CHALLENGES ENCOUNTER IN INCORPORATING ICT FOR BIOLOGY INSTRUCTION IN SENIOR SECONDARY SCHOOL IN ILORIN WEST LOCAL GOVERNMENT AREA OF KWARA STATE

BY

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CERTIFICATION

This is to certify that this research work was carried out by Abdulhameed Islamiyat Abakewith Matric Number: KWCOED/IL/22/0536 of the Kwara State College of Education Ilorin, Nigeria

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DEDICATION

This project is dedicated to Almighty Allah the most beneficent, merciful and the most high for sparing my life throughout the period of my programme and to my Amiable self for the endurance and patient i had all through kudos to me and to my late parents, sisters and brother for their support towards the success all through my NCE programme

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ABSTRACT

This study assesses Readiness of teachers towards integrating ICT in teaching biology in schools. Specifically, the study examines the extent is ICT used in teaching biology in secondary schools, whether the use of ICT is important in the teaching of biology in secondary schools, finds out whether the use of ICT in teaching biology in secondary schools improves academic performance and examines the challenges of using ICT to teach biology in secondary schools. The study employed the survey descriptive research design. A total of 200 responses were validated from the survey. The study adopts the Jerome Bruner's Cognitive Theory of Instruction. From the responses obtained and analysed, the findings reveals that the extent ICT used in teaching biology in secondary schools is very high. Furthermore, the use of ICT is important in the teaching of biology in secondary schools. The study recommends that Government should ensure that ICT policy statements in education are translated into reality. An ICT policy implementation commission should be created. This commission should be funded and given the power to provide ICT facilities in Nigerian Secondary schools and also empowered to monitor their usage. The study further recommends that adequate ICT resources, including the internet, need to be provided in schools for teaching and learning Biology and other subjects.

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CHAPTER ONE

INTRODUCTION

Background of the Study

Recently, ICT has become one of the basic tools in modern society (Daniel, 2022) and it is an essential element within this modern technology for success in life and competition for job (Rychen & Salganik, 2021). In schools, ICT has been found to be used in different aspects relevant to education. Some of these aspects include: teleconferencing, audio conferencing, television lessons, radio broadcast, interactive radio counselling and the system of interactive voice response (Sharma, 2023). The acceptance and use of ICT in education plays a key role in preparing the 21st -century generation with adequate skills and knowledge (Pineida, 2019). According to Miguel (2017), ICT enhances an easy communication among students and teachers. The study of Roy (2015) has found that ICT creates a new learning environment that enablesboth teachers and learners to access new opportunities for future studies to carry out quality research in education through collaboration with different experts. In addition, ICT increases accessibility to relevant and updated teaching and learning content hence improved quality of education (Meenakshi, 2013).

In teaching Biology, ICT can increase not only the level of knowledge but also the attitudes of students towards Biology (Haunsel & Hill, 2019). In this regards, ICT was found to be used in various Biological aspects. The ICT was found to be used in virtual laboratories (Muhamad, Zaman, & Ahmad, 2017), simulations of different experiments and phenomena (Sommer & Sommer, 2018), and data logging. The virtual laboratories are crucial in carrying out the experiments that were impossible in physical laboratories due to the lack of adequate laboratory materials and reagents (Yildirim, 2021). On the other side, they could be used for performing the harmful experiments to the students to prevent possible accidents that could arise during physical experiments (Muhamad et al., 2017). Some of virtual experiments include virtual frog dissection (Kinzie, Burch, & Boker, 2019), virtual DNA replication, virtual process of mitosis and microbial culture (Bistolfi, 2020) as harmful microorganisms are not advised to be cultured in schools. Virtual laboratories and simulations provide different opportunities in teaching and learning, like enhancing easy collaboration among students and teachers (Surxonidinovna & Madrimovich, 2020), providing flexibility towards the time and place, and facilitate the access to the global resources (Osborne & Hennessy, 2018).

Regardless to different benefits provided by ICT in educational practice, its full integration has been challenged by many factors. According to Veen (2023), the effective use of ICT in teaching and learning process has been affected by technical support provided by school. Other studies revealed that personal factors such as teachers' competence, teachers' attitudes and time, may also influence the successful use of ICT in teaching and learning process. On the other side, the presence of ICT resources was found to be relevant in integrating ICT in teaching and learning. According to Beldina, Nyawire, Stanslous & Linda (2015) the whole prerequisite hardware infrastructure such as electricity, computer, internet connection provider and technical support need to be available for supporting ICT integration in schools. Additionally, Njoroge, Margaret & Joab, (2017) found that teachers' decisions about the use of computers in their classrooms are probably associated with accessibility and availability of appropriate infrastructures. Within this context, this study was organized to identify the level at which ICT is used and challenges preventing the Nigerian teachers to its successful use in teaching and learning Biology.

Biology is a subject that receives a great deal of attention. Its comprehension necessitates a well-balanced secondary school education. Biology as a school topic may contribute to the improvement of students' lives and their local surroundings (Gregor 2017).

In a developing country like Nigeria, the use of "ICT" in the teaching of biology should be encouraged in all secondary schools, as the national education policy stipulates that "the general purposes of secondary education should be preparation for or higher education." In more concrete terms, secondary education should prepare students to live effectively in today's age of science and technology.

According to Ogbonna (2016), information and communication technologies (ICT) have significantly impacted every element of human life, including education, aviation, agriculture, and manufacturing. In Nigeria, it appears that the majority of students and schools lack information communication technology facilities; nonetheless, the effect of media devices such as projectors may help to improve the teaching-learning process for the subject of biology.

The abbreviation ICT stands for Information and Communication Technology. They are a wide range of technical instruments and resources

used for communication, as well as for the creation, dissemination, storage, and management of information. Computers, the internet, broadcasting technologies (radio and television), and telephones are all examples of these technology (Volman,2022). Recently, there has been a surge of interest in determining the most efficient ways to leverage computers and the internet to increase the efficiency and efficacy of education at all levels and in both official and informal contexts (www.en.m.wikibooks.org). However, ICTs encompass more than these technologies; earlier technologies such as television, radio, and telephone, which have received less attention in recent years, have a longer and more illustrious history as educational aids.

In underdeveloped nations, computer and internet use are still in their infancy, if they are utilized at all, due to insufficient infrastructure and the associated high cost of access. ICTs are transforming society. They have an impact on every element of life. At schools, the affects are becoming increasingly noticeable. Because ICTs enable both students and instructors to tailor teaching and learning to individual requirements, society is pressuring schools to react appropriately to this technological breakthrough. Tinio (2022) discusses the potential for ICTs to improve education in underdeveloped nations by increasing access and raising the relevance and quality of

education. Additionally, he claimed that ICTs significantly promote the acquisition and absorption of information, providing developing nations with unparalleled chances to improve educational institutions, policy creation and implementation, and broaden prospects for biology and the poor. One of the major difficulties faced by the poor, and many others who reside in the world's poorest countries, is their sense of isolation, and ICTs may expand access to information in ways previously inconceivable (Peter 2015).

According to Watson (2021), ICTs have transformed how people work today and are now revolutionizing education institutions. As a result, if schools continue to teach kids with yesterday's skills and technology, they risk being ineffective and unprepared for the world of tomorrow. This alone is motivation enough for ICTs to garner worldwide prominence and attention. For example, ICTs are effective instruments for achieving one of the Millennium Development Goals (MDGs), which is universal basic education by the year 2015. Former United Nations Secretary-General Kofi Anan notes that in order to achieve Universal Primary Education by 2015, we must guarantee that information and communication technology unlock the door to educational systems. This demonstrates the increased demand for the

importance of ICTs in education. Because ICTs enable students and instructors to tailor learning and instruction to individual requirements, society is pressuring schools to respond appropriately to this technological revolution.

The usage of ICT is having a significant impact on students' learning and teaching techniques. Over the last two decades, schools in the western world have invested heavily in ICT infrastructure, and pupils now use computers more often and for a considerably broader range of purposes (Volman, 2022). Numerous studies demonstrate that pupils who use ICT facilities often demonstrate greater learning gains than those who do not. ICT provides a number of technological instruments that enhance the academic experience by enabling greater variety, diversity, and organization in education. As with many other fields of study, Biology Education provides a fertile ground for exploring the possibilities given by ICT (Peter 2018).

Scientific study, particularly in the twenty-first century, has significantly expanded our understanding of the world we live in. This has resulted in numerous changes in several fields of human effort, including education, health, energy, industry, and the environment. It has fostered healthier living and ethical behavior. There has been a great growth in

research, which has resulted in several scientific and technological breakthroughs. All of these breakthroughs and advances are interconnected and interdependent. Natural science has made tremendous strides in the last century, and science has demonstrated a great deal in the field of invention and technology, as well as a great deal of promise for improving his existence and the world around him. The advancement of science and technology is critical for society and the nation as a whole, which is why our schools have recently placed a high premium on it (Okoh 2016).

It goes without saying that biology cannot flourish in the current day without an informational and communicative edge, nor can graduates of biology education be internationally competitive without having been instilled with ICT abilities. Thus the researcher seeks to assess Readiness of teachers towards integrating ICT in teaching biology in schools against this backdrop.

Statement of the Problem

According to Okoh (2016), continuous examination of the influence of ICT on the teaching of core courses such as biology is necessary. It has been brought to the attention of stakeholders in biology education how critical ICT tools such as computers, audio-visual equipment, and internet access are to the course. They are unsure, however, if this technology possibility is being

grasped and explored most efficiently and ideally. Biology and biology education are inextricably linked, and their widespread usage, particularly in recent years, is increasingly being integrated into undergraduate training (Peter 2015). Additionally, several institutions and libraries around Nigeria are rapidly integrating ICT technologies such as computers and the internet into their programs for student usage. The purpose of this study is to determine Readiness of teachers towards integrating ICT in teaching biology in schoolss.

This aims to assess the amount of success achieved by students in Biology as a result of the growing use of computer-based education in Nigeria.

Objectives of the Study

The primary objective of this study is to assess the significance of using information and communication technology (ICT) in the study of biologys. Other objectives of this study are:

To determine the extent ICT is used in teaching biology in secondary schools.

To find out whether the use of ICT is important in the teaching of biology in secondary schools.

To find out whether the use of ICT in teaching biology in secondary schools improves academic performance.

To examine the challenges of using ICT to teach biology in secondary schools.

Research Questions

The following questions will be answered in this study:

To what extent is ICT used in teaching biology in secondary schools?

Is the use of ICT important in the teaching of biology in secondary schools?

Does the use of ICT in teaching biology in secondary schools improves academic performance?

What are the challenges of using ICT to teach biology in secondary schools?

Significance of the Study

This study would benefit all stakeholders in the education sector since the findings will demonstrate the critical nature of ICT integration in the teaching of biology in Nigerian schools, prompting policymakers to develop appropriate policies that effectively implement ICT usage in Nigerian schools. This study is particularly crucial for school administrators and instructors since the findings will demonstrate the impact of using ICT in the teaching of biology and the benefits to students.

Finally, this study will be extremely beneficial to academics and scholars since it will serve as a foundation for future studies and research.

Scope of the Study

The primary objectuve of this study is focused on assessing Readiness of teachers towards integrating ICT in teaching biology in schools. Specifically, this study is focused on determining the extent ICT is used in teaching biology in secondary schools, finding out whether the use of ICT is important in the teaching of biology in secondary schools, finding out whether the use of ICT in teaching biology in secondary schools improves academic performance and examining the challenges of using ICT to teach biology in secondary schools.

Biology teachers and students of secondary schools in Mushin Local Government Area of Lagos State will be the respondents of the survey of this study.

Limitations of the Study

The primary objective of this study is limited to assessing the significance of using information and communication technology (ICT) in the study of biology. Specifically, this study is limited to determining the extent ICT is used in teaching biology in secondary schools, finding out whether the use of ICT is important in the teaching of biology in secondary schools, finding out whether the use of ICT in teaching biology in secondary schools improves

academic performance and examining the challenges of using ICT to teach biology in secondary schools.

Biology teachers and students of secondary schools in Mushin Local Government Area of Lagos State will be the respondents of the survey of this study, thus the sample size was limited because only a few respondents were chosen to answer the research instrument, therefore the results cannot be generalized to other secondary schools outside the area.

Definition of Terms

Assessment: The action of assessing someone or something.

ICT: Information and communications technology is an extensional term for information technology that stresses the role of unified communications and the integration of telecommunications and computers.

Biology: The study of living organisms, divided into many specialized fields that cover their morphology, physiology, anatomy, behaviour, origin, and distribution.

CHAPTER TWO

LITERATURE REVIEW

2.1 Integration of ICT in teaching and learning process

ICT infrastructure refers to the hardware and software used for enhancing the teaching and learning process. The hardware includes computers, scanners, mobiles phones, printers, projectors, radio, camera recorders and TV sets, while software may include, some applications like data logging and simulations. In addition, electricity and internet connection are relevant infrastructures for integration of ICT in the teaching and learning process. Researchers have advised that ICT infrastructure should be easily accessed and used by all (Tsholofelo, 2015).

Integration of ICT in the teaching and learning process, is the way of using ICT tools in all activities related to teaching and learning thus creating a conductive learning environment in which students participate actively and constructively (Volman & Van, 2021). In fact, ICT should not be taken as a tool to replace the existing teaching methods, it should be used in supporting teaching and learning process. In this context, it is used to develop the skills of students in terms of cooperation, communication, problem solving and

lifelong learning (Plomp, Brummelhis, & Rapmund, 2019). The use of ICT in the teaching and learning process has to be applied in all subjects rather than being taught as isolated course or topic in itself (Mwanda, Mwanda, Midigo & Maundu, 2017)

The innovative use of ICT can enhance student-centered learning (Drent, & Meelissen, 2008). Therefore, every teacher in each classroom practice should adopt it to improve the students learning in every subject. This will engage them in developing critical thinking ability, decision making skills and problem solving behaviors (Grabe, & Grabe, 2021). In teaching Biology, ICT makes learning environment more enjoyable, motivating and attractive as it increases learners' attention to the subjects, thus increasing the effective teaching and learning process (Tomljenović & Zovko, 2016).

However, most Biology teachers are still relying on traditional teaching methods where they only use books as the only source of content for teaching. Some Biology topics have been found to be difficult in traditional teaching methods, so Biology teachers have to think abouthow ICT can simplify the task (Mwanda, Mwanda, Midigo & Maundu , 2017).

Integrating ICT in teaching Biology provides teachers with opportunities to bring the nature into classroom activities (Demkanin, Kibble,

Lavonen, Guitart, & Turli, 2008). The Edmodo interface, 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, Sivapragasam, & Senthamaraikannan, 2014). The research of Kareem, (2018), described how multimedia strategy used in teaching and learning process is one of the best methods to be adopted for making teaching Biology meaningful. Regardless to the importance of ICT in the teaching and learning process, its use was found to depend on different factors ranging from the simple to complex ones. Some of these factors are based on teachers' perception about its usefulness (Kafyulilo, Fisser, & Voogt, 2016), technical supports, professional development, ICT infrastructure, teachers' age and teaching experience (Unal, Ozturk, Onsekiz, & Education, 2017)

Factors that could influence the use of ICT in teaching

Teachers' perception Different studies have identified that teachers' attitudes and perception influence more on the integration of ICT in education (Sánchez, Marcos, González, & GuanLin, 2017, Player-Koro, 2017). This is in line with many educational theories explaining that the use of ICT in education is started by its acceptance, which could be associated with

teachers' attitudes (Koohang, 2019). Positive perception encourages teachers to adopt and use technology in their classrooms regardless of some challenges that may be found in this practice (Mustafina, 2015). Additionally, teachers with positive perception are likely to use available resources at maximum level while teachers with negative attitudes always remain complaining about the shortage of adequate materials to start using ICT in education (Norma, 2013). For the successful implementation of this contemporary paradigm, positive attitudes and good perception on its usefulness should be developed in teachers through provision of adequate trainings to the integration of ICT in their teaching practices. The study of Al-zaidiyeen, Mei, Leong & Fook, (2010) has found that the main predictor of teachers' ability to use ICT in education is their attitudes toward its use. Teachers' attitude is the most critical factors for influencing the use of ICT in teaching and learning process. In this line, the study of Prospery (2018) has found that positive attitudes towards ICT use have to be promoted as a necessary condition for integrating ICT in teaching and learning.

Technical and administrative support

Different researchers have found technical and administrative support to be very important in enhancing the use of ICT in classrooms (Priscilla, et

al, 2017; Butler & Sellbom, 2014). This is ensured through the provision of trainings for equipping teachers with relevant skills in using ICT in education and motivating teachers to use ICT in their daily activities. ICT related technical support was found to be helpful as it has been found that its lack may affect teachers' willingness in adopting and integrating ICT in teaching practices (Charles, 2017). Technical support is also needed for troubleshooting issues. In this regards, teachers should be trained on some basic techniques used in fixing some simple technical problems. This can reduce their anxiety towards the use of ICT in teaching and learning process.

In this context, school leaders should adopt strategies that will facilitate teachers to use ICT as the basic tool in their daily teaching practices (Charles, 2017). School authorities are the ones to set and discuss with teachers the visions and ICT policies in their schools and how the available resources may be shared appropriately. Similarly, school authorities have to keep a follow up on the implementation of ICT in education policy so that they might identify early the challenges encountered by teachers and find out the possible solutions as well. Motivation on using ICT in education should be more effective if it starts from school leaders. School administrators play a great

role in integrating ICT in education through acquisition and coordination of all resources required for ICT use in teaching and learning process.

Teachers' professional development

For effective implementation of any education program, teachers' professional development was found to play a great role. Professional development increases teachers' skills, morale and motivation (Baylor & Ritchie, 2022). In line with the integration of ICT in education, teachers have to be trained on different aspects of using ICT in classroom for reducing their anxiety hence increasing their confidence and ICT use willingness. These trainings should be tailored in relation to the teachers' needs in terms of integrating ICT in education. In this context, teachers have to be trained on trends of ICT in education, best application and web platforms for both teachers and students and how to create engaging and interactive multimedia content and presentation (Manuel, 2008). In addition, teachers may be trained on the best way of integrating ICT in education as well as how to use ICT in students' motivation and innovations in classroom (Mukuna, 2014). For teaching Biology, teachers need to be trained in the areas of using virtual laboratories, simulations and video presentation, sorting and treating data during teaching and learning process.

Even though teachers' trainings are at the heart of effective implementation of any education program, it has been found that teachers' trainings on using ICT in education are still low and inadequate (Afshari, Bakar, Su-Luan, Samah, & Fooi, 2009). The study of Baylor & Ritchie (2022) revealed that most of ICT teachers' trainings focus on general ICT skills but little consideration is given to specific skills for effective integration of ICT in teaching different subject. This may be the reason behind their nonsystematic use of ICT in the teaching and learning process as they don't have enough skills for integrating ICT in their daily teaching practices. Similarly, Belay, Khatete, & Chomba, (2020) have found that the trainings provided to the majority of Biology teachers were not adequate to help them in integrating ICT in teaching Biology.

Age and Gender Based on Global Gender Gap

Report, the gap among men and women is found all over the World in different forms of life (World Economic Forum, 2019). This gap has also been recognized in the ICT aspect where males dominate females in using ICT for different purpose (Laura, Laura, Joseph & Jeremiah, 2014). The level of integrating ICT in the teaching and learning process has been found to be different between men and women. The study of Birgin, Çoker, & Çatl,

(2010) has found that the level of using internet in women is lower compared to that of men. Consequently, women miss some opportunities for accessing useful information and online services. This low level of using ICT in women, was reported to be caused by their negative attitudes toward the new technology. In addition, it has been found that female teachers show lower computer skills and competencies compared to male teachers (Umar, Tarmizi, & Yusoff, 2014). In this line, educational institutions have to establish a clear plan for facilitating women to upgrade their skills and competences so that they may be involved in implementation of ICT in education policy effectively.

The study has also shown that males are more experienced in using ICT in education due to their positive attitudes towards its use, less computer anxiety and more confidence in using ICT than females (Volman, Van, Heemskerk, & Kuiper, 2022). In addition, the integration of ICT in teaching and learning has been also found to be influenced by the age of teachers. The young teachers have shown positive attitudes towards the use of ICT in teaching activities compared to the old teachers (Cathrine, 2008).

Availability of ICT resources

For integrating ICT in education in schools both hardware and software are needed. Several studies identified the lack and insufficiency of computers as one of the important obstacles in integrating ICT in the teaching and learning process (Pelgrum, 2021). On the other hand, Mumtaz, (2006) states that the lack of hardware and software is the one reason for teachers to not use ICT inclassrooms. Connectivity to electricity and internet facilities are also highly needed during the implementation of ICT in the teaching and learning process hence it can be difficult to use computers without electricity. In addition, internet is needed for teachers to get enriched content from different sources. Nevertheless, electricity and internet connectivity are in short supply, which continues to be a challenge in many African developing (Mathevula & Uwizeyimana, 2014). Based on the findings from different studies discussed above, it has been found that the effective use of ICT can influenced by different factors. In this regards, the present study, sought to investigate the level at which Biology teachers used ICT in teaching Biology and the challenges preventing the successful use of this current policy.

CHAPTER THREE

RESEARCH METHOD

Research Design

Research Design This study was conducted through descriptive study using survey design. Descriptive studies describe the state of affairs as they exist (Kerlinger, 2023). Survey designs provide numeric descriptions of some part of the population- representative sample from which a pointer to the population trend is established (Bell, 2022). Descriptive survey design enabled the researcher to obtain information on the state of ICT integration in the pedagogical teaching of Biology in secondary schools in Mumias Sub county by accessing opinions of students, teachers, head of Biological Science departments and Principals of the schools to asses the effects such integration has on pedagogical teaching of the topics (Best & Kahn, 2022). The approach to the study was both quantitative and qualitative.

Population

The population consisted of selected secondary schools in Ilorin west local government of kwara state having 100 students, 10 teachers and 10 Principal. All of these, are public schools. County, some private and sub-County secondary schools in the sub county are endowed with ICT resource

tools for pedagogical teaching. The researcher therefore felt that selecting 4 schools and one private school would provide a reliable picture of ICT integration in schools in the sub-county. Sampling Techniques The researcher selected 5 schools from a sampling frame of 49 schools selected through stratified sampling. This being a finite universe the researcher employed a sampling technique that could minimize bias in sample selection while at the same time being representative of the population. Two forms of probability sampling- stratified random sampling and simple random sampling were used to put schools into three categories- County schools, Sub-county schools and private schools. Four County schools and one private school were selected through random sampling. Teachers and student respondents were purposively or randomly selected in the schools while the Head teacher of the schools were selected for interview.

Sample of students.

After selecting the 5 secondary schools, a stream in forms 1,2,3 and 4 was randomly selected for the purpose of administering student questionnaire. Ten percent of students (5) in a chosen stream of a class were sampled for study. Where there was single sex systematic sampling was applied. Admission numbers were used where students were present in schools.

Admission register was used to obtain student admission numbers. Where both boys and girls were present the researcher strove to strike gender balance by employing stratified sampling method to separate boys and girls and thereafter get 10% of either sex through systematic random sampling. A total of 100 students from the schools were selected for study. Sample of teachers. A biology teacher in every school teaching a cross section of biology classes was selected through random sampling unless he/she was the only biology teacher. The most experienced teacher was purposively sampled where there was more than one Biology teacher. Sample of Principal. One Head teacher from each of the five chosen schools was subjected to an interview by the researcher. Principal from the three pilot schools were also interviewed. The researcher interviewed all of the eight Principal. Determination of Sample Size A sample is part of the target (or accessible) population that has been procedurally selected to represent it. It is any number of cases less than the total number of cases from which it is drawn (Ingule & Gatumu, 1996). The sample consisted of 5 secondary schools selected from 50 secondary schools in the Ilorin west. This represents 10% of the total number of secondary schools in the district. The sample size of students will be 10% of the number of chosen students in a class. The Principal of each of the sampled schools

will be interviewed Construction of Research Instruments The researcher used Questionnaires and interview schedule as the main instruments for data collection. The researcher was mainly concerned with views, opinions, perceptions, feelings and attitudes. Such information can best be collected through the use of questionnaires and interview schedules (Bell, 2022; Touliatos & Compton, 1988). Questionnaires for teacher, Students and Heads of department were semi-structured. This enabled the researcher to balance between the quantity and quality of data collected and on the other hand provides more information useful for a fuller explanation of the phenomena under investigation. Observation schedule was deployed to observe live lesson taught using ICT integration and students' responses. Questionnaires The researcher employed questionnaires for students, teachers and Heads of Biology departments. The semi-structured questionnaires gave respondents greater chance of expressing their views, ideas, opinions and suggestions on ICT integration. Quantitative and qualitative data was collected through the questionnaires developed by the researcher and modified by experienced teachers after undergoing Pilot study. Data from teachers questionnaires was used to cross cheek and supplement information provided by students on ICT integration. The questionnaires were administered by the researcher and

research assistant working under researchers' instructions. The heads of departments' supplemented information given by teachers and provided overall picture of ICT integration in all classes taught by various teachers. Student questionnaires had three sections-A, B and C. Section A dwelt on personal information, section B on preparedness of students in learning through ICT integration while section C was on ICT tools, integration process, challenges in the use of ICT integration in T/L and possible solution to the challenges. Teachers and HoD's questionnaire followed the same format but 'learning' had been replaced by 'teaching.' Interview schedules. Interview schedules-for Head teacher was used to collect information pertaining to the use of ICT in the schools in terms of availability, usage, challenges in usage, improvement in ICT infrastructure and training. Bode and Henry (1983) state that interviewing is an appropriate instrument for any study as it helps the interviewer to cover all the dimensions of the investigations through probing of the respondents Observation schedule.

Validity of Instrument

A valid instrument accurately measures what it is supposed to measure (Bennars & Otiende, 1994). According to Mugenda and Mugenda (2023), an instrument that yields valid data will necessarily yield valid information. The

validity of the instrument was determined by using long serving teachers in the district to judge how well the measuring instruments met standards through content (content validity). The instruments appearance – showing genuine features was checked to ensure originality (face validity). Comparison of the outcome of the prevailing conditions with the predicted outcome was made and correction made (criterion related validity). Experienced teachers in the county ascertained construct validity during construction of instrument by presenting it for review during piloting. The researcher also ensured that the scores from instrument accurately predicted a criterion measure by making amendments (predictive validity). Finally the results obtained using instrument was checked if they correctly correlate with other results (concurrent validity) and amendments made to make it valid. To establish validity, the instrument was given to two experts to evaluate the relevance of each item in the instrument to the objectives and rate each item on the scale of very relevant (4), quite relevant (3), somewhat relevant (2) and not relevant (1) Validity was determined using content validity index (CVI) .CVI = items rated 3 or 4 by both judges divided by the total numbers of items in the questionnaire. This is symbolized by n3/4/N. A coefficient of 0.80 or more will imply that the instrument is highly valid.

Reliability of Instrument

Reliability can be defined as the degree of consistency between the measures of the same kind. Kothari (2005) defines reliable instrument as that instrument that provides consistent results. The researcher ensured that responses from respondents are consistent across variables through testing and retesting the questionnaires. Students of the same class level and streams were used to ensure that the individuals do not vary their responses if the instruments were to be administered a second time (stability). Colleagues were encouraged to administer a copy of the same questionnaires to students and rectifications were made to ensure that errors made during administration or scoring of instruments is eliminated. The colleagues' scores were compared with the result obtained by using researcher's questionnaire (equivalent aspect) to enable rectification to be made. The instruments was piloted in the schools which were not be included in the study sample and modified to improve their reliability coefficients to at least 0.70. According to Kathuri & Pals, (2022) coefficients of at least 0.70 are acceptable as valid and reliable in research. Reliability involves formulating the main instrument - student and teachers questionnaires by splitting them into two halves, odd and

even with items sampled from the main domain of indicators measuring variables Respondents score in one part will be correlated with scores

Data Collection Technique

The researcher sought permission to conduct research from Principal of Schools and later used the privilege to interview the Principals and administer questionnaire to teachers, HODs and Students. The data was collected using questionnaires and Interview schedule. The researcher visited the schools under study before the start of research to familiarize with respondents and request for their cooperation made.

Data Analysis Procedures

Analysis is the computation of certain indices or measures along with searching for patterns of relationship that exists among the data group (Kothari, 2005). Since open-ended items were included in the semi structured questionnaire qualitative or non-empirical data generated required qualitative and quantitative techniques of data analysis. Data Analysis from Questionnaires Raw data obtained from the field using questionnaires for teachers and students were organized and edited for errors and omissions.

Data were separated into consistent component parts or elements separately and in relation to the whole. Data were then coded by assigning numerals and other symbols so that responses can be put into limited categories. It was important because the data was mainly descriptive hence requiring translation from qualitative to quantitative forms. After coding data was classified by arranging them into groups or classes to reduce the large volume and put them into homogenous groups to get meaningful relationship. They were then be analyzed by aid of statistical package for social science (SPSS) using descriptive statistics. Frequencies and percentages were mainly be used. Tabulation of the results was done by arranging same kind of data in a concise and logical manner to help answer research questions.

CHAPTER FOUR

RESULTS AND DISCUSSION

After analyzing data by using SPSS software, the findings were presented in different forms including tables and graphs as shown in the following section.

4.1 Demographic characteristics of the research participants

Information presented in the figure 1 below is related to the gender, age, and teaching experience of Biology teachers involved in the research.

Figure 1. Characteristics of Biology teachers
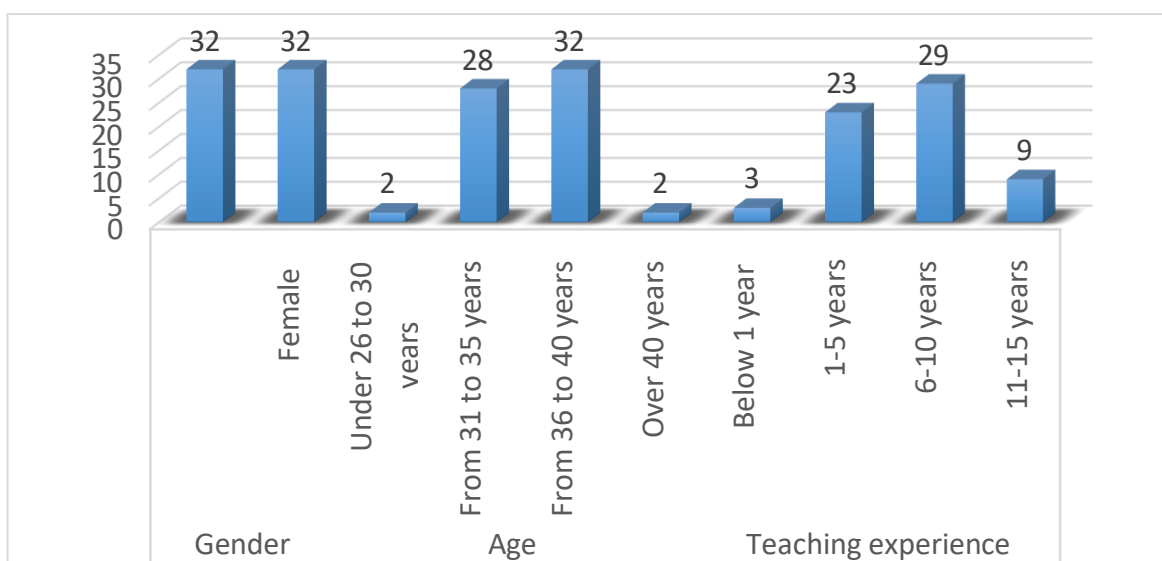
In the present study, it was important to know demographic parameters of the respondents as they might influence the level at which ICT was used in teaching Biology. As presented in figure 1 above, 32 (50%) Biology teachers were males while 32 (50%) were females, the equivalent number of male and female was purposely selected for having a shared contribution in providing

their views. On the other side, majority of Biology teachers involved in this research were between 31 and 40 years old. In this context, 2 (3.1%) Biology teachers were between 26 and 30 years old, 28 (43.7%) between 31 and 35, 32 (50%) between 36 and 40 while only 2 (3.1%) were over 40 years old. This variation of age among Biology teachers involved in this research showed that most of teachers were in active age to work so they were able to adopt the new technology that could help them in improving their teaching and learning process. Final demographic parameter that was investigated was the teaching experience. Generally, it was found that majority

of Biology teachers involved in research were experienced in teaching professional. Here, 3 (4.6%) had the teaching experience which was less than one year, 23 (35.9%) teaching experience ranging 1-5 years, 29 (45.3%) teaching experience between 6-10 years while 9 (14%) had the range of teaching experience of 11-15 years. Based on the relevant teaching experience for most of Biology teachers involved in this research, it could be better, if the ICT is used for transmitting their content knowledge in technological way.

4.1 Level at which ICT is used for teaching Biology

Figure 2 below summarizes the findings on the level at which Biology teachers use ICT in various aspects of teaching and learning process.
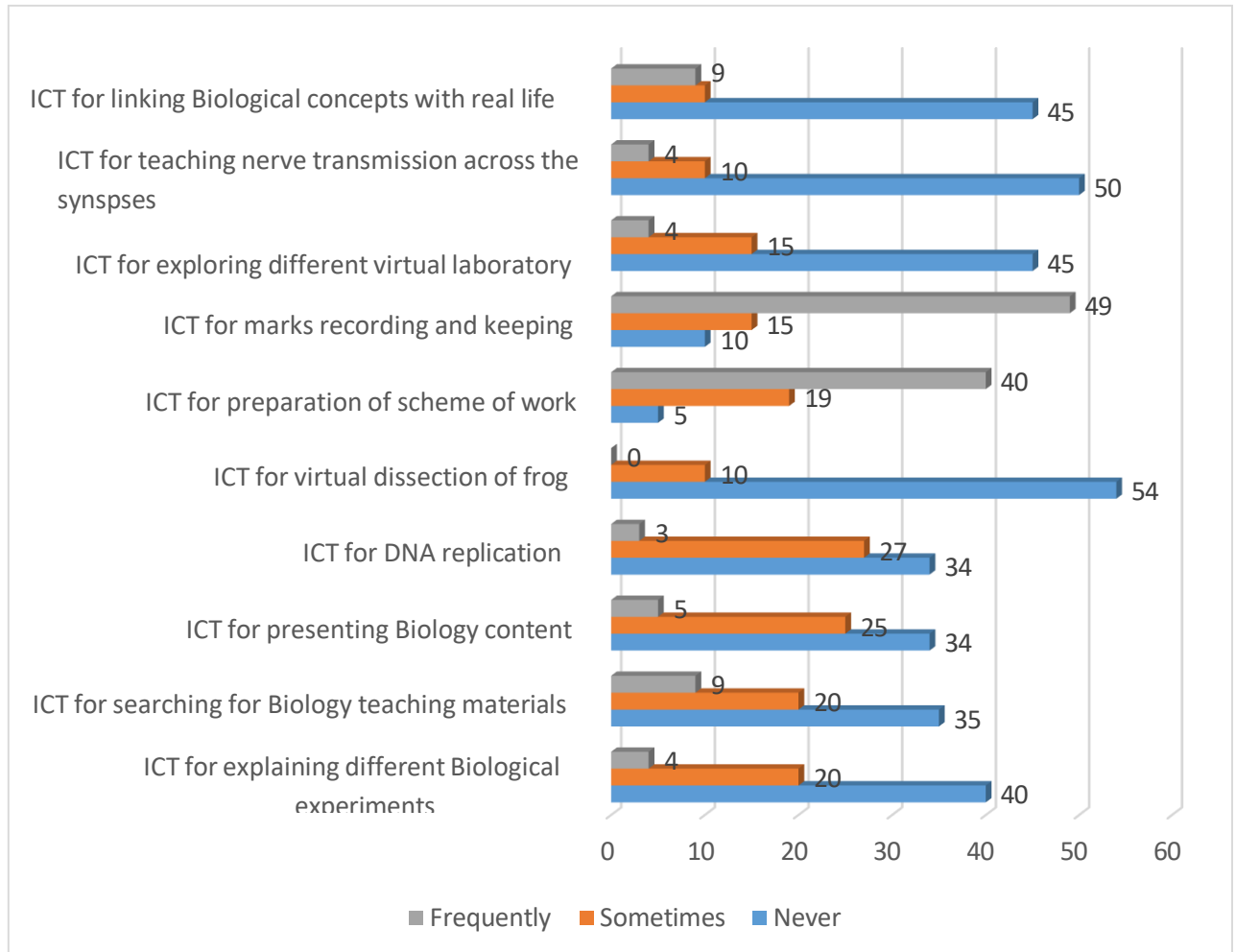

Figure 2: The frequency at which ICT is used in teaching and learning process (numbers are expressed in frequency per 64 Biology teachers)

Figure 2 above indicates that majority of Biology teachers used ICT in the general applications rather than focusing on specific use of this technology in teaching and learning of Biology. It has been found that ICT was highly used in preparation of Biology scheme of work (40/64 frequently used ICT) and students' marks recording and keeping (49/64 frequently used ICT). In line with the findings of Belay, Khatete, & Chomba (2020) indicating that majority of Biology teachers had received inadequate ICT training, the findings from this study also showed that ICT was not used specifically for teaching the specific topics in Biology that could be associated with the lack of adequate trainings for integrating ICT in teaching and learning Biology.

In this regards, 40 (62.5%) never used ICT in explaining Biological experiments, 35 (54.6%) never used ICT in searching Biology content while 34 (53.1%) never used ICT in presenting Biology content during teaching. Similarly, 54 (84.3%) never used ICT in dissection of frog, 34 (53.1%) didn't used ICT for explaining the process of DNA replication while only 4 (6.2%) Biology teachers explored different virtual laboratory experiments against 45 (70.3%) who never explored these platforms. 50 (78.1%) Biology teachers never used ICT in the teaching of nerve transmission, while 45 (70.3%) never used ICT for linking Biological concepts with real life context.

One of the trained teachers said: *"I have been trained on using ICT in preparation of notes, recording student marks and the way of storing documents in a computer. I have not been trained on how to use ICT in teaching Biology I have received".*

Based on the above research, it is clearly indicating a generic use of ICT in teaching and learning rather than being used specifically in teaching and learning Biology. These findings are confirms by the finding of Baylor & Ritchie, (2002) which revealed that most of ICT teachers' trainings focused on general ICT skills but little consideration was given to specific skills for effective integration of ICT in teaching different subjects. Therefore, most of teachers use ICT for general purpose as they have been trained in this aspect.

During the interview, most of Biology teachers claimed that they never received any training related to the use of ICT in teaching. One of the interviewed teachers said: *"I have been serving as Biology teacher in this school for 6 years, but I have never been trained on using ICT tools. My little ICT skills I have, comes from my fellow teachers who showed me how to use computer. Use of virtual laboratory in teaching Biology is new term for me".* However, some of the interviewed Biology teachers declared that they have

received some trainings on using ICT but these trainings were concerned on general use of the technological tools.

4.2 Challenges in using ICT for teaching and learning Biology

The use of ICT in the teaching and learning Biology may be influenced by different factors. Some of these factors were investigated and are presented in the table 1 below.

Table 1: Challenges in using ICT for teaching and learning Biology

STATEMENT	Strongly	Disagree	Neutral	Agree	Strongly agree	Total
Lack of technical support	6	26	1	25	6	64
	(9.37%)	(40.63%)	(1.56%)	(39%)	(9.4%)	(100%)
Lack of adequate training on using ICT for teaching biology	6	15	3	36	4	64
	(9.37%)	(23.44%)	(4.69%)	(56.25%)	(6.25%)	(100%)
Lack of consistency access to computer	9	24	0	2	29	64
	(14%)	(37.5%)	(0%)	(3.12%)	(45.3%)	(100%)
Poor internet connection	11	15	3	26	9	64
	(17.18%)	(23.43%)	(4.69%)	(40.62%)	(14.0%)	(100%)
Insufficient basic ICT tools	7	20	1	29	7	64
	(10.94%)	(31.25%)	(1.56%)	(45.31%)	(10.94%)	(100%)
	14	35	2	13	0	64

Inadequate electricity	(21.87%)	(54.69%)	(3.12%)	(20.31%)	(0%)	(100%)
	6	20	2	32	4	64
Lack relevant digital content (simulations, videos…)	(9.37%)	(31.25%)	(3.12%)	(50%)	(6.25%)	(100%)
The lack of materials for virtual laboratory tools	5	3	2	40	14	64
	(7.8%)	(4.6%)	(3.12%)	(62.5%)	(21.9%)	(100%)

Table 1 above presents the findings on the ratings (agreement and disagreement) of Biology teachers in relation to the challenges they faced in using ICT. Biology teachers had different perceptions on the challenges under investigation. In this context, 50% of the research participants disagreed on lacking the technical support in using ICT while 48.4% supported the statement. On the other side, the participants who lacked adequate trainings were 62.5% while only 32.81% disagreed with the lack of adequate trainings. This showed a gap in ICT training that may be a hindrance of effective use of ICT in teaching Biology.

The shortage of adequate ICT trainings among participants involved in this research concurs with findings of Afshari, Bakar, Su-Luan, Samah, & Fooi, (2009) who revealed that the ICT use trainings provided to teachers were low and inadequate. However, Baylor & Ritchie (2002) stated that professional development increases teachers' skills, morale and motivation. Yet a great

effort was made in terms of distributing computers across the schools around the country, 48.42% claimed to not have accessed a computer. This indicated a need of more effort in distribution of ICT resources, including computers in terms of ending gap among those who have access to computer and those with a limited access to it.

The shortage of computers is associated with the insufficiency of other ICT tools (55.31%), and digital content (56.25%) including the videos and simulations that could be used in teaching and learning Biology. Similarly, 54.62% claimed to not have access to adequate internet connection. However, electricity was found to be available in many schools (76.56%) except some schools (20.31%) which installed electricity in the staff offices only. It contrasts the findings of Njoroge, Margaret & Joab (2017) stating that the decisions made by teachers about the use of computers in their classrooms are likely to be influenced by the accessibility and availability of the relevant infrastructures.

During the interview with Biology teachers, it was found that most of interviewed teachers were challenged by insufficient ICT infrastructure like shortage of computers and unreliable internet connections. One of the interviewed Biology teachers claimed to have few computers in their

SMART classroom the reason why it was used in teaching ICT subject only. On the other side, another said that their internet connection was not powerful for downloading some simulations to be used in teaching and learning Biology.

Another key challenge investigated as a barrier for effective use of ICT in teaching and learning Biology was the lack of adequate tools and software (84.4% agreed) used in different virtual laboratory experiment in Biology like frog dissection, DNA replication and Nerve transmission across synapses. This hinders the successful use of ICT for filling the gap of physical laboratory shortage.

4.4. Effect of gender on the level of using ICT in teaching and learning Biology

The 3rd objective of this research was to determine the effects of gender on the use of ICT in teaching and learning Biology. In this regards, tables 2 and 3 present the findings related to t-test for evaluating the relationship between gender and use of ICT.

Table 2: Group Statistics

Gender	N	M	SD
Male	32	2.32	0.63
Female	32	2.16	0.54

SD: standard deviation, **N:** number of participants**, M:** Mean

Table 2 presents the descriptive statistics for males and females while table 3 presents the results on independent sample t-test. From table 2, it can be observed that the males had the mean of 2.3 and SD=0.63 while the females had mean of 2.16 and SD=0.54 indicating a certain difference in using ICT. To evaluate if there was a significant difference between males and females, an independent sample t-test was used at 0.05 level of significance.

Table 3: Results of independent sample t-test of teachers' means in males and

females

Gender	N	M	SD	t	Df	Sign
Male	32	2.32	0.63			
				2.508	62	.015*
Female	32	2.16	0.54			

: Difference is significant**, SD:** standard deviation, **N:** number of participants,

M=Mean, **df:** degree of freedom, **Sign**: significant level.

Based on the findings in table 3 above on the effect of gender to the level of using ICT in teaching Biology, it is clear indicated that there is a different in using ICT

between males and females (t=2.508, p=.015). In this perspective, males used ICT at high level (M=2.32) compared to their female counterparts (M=2.16). This is in line with finding of Volman, Van, Heemskerk & Kuiper (2005). In their study, they have found that males are more experienced in using ICT in education due to their positive attitudes towards its use, less computer anxiety and more confidence in using ICT than females. Additionally, it has been found that female teachers showed lower computer skills and competencies compared to male teachers (Umar, Tarmizi & Yusoff, 2014).

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

The integration of ICT in the teaching and learning of Biology has been shown to have a significant impact on students' understanding and performance. Here are some key points summarizing the findings:

- **Enhanced Learning**: ICT tools like multimedia presentations, online simulations, and virtual labs have been found to improve students' engagement, motivation, and achievement in Biology.

- **Teacher Utilization**: Many Biology teachers utilize digital tools such as Google search engine and Wikipedia to facilitate their teaching. However, there is a need for more training on how to effectively use these tools.

- **Challenges**: The high cost of internet subscriptions and slow internet speeds are major constraints to the effective utilization of digital tools in secondary schools

Conclusion

Based findings related to the level of using ICT in teaching and learning Biology as well as the challenges faced by Biology teachers in this integration, it has been found that the use of ICT still at low level. This low level could be associated with the lack of adequate trainings to Biology teachers and insufficient adequate ICT infrastructure. Teachers were found to be trained on only using ICT in general

purposed rather than being trained on specific applications of ICT in teaching and learning Biology. Few available ICT tools were found to be used in teaching ICT as subject because they were not enough to be shared with all teachers for teaching other subjects. However, a clear policy is needed in different schools for clarifying how the few available ICT resources should be shared for teaching all subjects towards the benefits of all students.

Recommendations

Based on inadequate use of ICT in teaching and learning Biology, it was recommended that, the government and other educational actors should assist secondary schools in getting ICT related infrastructure for enhancing the integration of ICT in the teaching and learning process for all subjects. Additionally, sufficient and adequate trainings are needed to empower teachers through the way of integrating ICT in the teaching and learning process. Furthermore, the plans of sharing the few available ICT resources should be developed by schools' administrators in terms of encouraging all teachers to use ICT in teaching their respective subjects. Motivation and encouragement to the left behind groups like: females and old teachers in terms of using ICT in their pedagogical activities are also needed.

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