HEAD TEACHERS' MANAGEMENT OF ICT INTEGRATION AND EFFECTIVE TEACHING OF BIOLOGY IN SELECTED SECONDARY SCHOOLS IN MBALE CITY, UGANDA

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DECLARATION

I Charles Wasukira declare that this work is not plagiarized and has never been presented to any other institution of higher learning for any award.

Signature....  Date 25/11/2024

APPROVAL

I certify that this research report has been written under my supervision and is ready for submission to the faculty of Education for examination.

Dr. Okurut David

Supervisor

DEDICATION

I dedicate this research report to my beloved parents (RIP) who instilled in me the spirit of education, wife and children who have given me their time, financial support and spiritual guidance towards my study.

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I appreciate the Almighty God for giving me knowledge, protection and guidance during proposal and report writing. Let all the glory in the success of this academic journey be ascribed to Him

I acknowledge my supervisor DR.D Okurut for his guidance which has led to successful completion of this research report. I also sincerely appreciate my Head of Department, research coordinator and entire lecturers in the department who have been very instrumental to the success of this journey.

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ABBREVIATIONS

CONAS: College of Natural Sciences

EAC: East African Countries

ICT: information and communication technology

ISQ: Instructional Supervision Questionnaire

SBM: School-Based Management Theory

SPSS: Statistical Package for Social Sciences

UNEB: Uganda National Examination Board United Nations Educational,

UNESCO: Scientific, and Cultural Organization

ABSTRACT

The study sought to investigate the effect of Head teachers' management of ICT integration on effective teaching of Biology in selected secondary schools in Mbale city, Uganda. The study was guided by specific research objectives which included; examining the impact of Head teachers' provision of ICT resources and integration on effective teaching of Biology in Mable city secondary schools, analyzing the impact of Head teachers' supervision of ICT integration on effective teaching of Biology in Mbale city secondary schools and determining the impact of teachers skills training in ICT integration on effective teaching of Biology in Mbale city secondary schools. The study was guided by the following null hypotheses in relation to the research objectives carried out; There is no statistically significant impact of provision of ICT resources and integration on effective teaching of Biology in Mable city secondary schools, Uganda, There is no statistically significant impact of supervision of ICT Integration on effective teaching of Biology in Mbale city secondary schools, Uganda and There is no statistically significant impact of teacher skills training in ICT integration on effective teaching of Biology in Mbale city secondary schools, Uganda. The study adopted a cross-sectional survey design with the population of study comprised of 762 and a sample size of 312 respondents comprising of Head teachers, Deputy Head teachers, Biology Teachers and Students. A self-constructed close ended questionnaire was used for data collection and On interview, data collected was analyzed through the use of content analysis of the responses given by specific respondents. The researcher recommends that the school should have the necessary infrastructure and resources to support ICT integration. This includes providing adequate devices (computers, tablets, interactive whiteboards, etc.), reliable internet connectivity, and appropriate software and applications, implementing a system to monitor and evaluate the effectiveness of ICT integration. Collect feedback from teachers, students, and parents to assess the impact on teaching and learning outcomes. Use data-driven decision-making to identify areas for improvement and make necessary adjustments to the ICT integration plan and investing in ongoing professional development for teachers to enhance their ICT skills and pedagogical knowledge. Provide training sessions, workshops, and mentorship programs to help teachers integrate ICT effectively into their teaching practices. Encourage teachers to collaborate and share best practices, fostering a culture of continuous learning and improvement.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter presents the focus of this study and attempted to give clear insights of the problem of this study. The chapter sought to justify this study as international, regional and local research evidence was presented to give more insights of the study variables. An objective as well as hypotheses of this study was presented in this chapter. It discussed the theoretical, conceptual, and contextual backgrounds.

1.1. Background to the Study

1.1.1. Historical Background

Whereas the aim of every educational institution is for learners to achieve academic success. The need for effective teaching cannot be undermined. “Effective teaching is the knowledge, strategies, processes and behavior which lead to good student outcomes. Effective teachers have a positive impact on their students and use their expertise to improve learning”. (Hawthorne. 2022). Much can be done in this present era of information and communication technology (ICT) to improve on teaching or making teaching more effective especially the teaching of science subjects.

The poor academic performance of students in sciences including Biology calls for the adoption of more dynamic approaches in teaching it. This study will focus on the integration of ICT resources in the teaching of Biology. “Biology is a worthwhile subject, as students can be prepared to face the real world of work through numerous career paths such as medicine, pharmacy, agriculture, nursing, food science, environmental studies, and many others” (Ndayambaje, 2021)

In Lesotho, Jackson (2011) identified poor performance in Biology among secondary school students and concluded in his study that an inadequate resource in secondary school, where one textbook is shared among many

students is a serious factor. In addition, poor performance of the students is commonly caused by the lack of school laboratories, and libraries.

In Nigeria, Ali *et al*. (2014) noted that Biology which is the fundamental science subject has been known to continuously record low students' enrolment, interest and poor achievement levels in all examinations – both internal and external. The analysis revealed that the performance over the years has been discouraging; this reveals the fact that there are some underlining factors which may be responsible for this trend. These factors may be multifaceted, ranging from the students' or teachers' attitudes, inadequate instructional materials and lack of laboratories to mention a few.

The study found out that the factors that influences poor performance were; Inadequate number of teachers, Lack of teaching and learning materials, Poor teaching methods (theory) and students' attitudes towards science subjects.

In Uganda, Adii (2023) reported that for about three consecutive years, statistics by the Uganda National Examination Board (UNEB) continue to show poor performance in science subjects, especially in Biology. He further stated that in comparison to Mathematics, Chemistry, and Physics in the 2022 exams, Biology was the worst. Biology was the worst done subject with 40.8% of candidates scoring two points (pass,E). Nangonzi (2023) affirms the poor performance of students in Biology, and stated that after a 10-year analysis of Biology's poor performance that cuts across all schools cannot be entirely explained by poor teaching methods yet the learners are doing well in other equally hard science subjects. This remains strange and calls for urgent necessary action that can forestall further disparaging rate of failure.

University College of Natural Sciences (CONAS) through the School of Biosciences recently analyzed the academic performance in Biology at UACE for nearly half a century and observed that since the late 1970s, poor performance subject has been the case. The college's analysis of the 2018 exams, whose results were released in February 2019, showed that a total of 13,061 candidates sat for Biology countrywide. Of these only one candidate scored an A principal pass, 38 per cent scored at least an E, leaving almost 80 percent with the score of O or F (fail).In 2019, the analysis showed that only 44 candidates countrywide scored A in Biology. The trend of poor

performance was noted in the 2022 exams. According to the results, only 0.1 percent (about 18 candidates) of learners scored A in Biology, 67.4 percent scored A-O while 32.6 percent (5,866 learners) failed. In comparison to Mathematics, Chemistry and Physics in the 2022 exams, Biology was the worst done science subject. (Mukhaye, 2023)

The instructional format provided by the teacher seems to be the medium of effective learning because good teaching helps the learners while poor teaching leads to poor learning and poor performance (Adebanjo, 2019). Therefore, methods for teaching Biology should be made stimulating, interactive and attractive to students. As Biology includes complex relationships of unfamiliar and abstract concepts, it is quite difficult to learn and teach. Students often experience difficulty in understanding certain biological subjects and try to learn them via memorization without understanding (Raji, 2017).

Considering the statistics of Uganda National Examination Board (UNEB) indicating disparaging performance in Biology, the researcher feels that if the same students could perform well in other science subjects, then it is safe to conclude that the problem is majorly linked to the teaching approaches adopted by Biology teachers. It is against this background that the researcher would predict that if the teaching of Biology in our secondary schools improves, students' performances in this subject will likely improve. One of the ways of improving on the teaching of Biology which this study will posit is by integrating ICT in teaching.

The use of ICT can help understanding a difficult subject easily. United Nations Educational, Scientific, and Cultural Organization (UNESCO, 2002 cited in Adebanjo, 2019) stated that "it is mandatory for education system globally to adopt the use of Information and Communication Technologies (ICTs) for delivery of classroom instructions to the students in order to impart the knowledge and the skills needed to function in the 21st century society". The researcher assumes that this directive by UNESCO may have been extensively adopted western countries. This is why research reports on poor performance in sciences by students in these countries is quite scanty. African countries including Uganda are still lagging behind in the use of ICT in teaching.

Onwuagboke, et al. (2015) described Information and Communication Technology as a system that has the capacity to capture, store, retrieve, manipulate, transmit or receive information or data. They include television sets, bulletin boards, radio, record players, disc players, still camera, video camera, projectors, internet and the internet resources.

Saktchivil' and Radha (2021) hold the view that ICT is critical in influencing teaching and learning, creating a favorable learning environment and helping learners to develop creative thinking and self-confidence. They further argue that ICT does not transform education from traditional to higher education, but influences teaching and learning methods, scientific research and information gathering, thus the role of ICT is critical in fostering interesting learning environment. However, the teachers have not shown clear embracing of the ICT use and still stick to their old way of teaching. The ICT is to be used both as a pedagogical tool for learning and also as a subject.

Kamonyo et al. (2022). Opine that "the use of ICT particularly in education sector can play a huge role in effective and efficient practical Biology teaching. The ICT tools in teaching and learning have been adopted in a number of countries. In Japan, the use of ICT in education has been put in place using audio-visual movies, focusing on teaching of sciences including Biology. However, some schools find it difficult to integrate ICT in teaching of Biology and it is still a major challenge to most governments of the developing countries, especially sub-Saharan part of Africa." In African countries, many teachers are still hesitant to using ICT and, in that way, affect negatively the teaching of Biology and learning outcomes (Bower, 2018).

Management means the process of planning, coordinating, controlling and directing human and material resources to achieve an expected goal (Kirthika, 2022), while "school management is the process of planning, organizing, directing and controlling the activities of an institution utilizing human and material resources so as to effectively and efficiently accomplish the function of teaching, learning and research for the purpose of achieving the aims and goals of a school".

Whereas there is need for teachers to use Information and Communication Technology (ICT) to enhance their teaching effectiveness, there must be availability and prudent management of Information and Communication Technology resources by school principals and in schools. This is because the proper management of ICT facilities in institutions of learning is very paramount for execution of school activities by the school personnel especially the teachers.

Etor, et al. (2020) explained that the school administrators are saddled with the responsibility of managing the scarce resources for the realization of educational objectives, hence the need for prudent management of ICT facilities such as computers, provision of internet services, example e-mail, WhatsApp, Facebook, Twitter, 2go and a host of others to improve teachers' teaching effectiveness and students' learning outcome. Provision of ICT implies the procurement of the relevant facilities and ensuring their equitable distribution or allocation to all departments for use by teachers and students for teaching and learning. Beyond provision of ICT facilities, the school administrator has to monitor and coordinate their utilization to ensure that all teachers and students can access them for use as the need arises. Another aspect of management of ICT by the school administrator is storage and maintenance. This implies that there must be appropriate storage facility or specified room for safe-keeping of all ICT facilities such as a laboratory in the school and trained personnel assigned to oversee their uses and also accord appropriate maintenance periodically, to ensure their proper use and operational efficiency. Managing of ICT naturally include planning, provision and maintenance of ICT facilities in the school. By planning, it involves identifying types of ICT facilities needed to enhance teaching effectiveness by teachers, as well as for students to access to enhance their learning outcome.

Many studies base their analysis on ICT use, only very few focus on management of ICT. This is a research gap which this study seeks to fill.

1.1.2. Conceptual Background

ICT stands for Information and Communication Technology. It is a broad term that encompasses the use of various technology tools and systems for

gathering, storing, processing, transmitting, and presenting information. ICT is a fundamental part of modern life and has a significant impact on various aspects of society, business, education, and more (Jain, 2023). He further defined ICT as "the integration of information and communication technologies to manage and process information. It involves the use of hardware, software, telecommunications, and various digital technologies to handle and exchange data, enabling individuals and organizations to access, share, and utilize information more efficiently".

ICT is a multidisciplinary concept (Jain, 2023) that brings together the following key components:

Information Technology (IT): This includes computer hardware and software, as well as networks and data storage systems used to process and manage information.

Telecommunications: This involves the transmission of data, voice, and video through various communication channels, such as the Internet, telephone networks, and wireless communication.

Digital Media: This covers the creation, manipulation, and sharing of digital content, including text, images, audio, and video.

ICT integrates these elements to enable the seamless exchange and processing of information across various platforms and devices.

Pedagogical Integration of ICT

This concept is not limited to the establishment of networks and/or the installation of equipment. It includes the use of technology in schools to improve learning and to facilitate educational development. Among other definitions, this concept implies a process of appropriate, regular, and regulated use of interactive technology with incurred beneficial changes in school practices and student learning (Ngamo, 2017).

ICT, or information and communications technology (or technologies), is the infrastructure and components that enable modern computing. Among the goals of IT technologies, tools and systems is to improve the way humans create, process and share data or information with each other. Another is to help them improve their abilities in numerous areas, including business;

education; medicine; real-world problem-solving; and even leisure activities related to sports, music, and movies (Awati& Pratt, 2023).The acronym *ICT* is sometimes used synonymously with IT. However, ICT is generally used to represent a more comprehensive list of all components related to computer and digital technologies.IT is more about managing the technologies related to information, and its various technical aspects, including software, hardware, and networking. IT management does not include considerations of telecommunications devices and technologies while ICT does. IT can be considered a subset of ICT.

The list of ICT components is exhaustive and continues to grow. Some components, such as computers and telephones, have existed for decades. Others, such as smartphones, digital TVs and robots, are more recent entries. ICT components include the following: Devices (hardware), Software, Middleware, Data, Wired networks, Wireless networks, Communication technologies, the cloud, Communications protocols and interfaces, Information security and governance policies.

1.1.3. Contextual Background

ICT in the context of education refers to the various aspects of computers, networks (including the Internet), software and other environments that act as a tool for teachers and students by supporting learning and instruction. ICT implementation in education is a complex and multifaceted process and, till now, many difficulties are still being encountered to integrate ICT in the school practices in Africa and in Uganda.

The use of Information and Communication Technology *(*ICT) in teaching and learning process is one of the innovative strategies which are being adopted in different countries around the world (Bhasin, 2012). Based on the 2030 United Nations (UN) Agenda for sustainable development, each United Nation member country has to use ICT in different domains for promoting national development (UN, 2016). African Union summit of 2015, emphasized on ICT infrastructure development as top priority for achieving the vision 2063. The policy could be achieved only if all African countries provide a reliable and affordable ICT related services such as increasing broadband connectivity,

accessibility of ICT at all school levels, and investing in ICT related project (African Union Commission, 2015).

Generally, ICT is used in different activities across different subjects. The common generic ICT applications include; word processing for text development, power point for content presentation, excel for calculations and internet for exploring different web sites in terms of getting the required content from different sources (Enu, et al., 2018). These generic ICT skills help students to acquire relevant competences in terms of doing and presenting their home works and sharing content with other communities.

On the other side, specific ICT tools and applications (software) were developed for teaching and learning Biology as well as other science subjects. Among this software we may include the;

- ✧ SimBio software for DNA replication (The SimBio Consortium, 2001, cited in Nduwayezu, &Nzabalirwa, 2022);

- ✧ the NeuroBytes for improving the teaching and learning of nerve transmission across the synapses (Isabel,et al., 2018) that was difficult to be grasped through the traditional didactic methods.

- ✧ On the other side, the virtual laboratories were also found to play a great role in teaching and learning Biology. Through this scenario, students are guided to understand the analogies of natural phenomena through visual representation and realistic simulations based on real phenomena (Sommer & Sommer, 2003 cited in Nduwayezu, &Nzabalirwa, 2022) The virtual labs use the power of computerized models and simulations and a variety of other instructional technologies to replace face-to-face lab activities.

This kind of learning process enhances students to get access to the hands-on activities that are not available in their physical laboratories (Muhamad, et al., 2012). Within virtual laboratories, we may find the virtual frog and other specimens' dissections also useful in improving Biology teaching.

- ✧ Interactive frog dissection provides both realistic imagery and opportunities for student practice on frog dissection and anatomical identification.

- ✧ Together with the above, different applets (small programs) have been developed for educational purpose. These include;

- ✧ Simulations of experiments and animated images (Demkanin, et al., 2008).

- ✧ Data logging has been also developed for helping teachers in science practical experiments.

- ✧ The teaching Biology concerns with the living organisms and life processes, however, some organisms are found in remote areas difficult to be accessible by every student. With the use of digital camera, the images of different living organisms can be brought in classroom (York University, 2002). Integration ICT in teaching and learning biology provides teachers with opportunities to bring nature into classroom activities (Demkanin et al., 2008).

- ✧ The Edmodo platform, which is an e-learning model, has been found to be successful in teaching Biology (Végh & Elbert, 2017).

It has been recognized that ICT increases students' motivation through facilitating the exchange of information between groups of students (Senthilkumar, et al., 2014).

1.1.4. Theoretical Background.

School-Based Management Theory (SBM)

School-based management employs theories of "equifinality" and "decentralization", assumes that "school is a self-managing system" and regards "initiative of human factor" and "improvement of internal process" as important. When compared with externally-controlled schools, the characteristics of school-based managing schools are very different in school functioning. They should have clear school mission and strong organizational culture. In these schools, managing strategies should encourage participation and give full play to members' initiative; there should also be considerable autonomy of procuring and using resources to solve problems in time; the role of people concerned should be active and developmental; human relationship is open, co-operative with mutual commitment; administrators should be high

quality and always learning; and evaluation of school effectiveness should include multilevel and multi-facet indicators of input, process and output in order to help the school learn to improve.

Collaborative School Management Cycle

A Model of School-Based Management Caldwell and Spinks (1988) designed a model of school-based management called the *Collaborative School Management Cycle*. This model was a cycle that called for a school to decide goals, make policies, create yearly plans, distribute resources, apply plans through programs of learning and teaching and evaluate outcomes. The model had six phases of functions, divided into two main areas labeled the policy group functions (goal setting and need identification; policy making; evaluating) and the program team activities (planning programs, preparation and approval of program budget; implementing). There is a forward and backward relationship and activities can start at any stage, although some stages form the basis for the sub sequence phases. The purpose of model is to demonstrate the appropriate engagement of stakeholders –teachers, parents and students in goal setting and needs identification, policy-making, planning, budgeting, implementing and evaluating.

This theory underpins this research because when it comes to the management of Information and Communication Technology (ICT) resources in schools, SBM can be highly relevant for several reasons: Schools are better positioned to understand their specific ICT needs based on the local context, student population, and educational goals. SBM allows schools to tailor their ICT resources and strategies to the unique requirements of their students and community, ensuring greater relevance and effectiveness. SBM gives schools the authority to manage their budgets, including allocating resources for ICT infrastructure, equipment, and professional development. Schools can prioritize and invest in ICT resources that align with their educational objectives, ensuring that funds are directed towards initiatives that have the greatest impact on student learning. In the context of ICT, involving stakeholders in decision-making ensures that the chosen technologies align with the community's expectations and that there is support for the integration of ICT in teaching and learning.

SBM provides schools with the flexibility to adapt to changing technologies and educational needs. Schools can quickly respond to emerging trends in ICT, update their technology infrastructure, and provide relevant training to teachers to integrate new technologies into the curriculum.

SBM encourages the active involvement of various stakeholders, including teachers, parents, and community members, in decision-making. SBM allows schools to allocate resources for professional development programs related to ICT for teachers and staff. With control over professional development, schools can ensure that teachers receive training that aligns with their specific needs and the school's goals for ICT.

1.2. Statement of the Problem

It is worthy to note that students' performance in the sciences is supposed to be positively correlated in the sense that high achievements in Mathematics, Physics and Chemistry should predict high achievement in Biology. Ideally, students who perform well in other sciences should perform well in Biology.

Unfortunately, the performance of students in Biology does not go the way it is expected in Uganda. This is evident in the report of Adii (2023) that for about three consecutive years, statistics by the Uganda National Examination Board (UNEB) continue to show poor performance in science subjects, especially in Biology. He further stated that in comparison to Mathematics, Chemistry, and Physics in the 2022 exams, Biology was the worst. Biology was the worst done subject with 40.8% of candidates scoring two points (pass,E). Another report by Nangonzi (2023) affirms the poor performance of students in Biology, and stated that "After a 10-year analysis of Biology's poor performance that cuts across all schools cannot be entirely explained by poor teaching methods yet the learners are doing well in other equally hard science subjects"

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(fail).In 2019, the analysis showed that only 44 candidates countrywide scored A in Biology. The trend of poor performance was noted in the 2022 exams. According to the results, only 0.1 percent (about 18 candidates) of learners scored A in Biology, 67.4 percent scored A-O while 32.6 percent (5,866 learners) failed. In comparison to Mathematics, Chemistry and Physics in the 2022 exams, Biology was the worst done science subject. (Mukhaye, 2023).Mabonga, (2021), revealed that many students at secondary level in Mbale city strongly despise the manner at which biology as a teaching subject is handled and delivered in a classroom environment. If this poor academic performance in Biology is not improved, many students will be discouraged and ill-motivated to study sciences, since Biology is a basic requirement for many science-based programs in the university.

Much has been done by government and other relevant stake holders to improve education quality delivery especially for science teaching in Uganda. As science teachers' salaries have been increased astronomically, opportunities created for teachers capacity building, laboratories are well equipped and a lot others. Yet the problem persists.

However, much has not been done research wise to explore the possible causes of this problem; this is a gap which this study seeks to fill. Thus this study is determined to investigate the influence of ICT resource management on effective teaching of Biology.

1.3 Objectives of the study

1.3.1 General Objective

The general objective of this study was to investigate the Head teachers' management of ICT integration and effective teaching of biology in selected secondary schools in Mbale city, Uganda

1.3.2 Specific Objectives

The study had the following specific objectives;

1. To examine the impact of Head teachers' provision of ICT tools and integration on effective teaching of Biology in Mbale city secondary schools, Uganda.

2. To analyze the impact of Head teachers' supervision of ICT integration on effective teaching of Biology in Mbale city secondary schools, Uganda.

3. To determine the impact of teachers skills training in ICT integration on effective teaching of Biology in Mbale city secondary schools, Uganda.

1.4 Hypotheses

The study will be guided by the following null hypotheses;

1. There is no statistically significant impact of provision of ICT resources and integration on effective teaching of Biology in Mable city secondary schools, Uganda.

2. There is no statistically significant impact of supervision of ICT Integration on effective teaching of Biology in Mbale city secondary schools, Uganda.

3. There is no statistically significant impact of teacher skills training inICT integration on effective teaching of Biology in Mbale city secondary schools, Uganda.

1.5 Justification of the Study

The poor performance of students in Biology is quite worrisome and therefore urgent research in this direction is required. Research evidence has shown that this trend of disparaging performance in Biology by secondary school students is common among African countries including Uganda. Since existing research evidence also reveals that the same students are doing well in other sciences, then the need for research focusing on teaching approaches using ICT resources is justifiable. For the use of these resources to be achieved, they have to be properly managed. Management of these resources involves planning for and providing the required resources, distributing, monitoring, maintenance, and personnel training. This study is justified because achieving success requires proper management.

1.6 Significance of the study

It is hoped that the findings and recommendations of this study may be beneficial to teachers, school heads, government, stakeholders and researchers.

The study will provide useful information for teachers on the contemporary approaches for effective teaching of Biology through the use of ICT resources.

The study will also provide useful guide to school heads on proper planning and provision of the necessary as well as relevant ICT resources needed in the school. This study may provide useful insight to head teachers on the available ICT resources and their functions in facilitating teaching.

The findings and recommendations of this study may be useful to guide government's direction on making policies and preparing budget for education. The findings of this study may clearly reveal that urgent attention is required by government and other stake holders in education to provide necessary ICT resources for the teaching of Biology.

The study will add to the existing body of knowledge and literature on utilization of ICT in instructional process and Biology teaching in the context of secondary schools. It will form a basis for future researchers to fill the unexplored gaps in this subject.

1.7 Scope of the study

The scope of the study considered three perspectives; these were content scope, geographical scope, and time scope.

1.7.1 Content Scope

The content scope of this study was delimited to management of ICT resources as the independent variable. In this study the management processes that were investigated were provision and distribution of ICT materials, monitoring/supervision of the use of the ICT materials provided, and teachers' skills training in the use of the materials. The dependent variable was the use of these materials for effective teaching of Biology.

1.7.2 Geographical Scope.

The study was carried out in Mbale city. The city also lies at the western foot of the extinct volcano Mount Elgon (4,321 metres), 75 miles (120 km) northeast of Jinja. Mbale is a city in the Eastern Region of Uganda. It is the main municipal, administrative, and commercial center of Mbale District and the surrounding sub-region. The coordinates of the city are 1°04'50.0"N, 34°10'30.0"E (Latitude: 1.080556; Longitude: 34.175000). The city also lies on the railway from Tororo to Pakwach. Mount Elgon, one of the highest peaks in East Africa, is approximately 48 kilometres (30 mi), north-east of Mbale, by road. Mbale is bordered by Tororo District in the south, Manafwa District in the south-east, Sironko District in the north-east, Kumi District in the north, Budaka District in the north-west, and Butaleja District in the south-west.

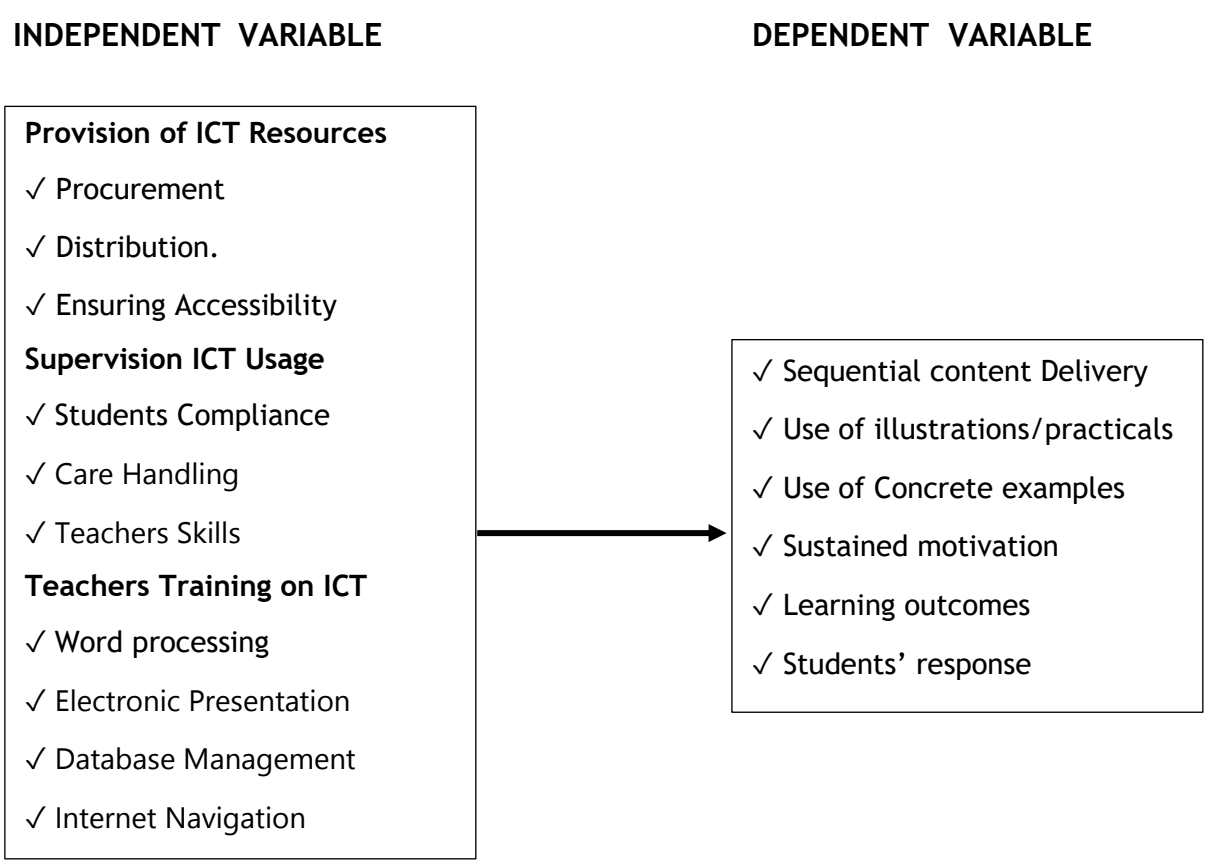
1.7.3 Time scope

The time scope of this study wasconsider the period between 2019 -2022. This period marks the peak of low academic performance by secondary school students in Biology in Uganda and Mbale city.

1.8 Conceptual Framework

This is a visual representation in research that helps to illustrate the expected relationship between cause and effect. It is also called a conceptual model or research model. That means that different variables and the assumed relationships between those variables are included in the model and reflect the expectations. (Mulder, 2017).

Figure 1.1 Conceptual Framework



CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter reviewed the works of other authors published in journals, monographs, edited magazines, and internet websites. It was presented under theoretical and empirical review. In the review of literature gaps identified were reported.

2.1 Theoretical Review

Scientific Management Theory by Fredrick Winslow Taylor (1909)

The whole idea behind the use of ICT is to improve on the teaching process in schools. Scientific management theory suitably underpins this study because it focuses on increased productivity. The primary goal of scientific management is to increase efficiency. Integration of ICT in schools is to increase teacher effectiveness. When Taylor began his scientific management experiments, he focused on increasing efficiency by reducing the amount of time needed to perform tasks. This was a good first step, but there's a lot more to improving efficiency than just decreasing work time. Since Taylor's time, other innovators have found more ways to increase efficiency, such as implementing automation software. In 1909, Taylor published *The Principles of Scientific Management*. In this book, he suggested that productivity would increase if jobs were optimized and simplified. He also proposed matching a worker to a particular job that suited the person's skill level and then training the worker to do that job in a specific way. Taylor first developed the idea of breaking down each job into component parts and timing each part to determine the most efficient method of working.

While it was initially developed for industrial settings, some principles of scientific management can be applied to teaching in educational institutions. Scientific management advocates for the standardization of work processes to increase efficiency. In teaching, this could involve standardizing certain aspects of lesson plans, teaching materials, and assessment methods. By identifying and implementing best practices, teachers can streamline their processes and enhance overall effectiveness. A key component of scientific management, involve analyzing and optimizing the time required to complete a task. Teachers can apply this concept by carefully planning and organizing

their lessons to make the best use of class time. This may involve breaking down lessons into specific time segments, ensuring that each segment contributes to the overall learning objectives. Scientific management suggests that workers should be trained to perform their tasks efficiently. In education, teachers could undergo professional development to enhance their teaching skills and stay updated on the latest educational trends and methodologies. Many teachers require this training to enable them handle ICT tools effectively. Integrating technology into teaching can align with scientific management principles by improving efficiency. Tools such as learning management systems, automated grading, and educational software can help streamline administrative tasks, allowing teachers to focus more on instructional delivery and student engagement.

2.2 Empirical Review

Literature will be reviewed in line with the objectives of this study. An empirical review involves summarizing, synthesizing, and evaluating the findings of various empirical studies related to a specific subject.

2.2.1 Head teachers' provision of ICT resources/integration and effective teaching of Biology

ICT related infrastructures play a great role in successful use of ICT in teaching and learning. In this regards, most of African countries are increasing computers and other ICT facilities in different schools but the gap in ICT infrastructure still to be a big challenge (Hennessy, et al., 2010). The shortage of Infrastructure such as: computers, scanners, mobiles phones, printers, projectors, radio, camera recorders, TV sets and software such as: data logging, simulations, virtual experiments tools, electricity and internet connection was found to be a serious obstacle in using ICT for teaching and learning process (Šorgo et al., 2010). Mumtaz (2006) stated that, the shortage of hardware and software is one of the reasons that prevent the effective use of ICT in classrooms. Mulwa and Kyalo (2011), Njoroge et al. (2017) stated that, the decisions of teachers on using computers in classrooms tend to be influenced by the accessibility and availability of relevant infrastructures. Connectivity to electricity and internet facilities are also highly needed during integration of ICT in teaching and learning process. Nevertheless, electricity and internet connectivity are still a big challenge in many developing countries mostly in Africa (Mathevula & Uwizeyimana, 2014). This

was also confirmed by the findings from that of Eze and Adu (2015) that revealed that the lack of internet connectivity and electricity was a barrier to the effective use of ICT in many African schools.

Another study by Inyang (2022) investigated on Availability and Utilization of ICT Resources in Teaching of Biology in Secondary Schools in Ukanafun Local Government Area of Enugu in Nigeria. Two (2) Research questions were constructed to guide the study. The research design adopted for this study was the survey design. The population for the study comprised all biology teachers in senior secondary two (SSII) in all the six (6) public secondary schools in the study area. The sample sizes of twenty (20) secondary school teachers with five (5) public secondary schools were selected using a simple random sampling technique. The instrument used for data collection was a questionnaire. The analysis was done using simple percentage statistical tools. The findings revealed that the Availability and Utilization of ICT Resources have a great influence on the teaching of Biology.

The above study failed to utilize the appropriate inferential statistic for data analysis. This is a methodological gap which this study seeks to fill by using inferential statistics to show if the influence is significant or not at .05 alpha levels. The above result is not dependable, descriptive statistics do not have the strength to measure the impact of a variable on another. They only describe central tendency, measure variability and dispersion.

A study by Baley et al. (2020) was to determine the availability of ICT resources for teaching and learning Biology in secondary schools in the Southern Region, Eritrea. The study was carried out in secondary schools of the southern region, Eritrea. A descriptive survey research design was adopted. The study targeted 27 public secondary schools in the region. Stratified random sampling technique was used to get a sample of 12 secondary schools from 12 sub-regions. The sample of respondents of the study was drawn from these 12 secondary schools of 12 sub-regions. The respondents were 12 school directors, 34 Biology teachers and 175 grade eleven students. Questionnaires, interview and observation schedules were used as instruments for data collection. Questionnaire for Biology teachers and students,

Interview Schedule for school Directors, were employed. Piloting and consultation were conducted to establish validity and reliability before the instruments were used for the actual data collection. The data collected included both qualitative and quantitative data. The quantitative data were analyzed using Statistical Package for Social Sciences (SPSS) version 22. The qualitative data obtained from the open-ended questions were analyzed thematically based on research objectives. The study found that that most of the sampled schools had inadequate ICT resources like computers, computer laboratories, projectors, televisions, video players, digital content, and the internet. These resources were not enough or available for use by Biology teachers in teaching and learning. Adequate ICT resources, including the internet, need to be provided in schools for teaching and learning Biology and other subjects.

Many research studies find that ICT materials are not provided in some cases, some researchers report that there are inadequate and this negatively affects the teaching of Biology. This study seeks to find out if Headteachers or school managements in Mbale city provide ICT materials adequately for effective teaching of Biology.

2.2.2 Head teachers' Supervision of ICT integration and effective teaching of Biology

In Ghana, research of Kweku and Stella (2018) revealed that instructional supervision by headteachers and performances of teachers have a weak significant correlation. Additionally, the findings show new teachers' orientation and performance of teachers are not correlated and that checking record of work of teachers and motivation of teachers are weakly by significantly and positively correlated. The findings also show in-service training provision and motivation of teachers are statistically, significantly and positively correlated (r= .278, p=.02, 2 tailed). The statistical findings further revealed a correlation which is weak, significant and positive between observing the lesson and performance of the teachers' work with r= .263, p= 0.3, 2 tailed; and that regularity and punctuality monitoring and performance of teachers are significantly and positively correlated with r=.352, p=.00. 2 tailed. Kweku and Stella (2018) indicates that supervisory practices of the school heads are important in improving performance of teachers, and that apart from new teachers' orientation all the other practices involved in the supervision by the head teachers are vital in improving motivation teachers in the Anomabo education circuit (Kweku & Stella, 2018)

Regionally like in East African Countries (EAC) countries, it was revealed that in Kenya, the experience of school heads' work is a very important factor affecting the supervision instruction since it develops performance of teacher (Kirui, 2012)

The study by Msuya and Mwila(2023) analyzed the effect of heads of schools' supervisory practices on students' learning achievement in public secondary schools in Ubungo municipality using 240 participants, including heads of schools, students, and teachers. The study employed a mixed approach with convergent parallel as the design. Various methodologies were employed to gather data, including questionnaires, documentary reviews, observations and semi structured interviews. The results revealed that the supervisory practices of school heads play a greater role in the quality of teaching and overall learning achievement of students in secondary schools. The academic achievement of students is impacted by supervisory practices such as classroom visits, teacher mentoring, assessing teachers' pedagogical abilities,

assisting teachers in creating lesson plans, and other creative teaching methods.

Supervision is one of the management functions of the head teacher to ensure quality delivery of instructions. This includes overseeing the use of ICT infrastructures. Nwachukwu, et al., (2020) investigated the relationship between head teacher supervisory indices and teachers' Job performance in Uyo Local Government Area in Nigeria. In order to achieve this purpose, three specific 0bjectives.three research questions and three null hypotheses were formulated and tested at 0.05 level of significance. The study adopted correlational survey research design. The population consisted of 129 public secondary school teachers in Uyo Local Government Area. The sample size for the study comprised 96 teachers in Uyo Local Government Area. Simple random sampling technique was used for the study. The results showed that the extent of relationship of headteachers' class visitation technique and checking of lesson notes with regard to teachers' job performance is high whereas that of teachers' self-appraisal is moderate. The result further indicated that there was a significant relationship between head teachers' class visitation technique, checking of lesson notes, and teachers' self-appraisal and teachers' job performance. It was recommended that head teachers should carry out their supervisory role regularly in order to maintain a constant improved education system.

In Uganda, Tayebwa, et al., (2021) reported that the Ministry of Education and Sports (MOES) designed a Teacher Supervision Tool in 2017, intending to standardize support supervision in schools. This study aimed at assessing the utilization of Teacher Supervision Tool in secondary schools and its effect on teachers' effectiveness in the Rukungiri District and was based on the Marzano Teacher Focused Model. Mixed methods research design was applied that involved qualitative and quantitative methods. From the study population of 750, a sample size of 255 was derived using random and purposive methods. The study established that frequency of support supervision has positively affected teachers' effectiveness in the Rukungiri district. One sample T- test results at a 95% level of confidence revealed a p-value of 0.00 (<0.05) showing a significant difference between support supervision and teachers' effectiveness. It was also found out that teacher appraisal positively affects teachers' effectiveness and this has been through

mentorship, time management, collaborative teaching, and professional growth.

A study by Nwankwoala (2020) study investigated the relationship between instructional supervision and teachers' job performance in public senior secondary schools in Rivers State. The study adopted a correlation design. A sample size of 347 persons where obtained from a population of 7,145 teachers in the two hundred and seventy eight (278) public senior secondary schools in Rivers State with the use of stratified random sampling technique. Implicitly, 5% of the entire population was used for the study. The instruments for data collection were self-constructed questionnaire titled; Instructional Supervision Questionnaire (ISQ) and Teacher Job Performance Questionnaire (TJPQ).The following findings were made; classroom visitation by supervisors, clinical supervision technique and holding conferences with teachers by supervisors before the actual classroom observation are significantly related to teachers' job performance. The study therefore concluded that supervision is a vital aspect of school administration, and thus recommended that the school administrators and supervisors from the Schools Board should carry out supervision.

The purpose of this study by Grace (2021) in Karamoja sub-region was to determine if there was a significant relationship between the degree of supervision and the level of teacher efficiency in the selected area of study. This study was guided by four objectives, to determine the profile of respondents in terms of age, gender, work experience, occupation and qualification, to determine the degree of supervision in terms of administrative, supportive and educative role of supervision, to determine the level of teacher efficiency in terms of teaching methods used, concern for students and delivery of subject matter. It was carried out using self-administered questionnaires and universal purposive sampling method was used to determine the sample size given populations of 150. Data were analyzed using frequencies, percentages, mean and Pearson's linear correlation coefficient with the use of SPSS software package. The study findings revealed that majority of the respondents were males (6l%) and minority were females (39%). It also revealed low degree of supervision (mean, 2.1) and a low level of teacher efficiency (mean L8) it also revealed a positive relationship between the degree of supervision and the level of

teacher efficiency. It was recommended that the Ministry of Education and Sports and Supervisors should constantly carry out supervision in schools to enhance teacher efficiency, constant evaluation of teachers in class through appraisal forms, feedback of supervisory visits be thoroughly discussed and that supervision should be broaden to include school personnel such as heads of department senior teachers.

2.2.3 Teachers' skills training on ICT integration and effective teaching of Biology

Belay et al (2020) carried out a study in secondary schools of the southern region of Eritrea and a descriptive survey design was employed with a target of 27 public secondary schools. The aim of this study was to find out teachers' skills for ICT integration in teaching and learning of Biology. The researchers used a descriptive survey research design focusing on 27 public secondary schools in the region. Stratified random sampling technique was used to get a sample of 12 secondary schools from 12 sub-regions. The respondents were 12 school directors, 34 Biology instructors and 175 grade eleven students. Questionnaires, interview and observation schedules were adopted as instruments for data collection. The study found that majority of Biology teachers had received inadequate training on computer literacy. However the current study sighted a geographical gap and a methodological gap of using an observation schedule in similarity of questionnaire and interview guide.

Faustin Nduwayezu and Wenceslas Nzabalirwa (2022) conducted a research on ICT and found it to be important in improving teaching and learning of Biology in selected secondary schools of Rulindo District – Rwanda. However the use of contemporary paradigm found not to be effective due to the different factors. Within this perspective this study aimed to investigate the Degree at which ICT was used in teaching Biology and the influence of trainings and availability of ICT tools on its successful use in selected secondary schools. The Descriptive survey research design was used to collect Data through interviews and a Questionnaire. From a Population of 132 participants, a sample of 98 participants including Biology Teachers and District representatives participated in the study. The Data obtained was analyzed both Qualitatively and Quantitatively. The results showed that ICT was not effectively used in teaching Biology. This was associated with Biology due to

inadequate trainings and ICT related infrastructure. However, though the studies above have been conducted in Rulindo District, Rwanda, there is need to carryout a similar research in Mbale Municipality in Uganda in order to establish whether the same situations do exist in the area under operation.

Gideon Mwanda et al (2017) carried out a study and opines that the purpose of that study was to find out the extent of integration of computer technology into teaching and learning Biology in secondary schools of Rachuonyo South Sub County of Kenya. The targeted population consisted of students and Biology teachers. Data was collected by use of questionnaire and an observation checklist. The Findings show that most of the schools had few computers. Teachers had inadequate training on the use of computer application, most of the teachers didn't use computer technology for personal growth and instructional purposes. The study recommends that there should be increased accessibility of computers, adequate training and the use of computer technology and development of place framework. Therefore, in agreement with the above forementioned researchers' arguments the current researcher therefore could be interested in carrying out a research in different geographical locations in order to observe whether similar situations can occur in the area under study.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This chapter presents the various methods adopted by the researcher to collect and analyze data. The key components was the research design, population, sample size and sampling technique, research instruments, validity and reliability of research instruments, and procedures of data analysis.

3.1 Research design

This provides a framework for data collection and analysis. “Research design is the specific procedure involved in the research process: data collection, data analysis, and report writing” (Creswell, 2014). The study adopted the causal research design as well as cross-sectional design. “Causal research is sometimes called an explanatory or analytical study. It delves into the fundamental cause-and-effect connections between two or more variables. Researchers typically observe how changes in one variable affect another variable” (Good, 2023).Cross-sectional design according to Thomas (2023) “It is a type of research design in which a researcher collects data from many different individuals at a single point in time. In cross-sectional research, you observe variables without influencing them”. The study adopted the mixed method paradigm. This involves both qualitative and quantitative approaches. The quantitative approach offered a complete numerical description of the findings. While the qualitative enabled the exploration of the emerging themes in the responses obtained through interview and records where necessary. Methodological triangulation has been applied here to mitigate bias and to ensure credibility of results (Bhandari, 2022).

3.2 Area of Study

The study was carried out in Mbale city. The city also lies at the western foot of the extinct volcano Mount Elgon (4,321 metres), 75 miles (120 km) northeast of Jinja. Mbale is a city in the Eastern Region of Uganda. It was the main municipal, administrative, and commercial center of Mbale District and the surrounding sub-region. The coordinates of the city are 1°04'50.0"N, 34°10'30.0"E (Latitude: 1.080556; Longitude: 34.175000). The city also lies on the railway from Tororo to Pakwach. Mount Elgon, one of the

highest peaks in East Africa, is approximately 48 kilometres (30 mi), north-east of Mbale, by road. Mbale is bordered by Tororo District in the south, Manafwa District in the south-east, Sironko District in the north-east, Kumi District in the north, Budaka District in the north-west, and Butaleja District in the south-west.

3.3 Sources of Information

This study obtained information from both primary and secondary sources. The primary sources of this study includedsurveys, questionnaire, personal interview, Government publications, websites, and journal articles. Secondary sources provide second-hand information and commentary from other researchers. This study used journal articles, monographs, dictionaries and encyclopedias, andpublished dissertation and thesis.

3.4. Population and sampling techniques

Population is a group of individuals, objects, or items taken to measure the sample" (Creswell 2018). "The target population was the entire population, or group, that a researcher is interested in researching and analyzing. A sampling frame is then drawn from this target population" (Akman, 2023). Amin, (2005) defined study population as a complete collection of all members of a group which is of interest in a specific study.

The target population of this study will comprise selected secondary schools in Mbale city. They will be a mix of Government and privately owned secondary schools to allow for inclusiveness. Thus, Mbale High School, Mbale Secondary School, Nkoma Secondary School, Nakaloke Secondary School, Bukonde Secondary School, Wanale View, University Link, and Mbale Progressive. A total of 8 Head teachers, 20 Deputy Head teachers, 67 Biology teachers, and 820 senior three students. So in all, the population from 8 schools was 915 participants.

3.5. Sample size

The sample is the group of individuals who actually participated in the research. They were drawn from the population (McCombes.2019). By sample size "we understand a group of subjects that are selected from the general population and was considered a representative of the real population for

that specific study" (Akman, 2023). The sample size for this study comprised 5 of the 8 schools. Find the sample distribution across the various categories of participants in tables 1&2 below.

The sample size determination will be guided by the Krejcie and Morgan (1970) table of determining a sample size from a given population.

Table 1: Target Population and Sample table for 3 government and 2 private schools

S/N	Category	Population	Sample size
1	Head teachers	05	05
2	Deputy H/Ts	17	15
4	Biology Trs	50	44
5	Senior 3 Students	690	248
		762	**312**

Table 2: Sample Distribution by proportion to Schools Population

School	Category	Population	Sample	Sampling Technique
A	Head teacher	1	1	Census method
	Deputy H/T	3	3	Census method
	Biology Teachers	8	8	Census method
	Students	150	54	Random sampling
B	Head teacher	1	1	Census method
	Deputy H/T	6	5	Purposive sampling
	Biology Teachers	12	10	Purposive sampling
	Students	150	54	Random sampling
C	Head teacher	1	1	Census method
	Deputy H/T	5	4	Purposive sampling
	Biology Teachers	15	13	Purposive sampling
	Students	150	54	Random sampling
D	Head teacher	1	1	Census method
	Deputy H/T	1	1	Census method
	Biology Teachers	5	5	Census method
	Students	90	32	Random sampling
E	Head teacher	1	1	Census method
	Deputy H/T	2	2	Census method
	Biology Teachers	10	8	Census method
	Students	150	54	Random sampling
	Total	**762**	**312**	

3.6 Sampling Techniques

The sampling techniques included both probability and non-probability sampling techniques.

Probability Sampling Technique according to Elliott (2020) “is when respondents are randomly selected to take part in a survey or other mode of research. For a sample to qualify as a probability sample, each person in a population must have an equal chance of being selected for a study, and the researcher must know the probability that an individual was selected. While Non-probability sampling was when a sample is created through a non-random process”.

3.6.1 Simple Random Sampling

In a simple random sample, every member of the population has an equal chance of being selected. This was a probability sampling technique that was adopted to select teachers. Thus the lottery method was used to randomly select the required number of teachers who were respondents.

Another sampling technique used in this to select respondents for this research will be purposive method.

3.6.2 Purposive sampling

This type of sampling, also known as judgment sampling, involves the researcher using their expertise to select a sample that has the characteristics the researcher need in the study of research.(McCombes,2019),This method was used because the researcher wanted to identify specific characteristics, trends or insights within a targeted subset of a population .The researcher adopted this method to select the Head teachers and Deputy Headteachers.

3.6.3 Census method

The Census Method was also called as a Complete Enumeration Survey Method wherein each and every item in the universe is selected for the data collection. Whenever the entire population is studied to collect the detailed data about every unit, then the census method is applied.

3.7. Procedure for data collection

The researcher obtained a letter of introduction from Uganda Christian University which was served as evidence that the research study was authorized by the UCU for only academic purpose. The researcher personally visited the sampled schools to obtain data. In every of the schools the researcher presented the letter of introduction and assured the various schools authorities of ethical considerations and confidentiality. He further sought permission to be allowed to obtain data from the deputy head teacher and board members. The researcher requested the assistance of either teachers or other staff in the school.

3.8. Data collection instruments and equipment

The researcher collected data using the self-administered questionnaire, and interview guide as explained below;

3.8.1. Questionnaire

Bhandari(2021) puts it "questionnaire is a list of questions or items used to gather data from respondents about their attitudes, experiences, or opinions. Questionnaires can be used to collect quantitative and/ or qualitative information" Teachers and students responded to the questions in the questionnaires. Thus two separate questionnaires were used for data collection viz; for the teachers and for students.

The questionnaires were designed by the author and validated to ascertain its validity index and reliability coefficient. The instrument was titled Management of ICT Integration and Effective Teaching of Biology Questionnaire. (MIIETBQ) for teachers. It comprised of 3 sections thus, section A: Demographic data of the respondents. Section B: Management of ICT resources. Section C: Integration of ICT in Biology teaching. The questions are constructed in positive form and were measured using the 5 points Likert scale 5-(SA), 4 (A), 3(U), 2(D), 1(SD).

The second questionnaires assessed the effectiveness of Biology teachers. This was determined by students' responses.

3.8.2. Interview Guide

The researcher interviewed the head-teachers because their busy schedules did not allow them time to respond to the questionnaire and basically to obtain explanatory information. Interview is a shared face to face interaction between the interviewer and interviewee, (Amin, 2005). A semi structured interview guide was used since some questions were built from the answers. The aim was to collect in-depth information on the impact of managing ICT resources on effective teaching of Biology. Interview has an advantage of tapping into explanations that could not be obtained or captured in a questionnaire.

3.9. Quality control

Data quality control was used to ascertain the validity and reliability of the instruments.

3.9.1. Validity

Validity refers to whether the measuring instrument measures the behavior or quality it was intended to measure and is a measure of how well the measuring instrument performs its function. Validity according to Creswell (2012) is the development of sound evidence to demonstrate that the test interpretation (of scores about the concept or construct that the test is assumed to measure). In other words, it is the extent to which a measure "covers" the construct of interest. The researcher consulted research experts to review the instruments and ascertain if the constructs were covered. The content validity index (CVI) of the instrument was determined. Thus

$$\mathbf{CVI} = \frac{R}{N}$$

Where **CVI**- content validity index

R- Number of items rated as relevant

K-Total number of items in the instrument

According to Amin (2005) any score above 0.7 is deemed as appropriate and valid as far as the instrument is concerned

3.9.2. Reliability

Reliability refers to the consistency of measures obtained from a given instrument. In other words it's the stability of an instrument from measures obtained from repeated administration. Reliability means that the scores of an instrument are stable and consistent (Creswell, 2005). The scores should remain the same when the instrument is administered repeatedly at different times, and it should remain consistent.

The reliability of this instrument was determined from pilot testing the instrument against a sample not included in the population. Therefore the participants for the pilot test were drawn from a small sample of Biology teachers and students in Pallisa District since they were assumed to possess the same characteristics with those in schools of the target population.

The internal consistency reliability method was adopted to determine the reliability coefficient. Internal consistency assessed the correlation between multiple items in a test that were intended to measure the same construct. Internal consistency was calculated without repeating the test or involving other researchers, so it was a good way of assessing reliability when you only have one data set (Middleton, 2019).Thus Cronbach alpha was used to calculate the reliability coefficient of the instrument. Ahuja (2000) argues that the research instrument will be acceptable as reliable and worth being used for data collection if found above 0.7.

3.10. Strategy for data processing and analysis

3.10.1. Quantitative Data

Quantitative data from the structured questionnaire was analyzed using descriptive and inferential statistics. However, the Statistical Package for Social Sciences (SPSS) was utilized to ascertain accuracy and dependable results. The descriptive statistics was used to summarize data in form of frequencies and percentages. Thus it was intended to describe the response rate and demographic characteristics of respondents in terms of gender, academic level, and academic programme. Inferential statistics involved the use of regression analysis with the aid of (SPSS). Regression was suitable statistic because; regression analysis was a way of predicting future happenings between a dependent (target) and one or more independent

variables (also known as a predictor).

3.10.2. Qualitative Data

Qualitative data from interview with head teachers was analyzed through content analysis. This involved transcribing and describing the data collected from interview. Qualitative data from interviews was sorted, edited and categorized into key themes according to the stated objectives so that the information given is complete and consistent. The contents were then analyzed and reported alongside the quantitative data. Generally, content analysis was done to make sense of the qualitative data. The essence thereof was to compliment the data from the questionnaire as well as drawing similarities and differences within the two forms of data collected.

3.11 Ethical Considerations

The researcher ensured that the study does not violate ethical issues whatsoever. Under ethical considerations, verbal consent to participate in the study was obtained from all the respondents, and they were assured of confidentiality thereafter.

Permission from the management of government secondary schools and private secondary schools in Mbale City was sought to use the students', Biology teachers and head teachers as respondents in the research. They wereassured that the information obtained was strictly be used for academic work.

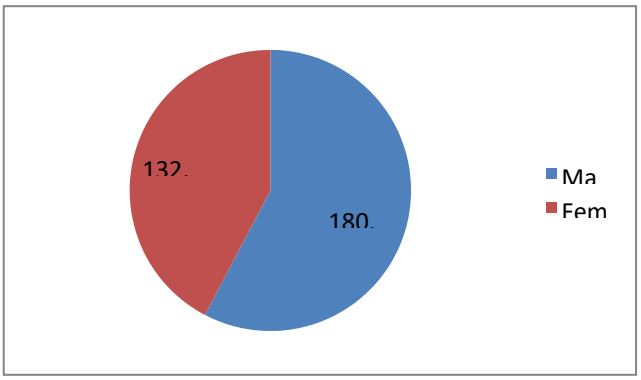
To the respondents, the researcher sought for their verbal consent before filling the questionnaire. Meanwhile, the researcher informed the respondents of their right to withdraw from the study at any time if they wish without any repercuss

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

This chapter presents data analysis and discussion of the findings as explained below;

Figure 1:Gender of the respondents

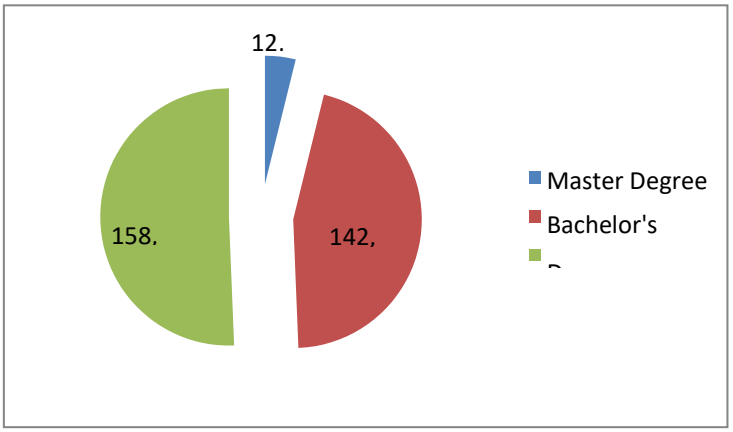


Source: Primary Data, (2024)

The findings indicate that majority 58% of the respondents as male while 42% of the respondents as female.

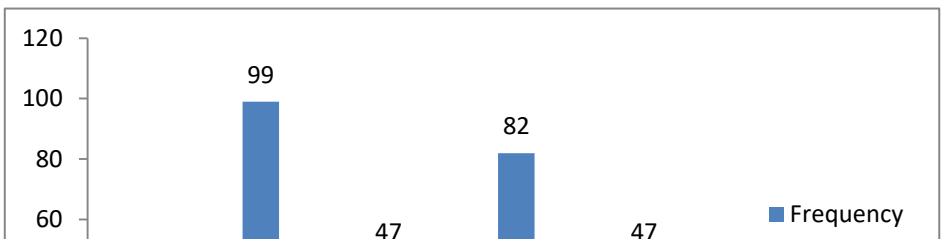
Figure 2: Academic qualification of the respondents

Source: Primary Data, (2024)



The study showed that 4% of the respondents had master degree, 45% of the respondents had bachelor's degree and 51% of the respondents had diploma.

Figure 3: Years of Service of the respondents



Source: Primary Data, (2024)

The study indicate that 11.9% of the respondents worked between 0-5 years, 31.7% of the respondents between 6-9 years, 15.1% of the respondents between 10-15 years, 26.3% of the respondents between 16-20 years and 15.1% of the respondents worked for 21-above years.

4.1. The impact of Head teachers' provision of ICT resources and integration on effective teaching of Biology in Mable city secondary schools, Uganda

This was the first objective under study and the responses obtained are explained below

Table 4.1: The impact of Head teachers' provision of ICT resources and integration on effective teaching of Biology in Mable city secondary schools, Uganda

	Head Teacher's Provision of ICT tools	SA	A	U	D	SD
P1	The ICT tools required for teaching of Biology are adequately provided	0.0	44.2	1.9	45.8	8.0
P2	They are accessible by teachers and students	4.8	51.3	0.0	30.8	13.1
P3	The ICT tools provided are all functional	4.8	29.8	17.6	45.5	2.2
P4	The ICT tools provided are relevant to the teaching of Biology	4.8	52.6	5.1	37.5	0.0
P5	The ICT tools provided are current models	0.0	33.3	11.5	40.7	14.4

Source: Primary Data, (2024)

The findings indicate that 45.8% of the respondents disagreed that the ICT tools required for teaching of Biology were not adequately provided while strongly agreed had no response.

Besides, 51.3% of the respondents agreed that they were accessible by teachers and students and only 13.1% of the respondents strongly disagreed.

The study show that 45.5% of the respondents disagreed that the ICT tools provided were not all functional while 2.2% of the respondents strongly disagreed.

Furthermore, 52.6% of the respondents agreed that the ICT tools provided were relevant to the teaching of Biology and strongly disagreed had no response.

Finally, 40.7% of the respondents disagreed that the ICT tools provided were not current models and 11.5% of the respondents were undecided.

Table 4.2: Head Teacher's Supervision of ICT integration

SI	Head Teacher's Supervision of ICT integration	SA	A	U	D	SD
SI1	Teachers are being regularly supervised on use of the ICT tools.	5.8	26.6	12.2	39.4	16.0
SI2	Head Teacher regularly checks students' compliance on the use of ICT tools.	7.4	36.9	11.9	34.3	9.6
SI3	Head Teacher checks regularly to ensure that ICT tools are handled with care by the teachers.	9.3	42.9	6.7	38.8	2.2
SI4	Head Teachers checks to ascertain teacher's skills in ICT integration.	0.0	29.2	31.7	36.9	2.2
SI5	Head Teacher regularly assess the success of teaching and learning by integrating ICT.	12.2	33.3	26.3	22.1	6.1
ST	**Teachers Skills Training on ICT Integration**	SA	A	U	D	SD
ST1	Head Teacher usually organizes skills training for Biology teachers on ICT integration.	7.4	35.6	13.1	38.8	5.1
ST2	ICT technical staff are provided to guide ICT integration	14.1	41.0	9.0	24.7	11.2
ST3	Biology teachers are given opportunities to upgrade their knowledge on ICT integration		64.7	8.7	21.5	5.1
ST4	Biology teachers are sponsored for special training in ICT integration		43.6	13.1	17.3	26.0

Source: Primary Data, (2024)

The findings revealed that 39.4% of the respondents disagreed that teachers are not being regularly supervised on use of the ICT tools while 5.8% of the respondents strongly agreed.

Furthermore, 36.9% of the respondents agreed that head teacher regularly checks students' compliance on the use of ICT tools and only 9.6% of the

respondents who strongly disagreed.

The study show that 42.9% of the respondents agreed that head teacher checks regularly to ensure that ICT tools are handled with care by the teachers while 2.2% of the respondents strongly disagreed.

Besides, 36.9% of the respondents disagreed that head teachers don't check to ascertain teacher's skills in ICT integration and 2.2% of the respondents strongly disagreed.

In addition, 33.3% of the respondents agreed that head teacher regularly assess the success of teaching and learning by integrating ICT and 6.1% of the respondents strongly disagreed.

The findings indicate that 38.8% of the respondents disagreed that head teacher don't usually organizes skills training for Biology teachers on ICT integration while 5.1% of the respondents strongly disagreed.

In addition, 41.0% of the respondents agreed that ICT technical staffs were provided to guide ICT integration and 11.2% of the respondents strongly disagreed.

Besides, 64.7% of the respondents agreed that biology teachers were given opportunities to upgrade their knowledge on ICT integration and only 5.1% of the respondents strongly disagreed. Lastly, 43.6% of the respondents agreed that biology teachers were sponsored for special training in ICT integration.

4.3. The impact of Head teachers' supervision of ICT integration on effective teaching of Biology in Mbale city secondary schools, Uganda

This was the second objective under study and responses obtained are discussed below;

Table 4.3.Response on ICT Resources in School

		Available and functional	*Available not functional*	*Available not adequate*	*Not Available*
IR1	Interactive whiteboard	25.6	5.8	10.9	57.7
IR2	Virtual Labs	5.8	25.3	12.5	56.4
IR3	Internet service	23.1	11.5	59.3	6.1
IR4	Simulations	9.6	13.1	19.2	58.0
IR5	Digital videos/ projectors	24.7	12.2	13.1	50.0
IR6	Wireless microphones	37.2	*0.0*	40.7	22.1
IR7	Quizlets	24.0	13.1	36.9	26.0
IR8	BioDigital Human:	17.3	6.7	22.8	53.2
IR9	computers	14.4	19.9	44.6	21.2

Source: Primary Data, (2024)

The study indicate that 57.7% of the respondents said that interactive whiteboard were not available and 5.7% of the respondents stated were available not functional.

The field findings show that 56.4% of the respondents pointed out that virtual labs were not available.

Besides, 59.3% of the respondents agreed that internet service were available but not adequate.

In addition, 58.0% of the respondents noted that simulations were not available and 9.6% of the respondents stated that were available and functional.

Furthermore, 50.0% of the respondents said that digital videos/ projectors were not available at the school and 12.2% of the respondents said that were available not functional.

The study indicated that 40.7% of the respondents said that wireless microphones were available but not adequate and 22.1% of the respondents said that they were not available.

The findings show that 36.9% of the respondents noted that quizlets were available but not adequate while 13.1% of the respondents said that they were available but not functional.

In addition, 53.2% of the respondents said that BioDigital Human were not available at the school while 6.3% of the respondents stated that they were available but not adequate.

Lastly, 44.6% of the respondents noted that computers were available but not adequate and 14.4% of the respondents said that they were available and functional.

Table 4.4. Integration of ICT in Teaching of Biology

Integration Of ICT In Teaching Of Biology	***Often 3***	***Sometimes 2***	***Rarely 1***	***Not at all 0***
Kindly indicate your use of ICT tools listed below in teaching Biology in the options provided				
Interactive whiteboard	28.5	11.5	26.6	33.3
Virtual Labs	16.0	14.1	30.1	39.7
Internet service	0.0	54.5	34.6	10.9
Simulations	0.0	18.9	37.5	43.6
Digital videos/ projectors	6.7	48.1	21.8	23.4
Wireless microphones	0.0	11.5	34.6	53.8
Quizlets	0.0	12.2	39.1	48.7
BioDigital Human:	6.7	12.2	30.1	51.0

Source: Primary Data, (2024)

The study indicates that 33.3% of the respondents said that interactive whiteboards were not used at all and 11.5% of the respondents stated sometimes.

The field findings show that 39.7% of the respondents pointed out that virtual Labs were not used at all and 14.1% of the respondents stated sometimes.

Besides, 54.5% of the respondents agreed that internet services were sometimes used while 10.9% of the respondents said not at all.

In addition, 43.6% of the respondents noted that simulations were not used at all and often had no response.

Furthermore, 48.1% of the respondents said that digital videos/ projectors were sometimes used and 6.7% of the respondents said that used often.

The study indicated that 53.8% of the respondents said that wireless microphones were not used at all and often had no response.

The findings show that 48.7% of the respondents stated that sometimes use quiz lets while 6.9% of the respondents said its used often.

In addition, 48.7% of the respondents said that BioDigital Human were not used at all while it being used often had no response.

4.4. The impact of teachers skills training in ICT integration on effective teaching of Biology in Mbale city secondary schools, Uganda.

This was the second objective under study and responses are discussed below;

Table 4.5. The impact of teachers skills training in ICT integration on effective teaching of Biology in Mbale city secondary schools, Uganda.

ET	***Effective teaching using ICT tools***	**SA**	**A**	**U**	**D**	**SD**
ET1	ICT tools help me to present my lesson contents sequentially	11.2	76.6	0.0	10.3	1.9
ET2	ICT tools make teaching/learning more concrete and realistic	11.2	48.7	5.8	21.2	13.1
ET3	I illustrate my lessons easily with the aid of ICT tools	18.6	13.1	5.8	55.4	7.1
ET4	ICT tools provide Augmented Reality (AR) and Virtual Reality (VR)	0.0	27.2	13.1	51.6	8.0
ET5	ICT tools provide Hands-On Learning through Virtual Labs	7.4	24.7	13.1	44.6	10.3
ET6	ICT tools increase students motivation and enthusiasm	20.8	44.9	5.8	19.2	9.3
ET7	ICT tools allow the visualization of complex biological concepts, making abstract ideas more tangible	26.9	17.9	13.1	32.7	9.3

Source: Primary Data, (2024)

The findings indicate that 76.6% of the respondents agreed that ICT tools help them to present their lesson contents sequentially and 1.9% of the respondents who strongly disagreed.

The study revealed that 48.7% of the respondents agreed thatICT tools make teaching/learning more concrete and realistic while 13.1% of the respondents strongly disagreed.

In addition, 55.5% of the respondents disagreed that they didn't illustrate their lessons easily with the aid of ICT tools and only 18.6% of the respondents strongly agreed.

Besides, 51.6% of the respondents disagreed that ICT tools does not provide Augmented Reality (AR) and Virtual Reality (VR) and strongly agreed had no response.

Furthermore, 44.6% of the respondents disagreed that ICT tools does not provide Hands-On Learning through Virtual Labs while 7.4% of the respondents strongly agreed.

The findings show that 32.7% of the respondents disagreed that ICT tools does not allow the visualization of complex biological concepts, making abstract ideas not more tangible while 26.9% of the respondents strongly agreed.

Table 4.6. ICT Integration and Learning of Biology

IB	***ICT Integration and Learning of Biology***	**SA**	**A**	**U**	**D**	**SD**
IB1	My Biology teacher uses ICT tools to present his lessons	16.0	18.9	3.5	36.2	25.3
IB2	I understand Biology better when I am taught with ICT tools	18.6	21.8	5.4	29.2	25.0
IB3	I find Biology very interesting to study	65.1	30.1	1.0	0.0	3.8
IB4	Since my teacher started using ICT tools for teaching Biology, I now score highly in test assignment and exam	13.8	33.7	10.3	22.1	20.2
IB5	I feel like specializing in Biology in my further studies	55.8	28.2	1.0	9.3	5.8
IB6	Use of ICT tools has made Biology simple for me	28.2	30.4	8.0	24.0	9.3
IB7	I am very happy with the way my teacher teaches us Biology	79.5	18.6	0.0	0.0	1.9
IB8	My teacher takes time to explain concepts clearly in his lessons	82.4	12.8	2.9	1.9	0.0
IB9	My teacher asks us questions in class	79.8	14.4	2.9	2.9	0.0
IB10	My teacher allows us to freely ask him questions in class	72.4	27.6	0.0	0.0	0.0
IB11	My teacher checks and corrects our notes regularly	42.3	33.7	4.5	15.7	3.8
IB12	My teacher marks our assignments/tests and gives us feedback on our performance	76.3	19.0	9.0	1.6	2.2

The study show that 36.2% of the respondents disagreed that Biology teacher does not use ICT tools to present their lessons while 18.9% of the respondents agreed.

The findings indicate that 29.2% of the respondents disagreed that they don't understand Biology better when taught with ICT tools and 18.6% of the respondents strongly agreed.

In addition, 65.1% of the respondents strongly agreed that they find Biology very interesting to study and only 3.8% of the respondents strongly disagreed.

Besides, 33.7% of the respondents agreed that since their teacher started using ICT tools for teaching Biology, they now score highly in test assignment and exam and 22.1% of the respondents disagreed.

Furthermore, 55.8% of the respondents strongly agreed that they feel like specializing in Biology in their further studies and 20.2% of the respondents strongly disagreed.

The findings indicate that 30.4% of the respondents agreed that use of ICT tools had made Biology simple for them while 5.8% of the respondents strongly disagreed.

The study revealed that 79.5% of the respondents strongly agreed that they were very happy with the way their teacher teaches them Biology and only 1.9% of the respondents strongly disagreed.

In addition, 82.4% of the respondents strongly agreed that their teacher takes time to explain concepts clearly in his lessons and strongly disagreed had no response.

Besides, 79.8% of the respondents strongly agreed that teacher asks them questions in class and 2.9% of the respondents disagreed.

In addition, 72.4% of the respondents strongly agreed that their teacher allows them to freely ask him questions in class while disagreed had no response.

Last but not least, 42.3% of the respondents strongly agreed that teacher checks and corrects their notes regularly as compared to 3.8% of the respondents disagreed.

Lastly, 76.3% of the respondents strongly agreed that teacher marks their assignments/tests and gives them feedback on their performance while 2.2% of the respondents strongly disagreed.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

The chapter presents the discussion, conclusions and recommendations of the study with regard to the effect of the Head teachers' management of ICT integration and effective teaching of biology in selected secondary schools in Mbale city, Uganda. During the study the researcher involved himself in distributing the questionnaires to teachers and students. He also conducted interviews to head teachers and deputy head teachers.

5.1 Discussion of the findings

5.1.1. The impact of Head teachers' provision of ICT resources and integration on effective teaching of Biology in Mable city secondary schools, Uganda.

The findings indicate that 45.8% of the respondents disagreed that the ICT tools required for teaching of Biology were not adequately provided while strongly agreed had no response. This corroborates with Baley et al. (2020) was to determine the availability of ICT resources for teaching and learning Biology in secondary schools in the Southern Region, Eritrea. s

Besides, 51.3% of the respondents agreed that they were accessible by teachers and students and only 13.1% of the respondents strongly disagreed. In agreement with Mulwa and Kyalo (2011), Njoroge et al. (2017) stated that, the decisions of teachers on using computers in classrooms tend to be influenced by the accessibility and availability of relevant infrastructures. Connectivity to electricity and internet facilities are also highly needed during integration of ICT in teaching and learning process. Nevertheless, electricity and internet connectivity are still a big challenge in many developing countries mostly in Africa.

The study shows that 45.5% of the respondents disagreed that the ICT tools provided were not all functional while 2.2% of the respondents strongly disagreed. Furthermore, 52.6% of the respondents agreed that the ICT tools

provided were relevant to the teaching of Biology and strongly disagreed had no response.

Besides, 40.7% of the respondents disagreed that the ICT tools provided were not current models and 11.5% of the respondents were undecided. The findings revealed that 39.4% of the respondents disagreed that teachers are not being regularly supervised on use of the ICT tools while 5.8% of the respondents strongly agreed.

Furthermore, 36.9% of the respondents agreed that head teacher regularly checks students' compliance on the use of ICT tools and only 9.6% of the respondents who strongly disagreed. The study shows that 42.9% of the respondents agreed that head teacher checks regularly to ensure that ICT tools are handled with care by the teachers while 2.2% of the respondents strongly disagreed.

Besides, 36.9% of the respondents disagreed that head teachers don't check to ascertain teacher's skills in ICT integration and 2.2% of the respondents strongly disagreed. In addition, 33.3% of the respondents agreed that head teacher regularly assess the success of teaching and learning by integrating ICT and 6.1% of the respondents strongly disagreed.

The findings indicate that 38.8% of the respondents disagreed that head teacher don't usually organizes skills training for Biology teachers on ICT integration while 5.1% of the respondents strongly disagreed.

In addition, 41.0% of the respondents agreed that ICT technical staffs were provided to guide ICT integration and 11.2% of the respondents strongly disagreed. Besides, 64.7% of the respondents agreed that biology teachers were given opportunities to upgrade their knowledge on ICT integration and only 5.1% of the respondents strongly disagreed. Lastly, 43.6% of the respondents agreed that biology teachers were sponsored for special training in ICT integration.

5.1.2. The impact of Head teachers' supervision of ICT integration on effective teaching of Biology in Mbale city secondary schools, Uganda.

The study indicates that 57.7% of the respondents said that interactive whiteboards were not available and 5.7% of the respondents stated were

available not functional. The field findings show that 56.4% of the respondents pointed out that virtual labs were not available. In relation to Kweku and Stella (2018) revealed that instructional supervision by headteachers and performances of teachers have a weak significant correlation. Additionally, the findings show new teachers' orientation and performance of teachers are not correlated and that checking record of work of teachers and motivation of teachers are weakly by significantly and positively correlated.

Besides, 59.3% of the respondents agreed that internet service were available but not adequate. In addition, 58.0% of the respondents noted that simulations were not available and 9.6% of the respondents stated that were available and functional.

Furthermore, 50.0% of the respondents said that digital videos/ projectors were not available at the school and 12.2% of the respondents said that were available not functional. The study indicated that 40.7% of the respondents said that wireless microphones were available but not adequate and 22.1% of the respondents said that they were not available.

The findings show that 36.9% of the respondents noted that quizlets were available but not adequate while 13.1% of the respondents said that they were available but not functional. In addition, 53.2% of the respondents said that BioDigital Human were not available at the school while 6.3% of the respondents stated that they were available but not adequate. The findings indicate that 44.6% of the respondents noted that computers were available but not adequate and 14.4% of the respondents said that they were available and functional.

The study indicates that 33.3% of the respondents said that interactive whiteboards were not used at all and 11.5% of the respondents stated sometimes. The field findings show that 39.7% of the respondents pointed out that virtual Labs were not used at all and 14.1% of the respondents stated sometimes.

Besides, 54.5% of the respondents agreed that internet services were sometimes used while 10.9% of the respondents said not at all. In addition,

43.6% of the respondents noted that simulations were not used at all and often had no response.

Furthermore, 48.1% of the respondents said that digital videos/ projectors were sometimes used and 6.7% of the respondents said that used often. The study indicated that 53.8% of the respondents said that wireless microphones were not used at all and often had no response.

The findings show that 48.7% of the respondents stated that sometimes use quiz lets while 6.9% of the respondents said it's used often. In addition, 48.7% of the respondents said that BioDigital Human were not used at all while it being used often had no response.

5.1.3. The impact of teachers skills training in ICT integration on effective teaching of Biology in Mbale city secondary schools, Uganda.

The findings indicate that 76.6% of the respondents agreed that ICT tools help them to present their lesson contents sequentially and 1.9% of the respondents who strongly disagreed. The study revealed that 48.7% of the respondents agreed that ICT tools make teaching/learning more concrete and realistic while 13.1% of the respondents strongly disagreed.

In addition, 55.5% of the respondents disagreed that they didn't illustrate their lessons easily with the aid of ICT tools and only 18.6% of the respondents strongly agreed. Besides, 51.6% of the respondents disagreed that ICT tools does not provide Augmented Reality (AR) and Virtual Reality (VR) and strongly agreed had no response.

Furthermore, 44.6% of the respondents disagreed that ICT tools does not provide Hands-On Learning through Virtual Labs while 7.4% of the respondents strongly agreed. The findings show that 32.7% of the respondents disagreed that ICT tools does not allow the visualization of complex biological concepts, making abstract ideas not more tangible while 26.9% of the respondents strongly agreed.

The study shows that 36.2% of the respondents disagreed that Biology teacher does not use ICT tools to present their lessons while 18.9% of the respondents

agreed. The findings indicate that 29.2% of the respondents disagreed that they don't understand Biology better when taught with ICT tools and 18.6% of the respondents strongly agreed.

In addition, 65.1% of the respondents strongly agreed that they find Biology very interesting to study and only 3.8% of the respondents strongly disagreed. Besides, 33.7% of the respondents agreed that since their teacher started using ICT tools for teaching Biology, they now score highly in test assignment and exam and 22.1% of the respondents disagreed.

Furthermore, 55.8% of the respondents strongly agreed that they feel like specializing in Biology in their further studies and 20.2% of the respondents strongly disagreed. The findings indicate that 30.4% of the respondents agreed that use of ICT tools had made Biology simple for them while 5.8% of the respondents strongly disagreed.

The study revealed that 79.5% of the respondents strongly agreed that they were very happy with the way their teacher teaches them Biology and only 1.9% of the respondents strongly disagreed. In addition, 82.4% of the respondents strongly agreed that their teacher takes time to explain concepts clearly in his lessons and strongly disagreed had no response.

Besides, 79.8% of the respondents strongly agreed that teacher asks them questions in class and 2.9% of the respondents disagreed. In addition, 72.4% of the respondents strongly agreed that their teacher allows them to freely ask him questions in class while disagreed had no response.

Last but not least, 42.3% of the respondents strongly agreed that teacher checks and corrects their notes regularly as compared to 3.8% of the respondents disagreed. Lastly, 76.3% of the respondents strongly agreed that teacher marks their assignments/tests and gives them feedback on their performance while 2.2% of the respondents strongly disagreed.

5.2. Conclusion

5.1.1. The impact of Head teachers' provision of ICT resources and integration on effective teaching of Biology in Mable city secondary schools, Uganda.

The findings indicate that ICT tools required for teaching of Biology were not adequately provided, ICT tools provided were not all functional, ICT tools provided were not current models, head teacher regularly checks students' compliance on the use of ICT tools, head teacher checks regularly to ensure that ICT tools are handled with care by the teachers, head teachers don't check to ascertain teacher's skills in ICT integration, and head teacher regularly assess the success of teaching and learning by integrating ICT and 6.1% of the respondents strongly disagreed.

5.1.2. The impact of Head teachers' supervision of ICT integration on effective teaching of Biology in Mbale city secondary schools, Uganda.

The study indicate that interactive whiteboard were not available, virtual labs were not available, internet service were available but not adequate, digital videos/ projectors were not available at the school, wireless microphones were available but not adequate, and quizlets were available but not adequate

5.1.3. The impact of teachers' skills training in ICT integration on effective teaching of Biology in Mbale city secondary schools, Uganda.

The findings indicate that ICT tools help them to present their lesson contents sequentially, ICT tools make teaching/learning more concrete and realistic, they didn't illustrate their lessons easily with the aid of ICT tools, ICT tools does not provide Augmented Reality (AR) and Virtual Reality (VR), ICT tools does not provide Hands-On Learning through Virtual Labs and ICT tools does not allow the visualization of complex biological concepts, making abstract ideas not more tangible.

5.3. Recommendations

The researcher recommends the following strategies;

Ensuring the sustainability of ICT integration by seeking long-term funding sources and partnerships. Explore grants, donations, or partnerships with local businesses to support the ongoing maintenance and upgrading of ICT infrastructure. Implement scalable solutions that can adapt to the growing needs of the school and changing technological landscape.

Implementing a system to monitor and evaluate the effectiveness of ICT integration. Collect feedback from teachers, students, and parents to assess the impact on teaching and learning outcomes. Use data-driven decision-making to identify areas for improvement and make necessary adjustments to the ICT integration plan.

Providing ongoing support and guidance to teachers throughout the ICT integration process. Encourage open communication and collaboration among staff, creating a supportive environment for experimentation and innovation. Lead by example by demonstrating your own proficiency in using ICT tools and sharing successful integration strategies with the teaching staff.

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APPENDIX 1

MANAGEMENT OF ICT INTEGRATION AND EFFECTIVE TEACHING OF BIOLOGY QUESTIONNAIRE. (MIIETBQ)

Dear respondent

I am Wasukira Charles a master degree student in Uganda Christian University (UCU) carrying out a research study on head teachers' management of ICT integration and effective teaching of biology in selected secondary schools in Mbale city, Uganda.

Within this context, you are kindly requested to participate in the study by responding genuinely to the items in this questionnaire to the best of your knowledge. Any data you provide shall be for academic purposes only, and all the information shall be treated confidentially.

Thank you for your cooperation.

You are therefore requested to place a tick **[√]**in any of the options in the boxes given below as follows: Strongly Agree [SA], Agree [A], Undecided [ND] Disagreed [D] and Strongly Disagree [SD]

QUESTIONNAIRE FOR BIOLOGY TEACHERS

SECTION A: Biometric information of respondent

Kindly place an √ in any of the options that is applicable to you

E. g [√]

1. Gender: Male [ ] Female [ ]

2. Qualification:

Master Degree	**Bachelor's Degree**	Diploma

3. Years of Service

1- 5yrs	**6 - 9yrs**	**10 - 15yrs**	**16 - 20**	**21 -above**

SECTION A:Head Teacher's Management of ICT Integration.

	Head Teacher's Provision of ICT tools	**SA**	**A**	**U**	**D**	**SD**
P1	The ICT tools required for teaching of Biology are adequately provided					
P2	They are accessible by teachers and students					
P3	The ICT tools provided are all functional					
P4	The ICT tools provided are relevant to the teaching of Biology					
P5	The ICT tools provided are current models					
SI	**Head Teacher's Supervision of ICT integration**	**SA**	**A**	**U**	**D**	**SD**
SI1	Teachers are being regularly supervised on use of the ICT tools.					
SI2	Head Teacher regularly checks students' compliance on the use of ICT tools.					
SI3	Head Teacher checks regularly to ensure					

	that ICT tools are handled with care by the teachers.					
SI4	Head Teachers checks to ascertain teachers skills in ICT integration.					
SI5	Head Teacher regularly assess the success of teaching and learning by integrating ICT.					
ST	**Teachers Skills Training on ICT Integration**	**SA**	**A**	**U**	**D**	**SD**
ST1	Head Teacher usually organizesskills training for Biology teachers on ICT integration.					
ST2	ICT technical staff are provided to guide ICT integration					
ST3	Biology teachers are given opportunities to upgrade their knowledge on ICT integration					
ST4	Biology teachers are sponsored for special training in ICT integration					

SECTION B: Integration of ICT in Teaching of Biology

Checklist of ICT Resources in my School.

		Available and functional	***Available not functional***	***Available not adequate***	***Not Available***
IR1	Interactive whiteboard				
IR2	Virtual Labs				

IR3	Internet service				
IR4	Simulations				
IR5	Digital videos/ projectors				
IR6	Wireless microphones				
IR7	Quizlets				
IR8	BioDigital Human:				
IR9	computers				

	Integration Of ICT In Teaching Of Biology	***Often 3***	***Sometimes 2***	***Rarely 1***	***Not at all 0***
	Kindly indicate your use of ICT tools listed below in teaching Biology in the options provided				
1	Interactive whiteboard				
2	Virtual Labs				

3	Internet service				
4	Simulations				
5	Digital videos/ projectors				
6	Wireless microphones				
7	Quizlets				
8	BioDigital Human**:**				

SECTION C: Effective Teaching of Biology through ICT integration

ET	***Effective teaching using ICT tools***	**SA**	**A**	**U**	**D**	**SD**
ET1	ICT tools help me to present my lesson contents sequentially					
ET2	ICT tools make teaching/learning more concrete and realistic					
ET3	I illustrate my lessons easily with the aid of ICT tools					
ET4	ICT tools provide Augmented Reality (AR) and Virtual Reality (VR)					
ET5	ICT tools provide Hands-On Learning through Virtual Labs					
ET6	ICT tools increase students motivation and					

	enthusiasm					
ET7	ICT tools allow the visualization of complex biological concepts, making abstract ideas more tangible					

APPENDIX II: STUDENTS QUESTIONNAIRE

MANAGEMENT OF ICT INTEGRATION AND EFFECTIVE TEACHING OF BIOLOGY QUESTIONNNAIRE. (MIIETBQ)

Dear respondent

I am Wasukira Charles a master degree student in Uganda Christian University (UCU) carrying out a research study on head teachers' management of ICT integration and effective teaching of biology in selected secondary schools in Mbale city, Uganda.

Within this context, you are kindly requested to participate in the study by responding genuinely to the items in this questionnaire to the best of your knowledge. Any data you provide shall be for academic purposes only, and all the information shall be treated confidentially.

Thank you for your cooperation.

You are therefore requested to place a √in any of the options in the boxes given below as follows: Strongly Agree [SA], Agree [A], Undecided [ND] Disagreed [D] and Strongly Disagree [SD]

IB	***ICT Integration and Learning of Biology***	**SA**	**A**	**U**	**D**	**SD**
IB1	My Biology teacher uses ICT tools to present his lessons					
IB2	I understand Biology better when I am taught with ICT tools					
IB3	I find Biology very interesting to study					
IB4	Since my teacher started using ICT tools for teaching Biology, I now score highly in test assignment and exam					

IB5	I feel like specializing in Biology in my further studies					
IB6	Use of ICT tools has made Biology simple for me					
IB7	I am very happy with the way my teacher teaches us Biology					
IB8	My teacher takes time to explain concepts clearly in his lessons					
IB9	My teacher asks us questions in class					
IB10	My teacher allows us to freely ask him questions in class					
IB11	My teacher checks and corrects our notes regularly					
IB12	My teacher marks our assignments/tests and gives us feedback on our performance					

APPENDIX III: INTERVIEW GUIDE FOR HEAD TEACHERS

Name of School…….

Category of School…….

Gender of Head teacher……

Years of Experience as Head teacher……..

Latest qualification ……..……..

Questions

1. How do you integrate ICT in teaching of Biology in your school?
2. What challenges do you face in integrating ICT for Biology teaching in your school?
3. What do you really check when you go out for routine supervision on ICT use for teaching?
4. What can you say about your Biology teachers' skills in ICT integration for effective teaching of Biology?
5. Which ICT materials for teaching Biology are you lacking in your school?
6. What are some of the weaknesses you have identified with Biology teachers in using ICT resources for teaching?
7. How are your students responding to learning of Biology?
8. How would you generally assess the integration of ICT in your school for teaching Biology?

APPENDIX IV: Krejcie and Morgan (1970) table for Determining Sample size from a given Population

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

UGANDA CHRISTIAN
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MBALE UNIVERSITY COLLEGE

Office of the Academic Registrar

To .....

.....

Dear Sir/Madam,

Re: Academic Research

Christian greetings!

We are honored to introduce to you Mr. Mrs./Miss. W/ASUBIRA CHARLES

Of Registration Number; REG22/U02/MED/07 pursuing a Masters' Degree/Postgraduate Diploma / Bachelor's Degree MASTERS/ DEGREE

He/ she is required to carry out an academic research on the topic

Headteachers' management of ICT integration and effective teaching of biology in Selected Sch in Mbale C

and thereafter produce a well bound hard cover research report (**MAROON**) in color for undergraduate and three (**BLACK**) copies for Postgraduate students as a University requirement for the award of a degree/diploma in the academic discipline that he / she is pursuing.

We shall be grateful for the help you may offer to him or her accordingly.

Thank you.

Yours faithfully,

19 FEB 2024

Mr. Akampurira Timothy

Academic Registrar

Received and granted opportunity