identified and corrected, the language and questioning techniques used were checked and any other errors for the researcher to make prior corrections.

3 .8.1 Validity of the research instruments

The researcher worked closely with the experts in this area of study during validation of instruments used. First, the researcher did consult with his supervisors in order to evaluate and include their recommendations in the research instruments. Secondly, it was done by conducting pilot interviews and thirdly, sought consent from the subject experts. The questions found ambiguous were reframed and those irrelevant to the study restructured. This ensured that the evaluation and improvement of the research instruments was done thoroughly. Kumar (2005) research study indicates that the validity concept ensures that correct procedures are applied in finding answers to the study questions. Vogt and Johnson (2005) also viewed validity as the trustworthiness of the statements used and the findings provided by the research area.

3.8.2 Research instruments reliability

Research reliability was done to ensure that the instruments produced consistent results if used repeatedly (Orodho, 2009). Jackson (2009) viewed reliability as the certainty of a research tool to measure and provide similar outcome every time is applied. Mugenda and Mugenda (2012) also stated reliability as the consistency and reliability of data collected through the use of a scientific instrument or data collection procedure under similar conditions. For maximum reliability, triangulation method was applied where multiple research instruments were used in data collection as supported by Creswell and Miller (2000). These methods were used in collection of similar and different types of data. According to the views of Creswell (2012), different subject informants help the researcher to gather information by triangulation method and therefore this ensures that the findings are accurate and credible.

In this study, the researcher used Spearman-Brown prophesies formula of internal consistency and reliability of 0.7 and above.

$$r = \frac{1-6(\sum d^2)}{N(N^2-1)}$$

Where r = reliability; N = Sample size; d = deviation

3.9 Data collection

Data collection involves actual process of collecting data from the respondents. The techniques used were as discussed below.

3.9.1 Resources

Checklists were used to itemize the ICT resources available for use in the teaching of Biology. The resources of interest were: projectors, computers, printers, laptops, photocopier machines, electrical sockets in classes, display boards, wi-fi connectivity, extension cables and any other digital learning materials.

3.9.2 Study questionnaires for teachers

Teachers of Biology were issued with questionnaires to fill. The questions were explicit and teachers answered them alone.

3.9.3 Lesson observations

Lesson observations were carried out during the teaching of Biology lessons in form II classes guided by the observation schedule. The researcher observed any use of technology and digital learning materials in actual teaching by the subject teachers visa-vis other teaching methods and learning aids by subject teachers identified as A, B, C and D for anonymity purposes. The researcher further collected data related to termly performance of individual classes since form one up to term II in form two from the examination department.

3.9.4 Interviews

The researcher visited the school principal in the office and carried out a face-to-face presentation of set questions in line of the study objectives. The responses were recorded for analysis later on.

3.10 Data analysis

The analysis started by checking out the collected raw data, usefulness and completeness. Data coding was done by the researchers then proceeded to run descriptive analysis guided by SPSS version 20.0. Data pre-coding and re-coding was done, then subjected into the program for descriptive analysis which was done in accordance to the study objectives.

3.11 Logical and ethical issues

The study involved school students below 18 years. According to Orodho, A. J, Nzambalirwa, W., Odundo, P., Waweru, N. P. and Ndayambaje, I. (2016), the researcher was required to understand the Kenya Constitution Bill of Rights. This ensured protection of human rights and preserved the dignity of individuals and community under this study and thus promoting social justice. The Bill gives everyone the right to freedom of expression. In order to respect this, the

researcher sought clearance letter from Kenyatta University, Graduate school; a research permit from NACOSTI, permission letter from the school principal for the study to be done with minimal challenges.

3.12 Summary

Detailed information was given on methodology, variables, design used, sampling process to obtain targeted sample size, piloting procedures, methods used in data analysis and how the reliability and validity was achieved.

CHAPTER FOUR

FINDINGS, INTERPRETATION AND DISCUSSIONS

4.1 Introduction

In this chapter, the study findings were presented, analyzed and discussed in line with the study objectives. This research investigated use of digital learning materials in teaching and their influence on learners' performance in Biology: case of Kalawa Secondary, Kitui County, Kenya. The study sought to identify available ICT resources for teaching Biology; establish influence of ICT digital learning materials integration on students' performance in Biology examinations and lastly explore challenges facing teachers of Biology during technology integration at Kalawa secondary. To meet these three objectives, the researcher used four instruments namely: RCL, LOS, BTQ and PIS.

4.2 Available digital learning resources for use in teaching of Biology.

This study objective was to identify ICT resources available for use in the teaching of Biology at KS. Checklist was used to itemize available resources. Resources of interest for the study were: electricity sockets in classes, desktops, projectors, laptops, display whiteboards, printers, photocopier machines, Wi-Fi connectivity in offices, ICT-Rooms in the school, electric extension cables and stored digital learning materials for the teaching of Biology. This research instrument was filled by the researcher from the school.

The researcher also visited the administration offices, computer laboratory room, Biology laboratory rooms, library, and the 18 classes to check the ICT resources and any other digital learning materials for use when teaching Biology. The available resources were presented in Table 4.1.

Table 4. 1: Fixed resources

Resources	With	Without
a) Electric sockets in classes	12	6
b) Display & white boards in classes	9	9
c) Wi fi connectivity in classes	9	9

It was established that 12 classes had electric sockets while 6 were without. It was also established that 9 of the classes were with white boards while 9 were without. It was also established that 9 of the classes were connected to WIFI while 9 had no connectivity. This study, found that KS had inadequate fixed digital learning resources for ICT integration. The study concurred with Sabina (2012) research which noted that there is a big concern of ICT resources especially electrical connectivity and hardware in schools.

Further, the researcher was interested with the portable resource hardware in KS as per Table 4.2.

Table 4. 2: Portable resources hardware

Resource	Total	Usable	Non- Usable
a) Projectors	1	1	0
b) Printers	6	5	1
c) Photocopier machines	4	3	1
d) Desktops/Laptops	28	24	4
e) Extension cables	18	11	7
f) ICT Biology simulation and tutorial software (flash-disks, DVD)	2	2	0

It was established that the schools had 1 working project, which was likely not sufficient for the school. The school has 5 usable printers, 3 Photocopier machines, 24 desktops/Laptops, 11 extension cables and 2 ICT Biology simulation and tutorial software (flash-disks, DVD) which

were inadequate for the school. This study agreed with Kingori (2016) research which indicated that teachers should interact through web-based portals and access latest Biology content with help e-learning platforms and resources. In addition, this study concurred with Ouma (2015) research that indicated that use of tablets and laptops in schools can revolutionalize learning.

4.3 Integration of technology in teaching of Biology and influence on students' performance

To achieve this objective on the influence of Technology use on students' performance in Biology, the researcher used both BTQ and LOS to identify the frequency of accessing and using the following resources in preparation and content delivery in classes: laptops, internet in down loading learning materials, photocopier machine and school printer, projector and computer Biology simulations and tutorial software were of interest to this study. The results from BTQ were as per the table 4.3

Table 4. 3: Use of resources in preparation and learning delivery

Resources	Frequently	Rarely	Never
Laptops	3	2	1
Internet in downloading learning material	4	1	1
Photocopier and printer	3	2	1
Projector	3	2	1
Computer Biology simulations and tutorial software	2	3	1

Table 4.3 shows frequently used ICT resources includes; internet in downloading learning material utilized by 4 teachers; 3 teachers frequently does use laptops. For photocopier, printer and projectors it was found that 3 out of 6 teachers used them frequently. For Biology simulations and tutorial software, 3 teachers rarely used them and 1 teacher never used them over the period of study. It was discovered that 3 teachers rarely used biology simulations and tutorial software while 2 teachers frequently used them. This was in line with Torruam and

Abur (2013) who argued that various resources are available for the teaching of Biology which include laptops, desktops, projectors and printers. Research reveals the availability of a variety of ICT resources that can be used in teaching Biology Torruam and Abur (2013). Kubiatko (2006), argued that schools should be equipped with digital learning materials and hardware discs for learning, in build ICT rooms for Biology teaching among others. Vogt and Johnson (2005) also recommended use of computer programs which involve set of instructions written in a form a computer can read ("machine readable") that tell it how to perform specific tasks.

Previous performance in Biology since form one term I up to form two term II for the four teachers labeled A, B, C and D were used to determine the relationship between use of ICT and students performance in biology in a class with highest exposure to ICT resources compared with class with least exposure to technology. The table 4.6 revealed the relationship.

The questionnaire further required respondents to give their computer application competency skills in a scale of 1 to 4 where 1=poor, 2=Fair, 3=Good and 4=Excellent. Responses obtained were as per Table 4.4

Table 4. 4: Respondents rating on computer application skills

Computer application (skills)	**Excellent**	**Good**	**Fair**	**Poor**
Frequency	**F**	**F**	**F**	**F**
a) Word processor e.g. MS – word	1	3	1	1
b) Spread sheet e.g. MS – excel	0	5	0	1
c) Data base e.g. MS- access	0	2	1	3
d) Presentation tools e.g. power point	2	1	3	0
e) Internet search tools e.g. Google	4	1	1	0

From table 4.4, a large percentage of Biology teachers were excellent in internet search tools e.g. Google 4 teachers, good in Spread sheet e.g. MS – excel 5 teachers and good in Word processor e.g. MS – word 3 teachers. The teachers were not poor in integrating ICT in teaching and therefore should be provided with enough ICT tools for teaching. This agreed with

Bingimlas (2009) who stressed that for excellent use of technology, teachers should be provided with ICT tools, enough professional development, technical support and adequate time from places of work.

BTQ also demanded the respondents to rating the school administration effort to promote ICT-integration. The ratings were as per the Table 4.5.

Table 4. 5: Teachers rating with reference to administration effort to promote ICT-integration in KS

	Excellent	**Good**	**Fair**	**Poor**
Item	F	F	F	F
a) Purchasing ICT resources	1	2	3	0
b) Sponsoring teachers for ICT in service training	0	4	1	1

Table 4.5 indicated that a larger percentage of the respondents felt that Sponsoring teachers for ICT in-service training was important (4 teachers) and Purchasing ICT resources was fair (3 teachers) in KS.

The researcher investigated on the relationship between ICT use by teachers and students' performance in Biology. Table 4.6 presented the results.

Table 4. 6: Relationship between ICT integration and performance

		ICT integration	**Performance**
ICT integration	Pearson Correlation	1	.652
	Sig. (2-tailed)		.000
	N	6	6
Performance	Pearson Correlation	.652	1
	Sig. (2-tailed)	.000	

N	6	6

Table 4.6 indicates a strong positive correlation between technology use in class and students' academic performance in Biology (r=0.652). This confirms that digital learning materials use in class improves students' outcome in exams. This study agrees with Kingori (2016), who argued that teachers and students can interact through web-based portals and access latest Biology content with the help of e-learning platforms through personal laptops and tablets and thus improve their performance. He further stated that by use of Skype and Zoom, students may share information online and also take examinations in scheduled time from home.

4.4 Lesson observation sheet (LOS) results

This tool was used to collect data from 4 Form II classes sampled during the teaching of Biology for a period of four weeks. The data collected related to any use of digital learning materials by Biology teachers during lesson presentation in class. For anonymity purposes, the teachers were labeled as A, B, C and D. The results were presented in figure 4.2

4.4.1 Lessons per week in which ICT digital learning materials were used in teaching

The researcher investigated the number of lessons per week when ICT was used. This is because for effective influence of digital learning materials in teaching to be realized, then its' use in almost every lesson should be there. This helped the researcher to explore how regularly ICT digital learning materials were being utilized by the respondents. The information was collected using direct lesson observations per class. The findings were represented in figure 4.1

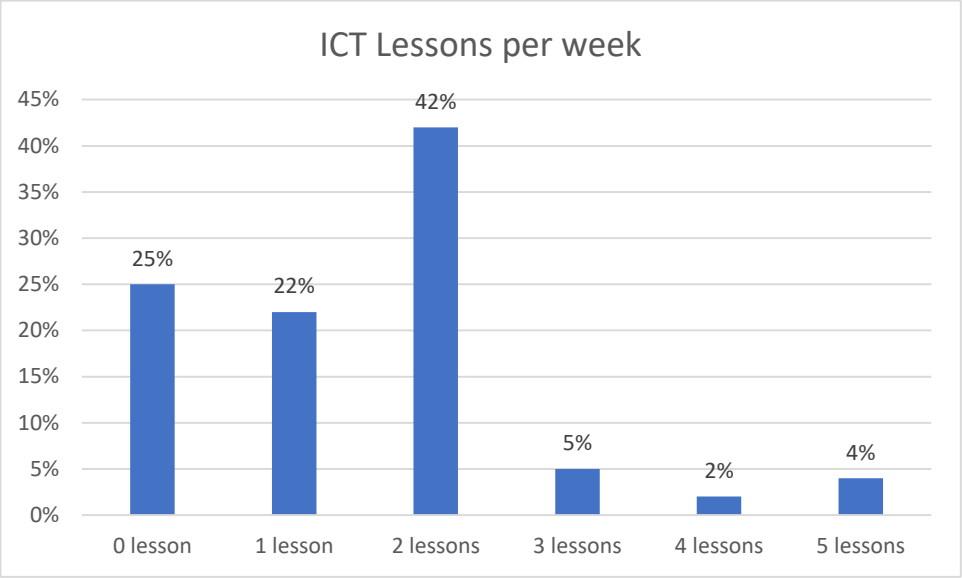

Figure 4. 1: ICT Lessons per week

According to figure 4.1, 25% of the teachers do not use digital learning materials in teaching in any Biology lesson per week. However, 75% of the teachers used software in teaching of Biology for at least a single lesson in a week. Gakime (2017) study noted that learning in classroom depends on the teaching methods used in content delivery which influences end results in examinations.

The grand total was presented in Figure 4.2

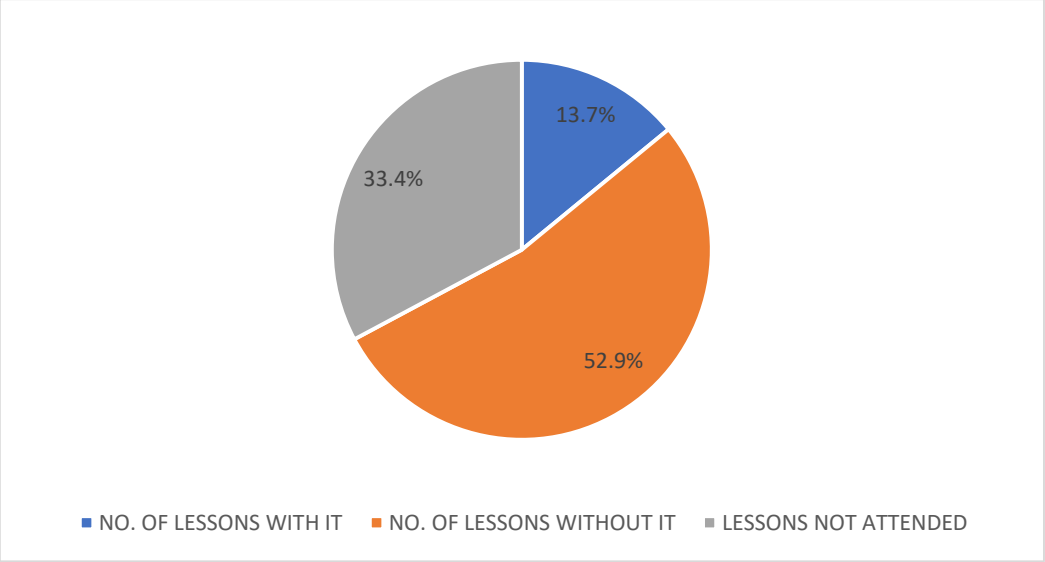

Figure 4. 2: ICT use

From Figure 4.2; it was found that 52.9% of the Biology teachers were using lecture and dictation methods of teaching in most of their lessons. This was followed by 13.7% who were using projectors and laptops as digital learning materials in class as well as laboratory experiments. 33.4% of the lessons observed were not attended. The study concurred with Oyebola (2018) which noted that use of multiple media in class improves learning among the learners and equally influences their academic performance.

4.4 Challenges teachers of Biology face on integration of ICT during teaching.

This study objective sought to explore the challenges teachers of Biology face during ICT use in KS. BTQ and PIS research instruments were used to gather information on the challenges. The researcher was interested in: ICT resources available and their accessibility by teachers and students, administration support on ICT, electricity supply in the school, ICT skills among Biology teachers. Table 4.8 below presents the findings

Table 4. 7: Teachers opinions on school resources and support

Statements	Yes	No	Total
School had enough ICT resources for Biology teaching	2	4	6
School administration offered necessary support for ICT integration	5	1	6
I have adequate ICT skills for teaching Biology in the school	5	1	6

Table 4.7 indicates that 4 teachers of Biology felt that the school had no insufficient ICT resources for Biology. 5 teachers were of the opinion that the school offered the necessary support for ICT and Biology teachers had adequate ICT skills for teaching. The researcher further intended to establish teachers' responses on challenges experienced in involvement of digital learning materials in Biology. Biology teachers through questionnaires were required to reveal challenges experienced when using ICT in teaching. Figure 4.3 presents the results obtained.

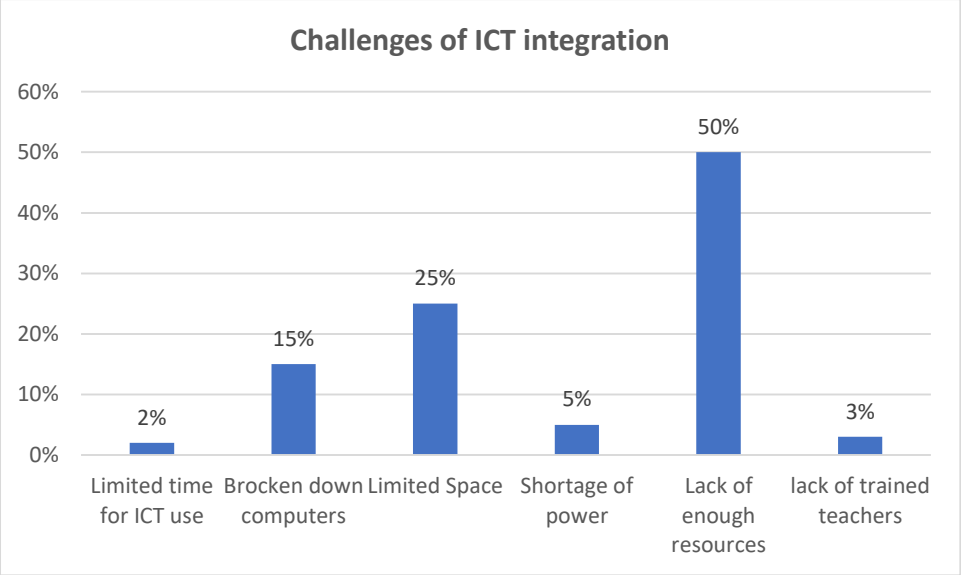

Figure 4. 3: Challenges of ICT integration

From the information in figure 4.3; 50% of the teachers noted the main challenge was lack of enough ICT resources followed by limited space 25% and broken computers which were never repaired 15%. This was in line with, Khalid (2009) study in Australia which indicated some of challenges to ICT integration as lack of enough resources, confidence and competence skills.

This study also agrees with Sabina (2012) research on e-learning in secondary schools which noted big problem on ICT resources availability.

4.5 Principals' interview schedule report

The principal reported that the school was performing well. It was also reported that the ICT integration had a positive impact in the school general performance. The principal disclosed that the school had insufficient ICT resources. The school administrator further confessed that he rarely encouraged teachers to use ICT in teaching, but he would. It was however reported that most teachers in the school had been trained on ICT use and could apply the knowledge well.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the study findings, conclusion, recommendations and suggestions for further study. The summary is organized around the available ICT tools and resources in KS for teaching Biology, the application of ICT in teaching the subject, challenges teachers face in using ICT in teaching Biology and whether digital learning materials use in teaching and learning influences students' performance in Biology. The final section study findings and recommendations for further research based on the findings are also discussed.

5.2 Summary of findings

This research study sought to investigate the available ICT resources for use in teaching of Biology at KS, to explore digital learning materials in teaching and its influence on students' performance in Biology and to document challenges Biology teachers face during integration of ICT during teaching of: Biology case of KS. Resource checklist, the questionnaires for the teachers, interview schedules for the school administrator and observation checklists were used in data collection. The summary presented here is based on the study findings and was done as per the study objectives.

5.2.1 ICT resources available for teaching Biology

The first study objective was interested in finding out what ICT resources were available in KS for teaching Biology. The research revealed that there were some ICT resources for use by some teachers of Biology. Resources of interest were electricity sockets in classes, desktops, projectors, laptops, display whiteboards, printers, photocopier machines, WIFI connectivity in offices, ICT-rooms in the school, electric extension cables and digital learning materials. It was established that 12 classes had electric sockets while 6 were without. It was also established

that 9 classes had whiteboards while 9 did not have. It was also established that 9 of the classes were connected to WIFI while 9 were not.

It was established that the school had 1 working project, which is likely not to be sufficient for the school. The school has 5 usable printers, 3 photocopier machines, 24 desktops and Laptops, 11 extension cables and 2 ICT Biology simulation and tutorial software (flash disks, DVD).

5.2.2 Integration of ICT during teaching of Biology and students performance

The second objective was to establish the levels of Technological influence on Biology examination performance among learners. The researcher sought to look at the frequencies of using the following digital learning materials in preparation and content delivery in classes by the teachers: laptops, Internet in downloading learning materials, photocopier machine and school printers, projector and computer simulations and tutorial software in class. The study established that the most frequently used resource was internet in downloading learning material (4 teachers), laptops (3 teachers), photocopier and printer (5 teachers) and projectors (3 teachers). For Biology simulations and tutorial software,3 teachers rarely used these, 1 teacher never did while 2 teachers frequently used them. The research also revealed that majority of the respondents were excellent in internet search tools e.g. Google (4 teachers), good in Spread sheet e.g. MS – excel (5 teachers) and Word processor e.g. MS – word (3 teachers). It was also established that the administration sponsoring teachers for ICT in-service training was good (4 teachers) and purchasing ICT resources was fair (3 teachers). The regression analysis showed existence of a positive relationship between use of digital learning materials use by the teacher and students' results in examinations($r=0.652$).

The study further established that 25% of Biology teachers never used technology in teaching while 75% indicated that there is some ICT use in teaching of Biology for at least one lesson in a week during lesson observations.

5.2.3 Challenges teachers of Biology face on integration of ICT

Third objective of this research sought to explore on the challenges teachers of Biology face during ICT use while teaching. It was established that 4 of the respondents felt that the school does not have enough ICT resources although 5 indicated that the school offers the necessary support and the teachers have adequate ICT skills for teaching Biology. The researcher was further interested in establishing teachers' responses on the challenges experienced in use of ICT in teaching Biology. Through questionnaires, teachers were required to state the challenges experienced when using ICT in teaching. It was established that the main challenge was lack of enough ICT resources for teaching indicated by 50% of respondents. The respondents further indicated that there was limited space (25%) as well as several broken computers which were never repaired (15%).

5.3 Conclusions

From this research, it was noted that technological use in teaching Biology is below the school expectations since most teachers rarely use or do not use technology in teaching of the subject. This was mainly due to inadequate ICT resources and other several challenges associated with the use of technology in schools and this therefore affected teaching of Biology in Kalawa Secondary. Classes where technology was used for at least two (2) Biology lessons per week recorded a better performance in Biology examinations than those where technology was used in only one Biology lesson per week or none. This consequently affected the general performance of students in Biology in KS.

There is also need for provision of adequate and variety of digital learning materials to meet all the learner's needs. Effective impact of digital learning materials in Biology occurs when there are adequate ICT resources and which are frequently used in classes. From this research it was resolved that involvement of ICT digital learning materials in Biology learning results to good performance in examinations.

5.4 Recommendations

From this study findings, the following recommendations were made:

a. School administrators should ensure that there is a variety of digital learning materials for teaching Biology for good performance in schools.

b. Teachers should vary the use of technology in every Biology lesson to create interest in the learner.

c. The school administration should ensure that they have equipped and spacious ICT resource centre or computer laboratories.

e. There is need for regular workshops, seminars and in-servicing training of teachers on effective utilization of digital learning materials in teaching.

5.5 Suggestions for further research

The suggestions below are deemed pertinent for further study:

a. Identify how the curriculum can be restructured to adequately cater for an effective and total use of technological digital learning materials in preparation and presentation of Biology content in class.
b. Find out how best teachers can be effectively involved in the use of technology for effective teaching and understanding of Biology.

c. Establish the extent to which use of ICT has been done in teaching of Biology and other subjects in other Centres of excellence secondary schools in Kenya.

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APPENDICES

APPENDIX I: RESOURCE CHECKLIST (RCL)

This research instrument was filled by the researcher from the school. The researcher visited the administration offices, computer laboratory room, Biology laboratory rooms, library, and the 18 classes to check the ICT- resources and facilities available for use in teaching Biology at KS.

SECTION A: BACKGROUND INFORMATION

1. School: Kalawa Secondary

SECTION B: CHECKLIST TABLE

TABLE 1 FIXED RESOURCES

RESOURCE	WITH	WITHOUT
d) Electric sockets in classes		
e) Display & white boards in classes		
f) Wi fi connectivity in classes		

TABLE 2 PORTABLE RESOURCES (HARDWARE)

RESOURCE	TOTAL	USABLE	NON- USABLE
g) Projectors			
h) Printers			
i) Photocopier machines			
j) Desktops/Laptops			
k) Extension cables			
l) ICT Biology simulation hardware (flash-disks, DVD)			

APPENDIX II: LESSON OBSERVATION SHEET (LOS)

This tool was used to collect data from 4 form II classes sampled during teaching of Biology for a period of four weeks. Data collected was on application of technology and use of digital learning resources in teaching of Biology by the form II teachers during lesson presentation in class.

SECTION A: Background Information

SCHOOL: Kalawa Secondary

WEEK: _____ TEACHER _____

CLASS: DATE:_____

SCHOOL: KALAWA SEC. SCHOOL

ICT RESOURCES /TEACHING METHODS USED	**LESSONS**			**TOTAL FREQUENCY**
	1	**2**	**3 & 4**	
a) Projector/laptops/ICT Digital learning materials				
b) Computer tutorial and simulations software				
c) Lecture /dictation				
d) Use of charts				
e) Laboratory (practical) experiments.				
Others				

APPENDIX III: BIOLOGY TEACHERS QUESTIONNAIRE (BTQ)

SECTION A: INTRODUCTION

This questionnaire is meant for academic research only. Information given here shall remain confidential to the researcher. Kindly provide truthful information as possible.

Thank you in advance.

SECTION B:

1. How often do you access and use the resources below in preparation and content delivery in class?
   a) Laptops: Frequently [3] Rarely [2] Never [1]
   b) Internet in down loading learning materials: Frequently [3] Rarely [2] Never [1]
   c) Photocopier machine and school printer: Frequently [3] Rarely [2] Never [1]
   d) Projector Frequently [3] Rarely [2] Never [1]
   e) Computer Laboratory experiments Frequently [3] Rarely [2] Never [1]
2. Does the school have enough ICT resources for Biology teaching?
   Yes [3] No [2] No Idea [1]
3. Do you think that the school administration offers necessary support for ICT use in teaching of Biology?
4. As a teacher of Biology, do you think you have adequate ICT skills for teaching Biology as a subject?

5. In a scale of 1 to 4 rate yourself in the following computer application skills?

	Excellent	**Good**	**Fair**	**Poor**
f) Word processor e.g. MS–word	[ ]	[ ]	[ ]	[ ]
g) Spread sheet e.g. MS – excel	[ ]	[ ]	[ ]	[ ]
h) Data base e.g. MS- access	[ ]	[ ]	[ ]	[ ]
i) Presentation tools e.g. power point	[ ]	[ ]	[ ]	[ ]
j) Internet search tools e.g. Google	[ ]	[ ]	[ ]	[ ]

6. How would you rate your school administration effort to promote ICT- integration?

	Excellent	**Good**	**Fair**	**Poor**
c) Purchasing ICT resources	[ ]	[ ]	[ ]	[ ]
d) Sponsoring teachers for ICT in service training	[ ]	[ ]	[ ]	[ ]

7. Are there challenges you face in technological integration in teaching of Biology?

_____

_____

_____

8. Indicate the number of lessons you use ICT in teaching Biology per week?

APPENDIX IV: PRINCIPAL INTERVIEW SCHEDULE (PIS)

SECTION A;

This research instrument was filled by the researcher. The researcher visited the school principal and conducted an interactive interview, recording the shared information.

SECTION B: INTERACTIVE QUESTIONS

1. If I may ask Mr. Principal how is the performance of Biology in your school?

2. In your view; do you think technology use in teaching Biology would have an impact on its general performance?

3. In your own assessment do you think the school has enough ICT resources for teaching Biology?

4. Mr. Principal, how often do you encourage teachers to integrate technology in the teaching of Biology?

5. On your own assessment, how do you rate ICT skills among teachers of Biology in your school?

APPENDIX V: RESEARCH BUDGET

PARTICULARS	EXPECTED EXPENDITURE (KSH)
Stationary	30000 /=
Typing and Printing	35000 /=
Binding	25000 /=
Transport and Communication	25000 /=
Miscellaneous	20000 /=
Total	**135000/=**

APPENDIX VI: TIME PLAN

ACTIVITIES	TIME
1. Proposal writing and consultation	April- December 2022
2. Submission of the final proposal draft	May – 2023
3. Defense of the Research proposal	July – 2023
4. Proposal Corrections and Resubmission	September – 2023
5. Data Collection, Analysis and Consultation	October – 2023 to January-2024
6. Corrections and presentation of the Thesis Draft to graduate school	February to May-2024
7 .Defense for Thesis submission	May-2025
8. Submission of the final Thesis draft	September – 2025

APPENDIX VII: GRADUATE SCHOOL PERMISSION LETTER

KENYATTA UNIVERSITY
OFFICE OF THE EXECUTIVE DEAN GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Our Ref: E55/CE/28691/2015

DATE: 16th November 2023

Director General,
National Commission for Science, Technology and Innovation
P.O. Box 30623-00100
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR MR. KASOVO EMMANUEL MUMO – REG. NO. E55/CE/28691/2015

I write to introduce Mr. Kasovo Emmanuel Mumo who is a Postgraduate Student of this University. He is registered for M.Ed. degree programme in the **Department of Educational Psychology.**

Mr. Kasovo Emmanuel Mumo intends to conduct research for a M.Ed. Thesis Proposal entitled, ***"Use of Biology Software in Teaching Biology and Its Influence on Learners' Performance: A Case of Kalawa Secondary, Kitui County, Kenya".***

Any assistance given will be highly appreciated.

Yours faithfully,

PROF. ELISHIBA KIMANI
EXECUTIVE DEAN, GRADUATE SCHOOL

PLO/rwn

APPENDIX VIII: DEFENSE MINUTES FOR THESIS

MINUTES OF THE BOARD OF EXAMINERS MEETING FOR KASOVO EMMANUEL MUMO M.ED THESIS DEFENCE HELD ON 22ND MAY, 2025 STARTING 10.00 AM

1.0 **PRESENT**

1.	Dr. Doyne Mugambi	Ag. Chairperson
2.		Internal Examiner
3.		Internal Examiner
4.		External Examiner
5.	Prof. Gladwell Wambiri	Board Member
6.	Dr. Lawrence Njau	Senate Representative

IN ATTENDANCE

1.	Dr. Aineah Wambasi	Supervisor
2.	Julius Irware	Graduate Secretariat

2.0 REMARKS

The following are concerns raised by the board members;

a. Use current literature
b. Objective 2 not clear and not aligned to the title
c. Biology software too broad
d. Element of thesis be summarized
e. Spelling word issues in title
f. Justification of sampling technique
g. Interpretation of the findings and results
h. Recommendations aligned with the main findings of the study
i. The conceptual framework is too simplistic. It needs to be reworked.
j. Suggestion of subtitle 5.5 for further research
k. How are you relating the performance with the study
l. Action verbs that are measurable
m. Justify gap in the literature
n. All the citations missing in the reference section and those missing in the text but present in the reference section should be included.

o. That the document requires thorough proof reading.

p. That the conclusions should emanate from the findings in chapter four.

q. That there were grammatical, typographical and editorial errors noted.

VERDICT

The Degree should be awarded subject to the candidate making MAJOR corrections in not less than four (4) months and not more than five (5) months, from the date of the oral defense. There is need of correction Overseer.

The Correction Overseer approved is Dr. Moses G. Kariuki.

APPENDIX IX : NACOSTI PERMISSION LATTER

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **803280**

Date of Issue: **12/January/2024**

RESEARCH LICENSE

This is to Certify that Mr.. EMMANUEL MUMO KAVOSO of Kenyatta University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kitui on the topic: USE OF BIOLOGY SOFTWARE IN TEACHING BIOLOGY AND ITS INFLUENCE ON LEANERS' PERFORMANCE: A CASE OF KALAWA SECONDARY ,KITUI COUNTY, KENYA. for the period ending : 12/January/2025.

License No: **NACOSTI/P/24/32423**

803280

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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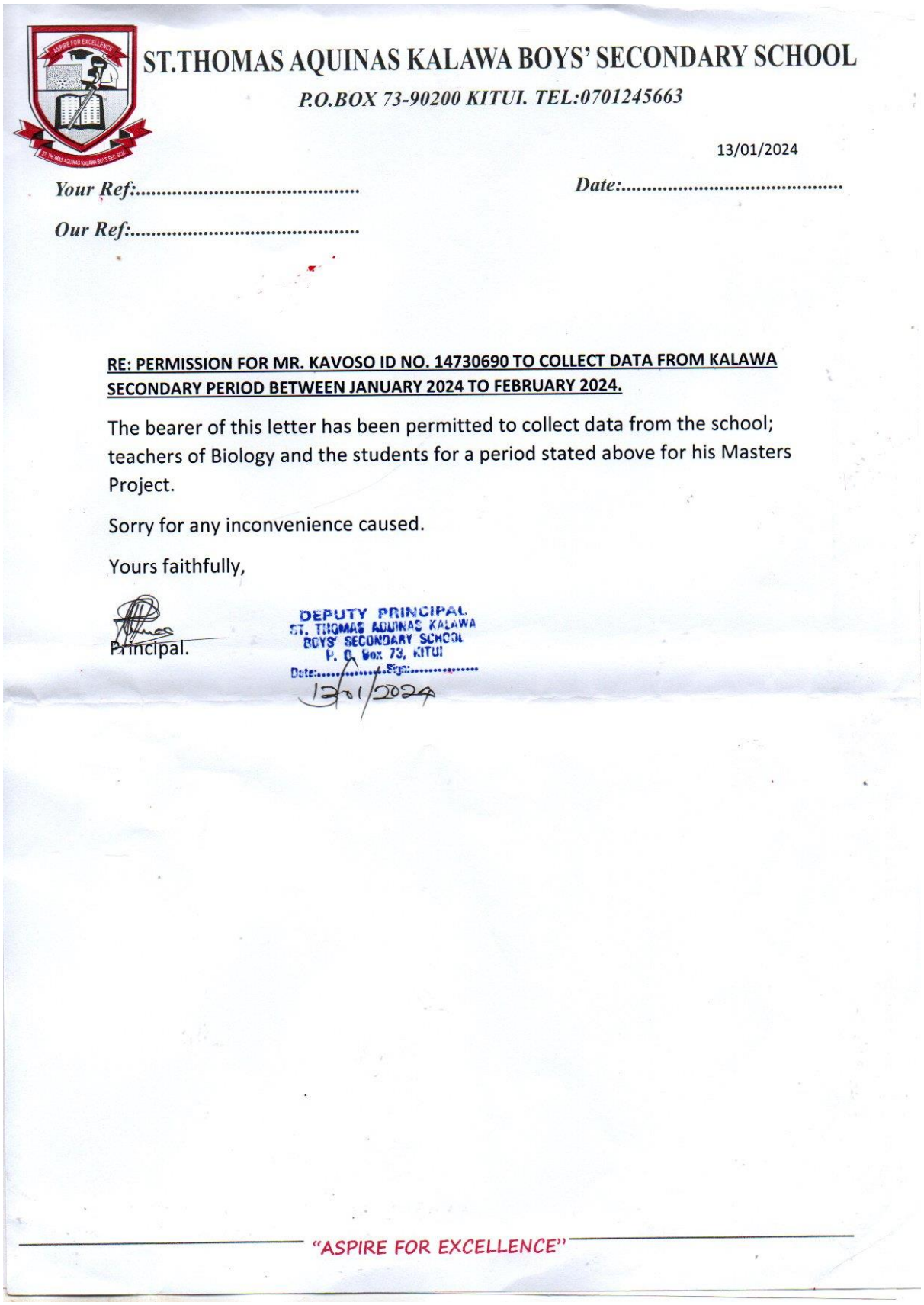
See overleaf for conditions

APPENDIX X : SCHOOL PERMISSION LETTER



ST.THOMAS AQUINAS KALAWA BOYS' SECONDARY SCHOOL

P.O.BOX 73-90200 KITUI. TEL:0701245663

13/01/2024

Your Ref:..... *Date:*.....

Our Ref:.....

RE: PERMISSION FOR MR. KAVOSO ID NO. 14730690 TO COLLECT DATA FROM KALAWA SECONDARY PERIOD BETWEEN JANUARY 2024 TO FEBRUARY 2024.

The bearer of this letter has been permitted to collect data from the school; teachers of Biology and the students for a period stated above for his Masters Project.

Sorry for any inconvenience caused.

Yours faithfully,

Principal.

DEPUTY PRINCIPAL
ST. THOMAS AQUINAS KALAWA
BOYS' SECONDARY SCHOOL
P. O. Box 73, KITUI
Date:..... Sign:.....
13/01/2024

"ASPIRE FOR EXCELLENCE"