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DEPARTMENT OF SCIENCE AND MATHEMATICS EDUCATION

**INTEGRATION OF EDUCATIONAL TECHNOLOGY INTO ORDINARY LEVEL
BIOLOGY LEARNING ACTIVITIES AT CHADEREKA SECONDARY SCHOOL**

BY

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**A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS OF THE BACHELORS OF SCIENCE EDUCATION HONOURS
DEGREE IN BIOLOGY**

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DECLARATION

I, Makosa Ian, do hereby declare that, except for the references to other people's work which have been duly acknowledged, this dissertation is a result of my research and has neither in part nor in whole been presented in the education programme

Signed: I.Makosa

Date: 24.06.24

(Student)

APPROVAL FORM

The under signed certify that they have supervised, read and recommended to the University for acceptance and examination a research project entitled: ***Integration of educational technologies into Ordinary Level Biology teaching and learning activities at Chadereka Secondary School***. Submitted by Makosa Ian in partial fulfilment of the requirements for the award of the Bachelor of Science Education (Honours) Degree in Biology.

Supervisor:



Date: 24.06.24

Dr. P. Chikuvadze

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Also of importance are my sons, Ian Jr., and his two brothers, Neville and Apostacy. The trio's comforting presence and camaraderie have made a significant difference and enabled me to pursue my dreams.

DEDICATION

I dedicate this project to the Makosa family, especially the Makosa brothers whose passion for knowledge and perseverance have inspired me to reach this milestone. May this achievement bring pride and contribute to the pursuit of knowledge and make a positive impact on the lives of others.

ABSTRACT

The study sought to explore the integration of educational technologies into the Ordinary Level biology teaching and learning activities. Data generation, analysis and discussion were grounded in an Interpretivist paradigm and qualitative approach. The five who formed the sample were purposively selected. From the findings it was noted that numerous educational technologies (mobile phones, personal computers, simulations, virtual laboratories, among others) were integrated into Ordinary Level Biology teaching and learning activities. It can be acknowledged that teachers were prepared through seminars, workshops and teacher capacity development programme to integrate educational technologies into Ordinary Level Biology teaching and learning. It was revealed that educational technologies were integrated into Ordinary Level Biology teaching and learning through approaches such as PBL, Project-based learning, design-based learning, etc. From the findings, it can be concluded that educational technologies to a certain were integrated into Ordinary Level Biology teaching and learning. Based on the findings, it can be recommended that the school should incorporate adaptive learning algorithms to cater for individual differences and deliver customized learning experiences, which are tailored to the unique needs of the individual learner.

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CHAPTER 1:

PROBLEM AND CONTEXT

1.1 Introduction

Chapter 1 one contains background to the study, Statement of the problem, research objectives, significance of the study, delimitations and limitations of the study, definitions of terms and lastly, the chapters layout

1.1 Background to the study

Zimbabwe inherited a type of education curriculum that was grounded in a teacher centered approach, that produced learners who lacked practical appreciation in their areas of specialty, and there-fore, irrelevant to the societal needs (Gumindoga & Muzhingi, 2017). The government set up the Nziramasanga Commission of 1999 to interrogate the education system from basic up to higher education, with the view to provide possible solutions to the identified deficiencies (Munemo, 2019). One of the findings of the commission was that Zimbabwe inherited a curriculum that was largely theoretical at the expense of marrying theory to practice (Makumbe, 2015). It is against this background that the curriculum framework (2015-2022) was adopted as it gives much emphasis to the acquisition of knowledge, skills and values as learners interact with their environment (Muchanechiya & Mufanechiya, 2020). In addition, this new thrust to teaching and learning in schools called for the inclusion of Information Communication Technologies (Ngwenya, 2020).

In line with the above idea, a number of educational technologies such as online learning platforms, virtual laboratories, among others have been adopted in teaching and learning activities in Zimbabwe (Muchenje, 2016). There are limited studies (Musamba, 2018; Marimo, 2019; Rusike, 2019), that have mostly focused on challenges faced when using educational technologies in urban schools. There are gaps around how educational technologies are integrated in teaching and learning activities in marginalized secondary schools in Zimbabwe. It is in this context that this sought to gain insight into the integration of educational technologies in Ordinary Level Biology teaching and learning activities at the targeted marginalized secondary school.

1.3 Statement of the problem

Ideally, Biology teaching and learning activities are expected to involve learners' direct interaction with the real objects (Anazifa, 2021). Thus, it calls for a hands-on approach to learning experiences as they seek to acquire the relevant knowledge, skills and values through the use of educational technologies in line with requirements of the curriculum framework 2015 – 2022 (Nherera, 2018). However, concerns have been raised on issues around the integration of educational technologies into the Ordinary Level Biology teaching and learning activities. It is from this research gap that this study sought to contribute to the raised issue guided by the following question: To what extent are educational technologies integrated into Biology teaching and learning at the selected marginalized secondary school?

1.2 Research questions

It is from the main research question that the following questions have been drawn:

1. What educational technologies are being integrated into Ordinary Level Biology teaching and learning?
2. To what extent are teachers prepared to integrate educational technologies into Ordinary Level Biology teaching and learning?
3. How are educational technologies integrated into Ordinary Level Biology teaching and learning?

1.4 Significance of the study

The findings of this study are expected to benefit the following in one way or other:

1.4.1 Policy makers

The curriculum designers will find the study useful as it enables them to evaluate the curriculum, in terms of its relevance or irrelevance in the ever-changing economic environment of our nation.

1.4.2 Biology teachers

Biology teachers are set to benefit from this study in many ways, which include using the information in the district and cluster workshops for staff development purposes. Since the main thrust of the study is the integration of educational technologies in Biology teaching and learning, biology teachers will be inspired to embrace technology to improve the quality of class room instruction. Teachers will also be enabled to offer project-based teaching, and use platforms such as Moodle, Google meet and Classroom to create their lesson, interact with their students and assign work. With educational technologies acting as the source of knowledge, the teachers will assume the role of a facilitator and mentor.

1.4.3 Learners

The study is also an effective tool to help learners, especially those studying Science subjects at ordinary level. It enhances computer literacy in students, and improves their critical and interacting skills. As they interact with their gadgets, learners are molded into responsible, and innovative citizens, who can provide answers or solutions to day-to-day problems.

1.4.4 Bindura University of Science Education

The findings of this study will help Bindura University of Science Education to design a curriculum that will equip and prepare Science Teachers in terms of Computer literacy, making them effective tools in using educational technologies to improve their pedagogical practices. Bindura University will evaluate its curriculum, to see if it is relevant to the modern trends of education. On the other hand, the university will find ways to enhance courses like Basic computer skills, Introduction to Computer Science and Educational Technologies with a view to improving teachers' capabilities in organizing lessons, assessing, evaluating and interacting with students on a learning platform.

1.4.5 Researcher

The study will help the researcher to come up with innovative ways to enhance the learner centered approach through educational technologies. The study will also help the researcher to understand how best educators can use educational technologies to improve classroom instruction. On the other hand, the study will inspire other researchers in the area of educational

technologies to spot research gaps and contribute to the ongoing investigations that are carried out to understand educational technologies.

1.5 Delimitation of the study

The Ministry of Primary and Secondary Education in Mashonaland Central Province, has seven administration districts: Rushinga, Mazowe, Bindura, Shamva, Muzarabani, Mbire, and Guruve. The study was conducted in Muzarabani District, which has 13 schools, all of which offer basic education from Form 1 - 4 guided by the dictates of the curriculum framework (2024 - 2030). In the targeted district the study focused on Chadereka Secondary School, with a staff compliment of 7 and an enrolment of 184 learners. At the selected marginalized secondary school focus was on exploring the integration of educational technologies into Ordinary Level Biology teaching and learning.

1.6 Limitations of the study

The research was conducted during second term and it was limited by the amount of time that was available to engage the educators and the students. The school policy required them to prioritize other activities like ball games, teaching and learning, hence, the researcher had little time to engage them.

1.7 Definitions of the key terms

In this section the selected terms are defined contextually:

1.7.1 Integration

In this context, it means associating or combining the educational technology tools with the teaching and learning activities. This can involve the seamless blending of technology tools and resources with traditional teaching methods to create a more interactive and engaging learning environment for students (Murithi, 2021). It encompasses the use of digital tools such as interactive whiteboard, educational soft wares, online resources and multimedia content (Mukandi & Pisirayi, 2020).

1.7.2 Educational technologies

Refers to the combined use of computer hard ware, software, and educational theory and practice to facilitate learning, (Alkhalifah, 2020). This encompasses the application of various technological tools and ideas to support and enhance teaching and learning processes in educational settings. Al-Hasani (2017) says it involves the use of tools such as interactive white boards, educational software, cloud-based learning, gamification online resources, multimedia content; among others.

1.7.3 Ordinary Level Biology teaching and learning

This refers to the level of education that is typically completed after primary education and before education. Ordinary level is often used to refer to exams that the students take at the end of their secondary education (Allen & Seaman, 2019). These are activities or tasks that are designed to help students learn about Biology concepts, such as laboratory experiments, simulations, or problem-solving exercises (Bryman et al., 2015)

1.8 Chapter layout

Chapter 1 puts the problem and its setting into context; chapter 2 outlines the theoretical framework that forms the lens through which the study will be observed. In addition, the gaps to be filled by this study will be identified; chapter 3 outlines the strategy through which data for this study will be generated, analysed, and discussed; chapter 4 explores the generated data through analysis, and discussion with the view to providing answers to sub-questions raised in chapter one. Chapter 5 gives an overview of the study, conclusion and recommendations.

1.9 Chapter summary

In this chapter, the gap to be filled by the study was identified, by giving the following topics specific attention: statement of the problem, significance of the study, delimitation of the study, and limitations of the study. In addition, key terms were contextually defined. Chapter 2 focuses on the discussion of relevant literatures.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 Introduction

Chapter 1 focused on an overview of the problem and its setting. Chapter 2 will identify gaps in other related research studies and try to fill them. Furthermore, it will outline the theoretical framework upon which the research study hinges. This will include the relevance of educational technologies in teaching and learning, methods to prepare the educators for the integration of educational technologies, strategies of integrating educational technologies and lastly, the associated challenges.

2.2 Theoretical framework

This section centers on the theoretical lenses that give guidance to this research study, in this case, Connectivism and Behaviorism theories to provide valuable insights into modern teaching and learning, with the assistance of educational technologies.

2.2.1 Behaviorist

Behaviorism is a psychological theory that focuses on observable behaviors and discounts any independent activities of the mind, by emphasizing on the role of stimuli and responses in shaping human behavior and treating learning as a response to stimulus (Ertmer, 2016). According to Holland (2017) the theory suggests that all behaviors are learned through interaction with the environment, in this case, learners can use their devices such as computers and smart phones that are connected to the internet to interact with their environment. The educational technologies offer the stimulus that results in a behavior change, through gamification (Isaboke, 2021a). Gamification refers to the application of game design elements and principles to engage and motivate students. It involves incorporating game like features such as points, rewards and challenges into activities to enhance user engagement and drive desired behaviors (Isaboke, 2021b).

A great example of behaviorism in educational technology, according to Lyton, et al (2021) is the website called Brain-Pop. This instructional website hosts videos that explain a variety of educational topics and are immediately followed by a short quiz, after which, based on the outcome, students can access their own understanding of the video and content material. On the other hand, Ford (2017) highlights that the results are shown immediately upon completion and provide succinct explanations to help students better understand. Reid (2015) adds that students will be willing to put forth more effort after reinforcement of higher scores. In this case, the key is the instantaneous responses and grades, which can be a source of praise and criticism, both of which are strong factors in student performance. According to Brett (2019), another newer technology that is utilizing both gamification and behaviorism is Class Dojo. Furthermore, teaching and learning are processes of conditioning students to properly react to stimuli, and technology can help facilitate this training by providing incentives in the form of various rewards such as social treasures, sweep stakes and balanced point systems, to encourage desired behavior (Snoeyink, 2015).

2.2.1. Connectivist

Connectivism is an innovative learning theory that emphasizes that, in order to learn effectively, students should embrace the integration of thoughts, theories, and information that one experiences when using modern day technology (Priestly, 2015). On the other hand, Abdi, (2016) says connectivism underscores the pivotal role of digital tools in modern education, recognizing that our era of connectivity offers limitless avenues for shaping our learning journey. The same source holds that the process and goals of learning in a highly networked and connected world is different than learning in the predigital world (Kleiner, 2017). Thus, learners are persistently connected to information sources and other resources through their electronic devices, such as smartphones or laptops (Mellinger, 2017).

According to Kizilcec and Seaman (2019), some still believe that learning experiences and processes as they exist in the real world are not fully represented, and this has become especially obvious now that we live in a society that is heavily networked and connected via electronic and social media. In other words, technologies in particular lead us to consider whether all memory, information processing, and other aspects of learning traditionally ascribed to the mind might not also be distributed with external device (Ajinomoh, 2017). From the connectivism point of view

learning needs not be isolated from the mind (Munemo, 2015). Thus, the goal of teaching and learning is to connect learners with one another, and with information resources, in a manner that is persistent and in which learners can make ongoing use of the network to solve problems. Connectivism has emerged, providing updated methodologies suited for tech-driven era, and to the educators and students alike, connectivism is a key to nurturing a conducive, modern learning environment (Wilson, 2015).

Connectivism has been included in this study because of its emphasis on the role of technology and networks in the learning process. Educational technologies have embraced Connectivist principles by leveraging digital platforms, social media and online resources to facilitate learning experiences that align with the connectivist theory (Steinke, 2015). In the context of educational technology, connectivism has several advantages that include: collaboration and networking. Taherdoost, (2017) explain that learners can connect with peers, experts and resources across global networks, fostering collaborative learning and knowledge sharing. Connectivism cannot be separated from educational technology; and from this study as it allows rapid information retrieval. Buell (2024) notes that the use of educational technologies enables quick access to information, which allows aligns with the connectivist view of learning as the ability to navigate and evaluate information within a networked environment. Machin (2015) high lights that connectivism and educational technology are intertwined in their focus on leveraging digital platforms, networks, and information resources to support a distributed and networked approach, and hence, cannot be excluded from this research study

2.3 Relevance of technologies to teaching and learning

Indra (2020), notes that educational technologies are tools that are used to support teaching and learning such as online learning platforms that including for an example, the Artificial Intelligence systems, the virtual laboratories, use of whiteboards, projectors; among others. According to Tuli (2015), the integration of educational technology in teaching and learning is of paramount importance both to teachers and students. Educational technology allows educators access to a wide range of resources, such as to customize instruction to each students' pace and learning style, and facilitate remote collaboration between teachers and students (Rusike, 2017). Furthermore, educational technology improves teaching profession where teachers must be able

to adapt to different kinds of technologies that have developed rapidly, for instance, Artificial intelligence system and the virtual laboratories (Iqbal et al., 2023).

Kebritchi and Santiago (2017) note that an understanding of robotics, programming and Artificial Intelligence is becoming a very valuable skill amidst the industrial revolution and rapid technological development, calling for educational technology. It is also important in contributing to the society which is increasingly becoming connected and automated (Stephenson, 2015). Technology may also help students to acquire critical thinking, creativity, and problem-solving abilities necessary to meet the demands of a more digital work place (Etikan, 2017). Furthermore, technology can reduce barriers such as cost, distance, time, language, disabilities that can prevent students from getting an education. Online courses can offer flexible and financially affordable learning (Liao et al., 2017). Lina et al (2023) note that students work with video conferencing tools to interact with experts from various fields of domains. Educational technology prepares students for the demands of the modern workforce by equipping them with essential digital literacy skills and exposing them to emerging technologies (Thames, 2016). On the other hand, Hariyadi (2023) educational technology enhances engagement and motivation by providing interactive multimedia rich learning experiences that captivate students' interest and stimulate their curiosity.

Students, technology facilitates personalized learning experiences tailored to the individual needs and learning styles of the students (Hamond, 2016). Adaptive learning platforms use data analytics and machine learning algorithms to customize instruction based on students' performance and progress, ensuring that each student receives targeted support and challenges appropriate to their level (Muchenje, 2016). Educational technology can foster creativity and innovation by sharing their own content and knowledge, and moreover, it allows students to learn at their pace, level, style and needs, according to their interest, and goals (Golam & Kusakebe, 2018). According to Cahya and Ahmadi (2020) educational technology can also provide feedback, guidance and support to students, and can provide students with easy access to information, accelerating the learning process and offering enjoyable opportunities to practice what they learn.

2.4 Methods used to prepare teachers for the integration of technologies in teaching and learning

The following strategies prepare the teachers for the integration of the educational technologies:

2.4.1 Workshops and seminars

Dambudzo (2015) highlights that attending these events provides teachers with actionable insights and training to enhance their teaching techniques and integrate educational technology into their classrooms. Workshops, on the other hand, help to unlock student success by offering tracks to customize learning, including cybersecurity training and hundreds of other resources, (Cooper, 2017). On the other hand, Olowe, (2016) further highlights some works are important since they offer educational specialist certification pathways, providing additional certificate courses designed for teachers.

Seminars on the other hand, are always held in small groups, sometimes at school, where educators share ideas on the integration of educational technologies in teaching and learning, (Madzudzo, 2019). According to Agonafer (2015), attending seminars offers teachers course specific instructional support through the integration of educational technology. Abubakari (2021) says seminars have several advantages such as interactive learning, allowing participants to engage in discussions, ask questions, and share their perspectives. Furthermore, seminars are a way of improving skill development as students practice skills required for effective communication and critical thinking, fostering their intellectual growth and academic development (Fathurrochman, 2021).

2.4.2 Professional development programs

According to Akram (2021) it is part of the government's ongoing effort, through the Ministry of primary and Secondary Education to offer educators professional development courses in the use of educational technology. This includes the use of various educational technologies and multimedia tools. The purpose is to equip teachers with skills in using the educational technologies like Artificial Intelligence tutoring system and virtual laboratories, among other tools to effectively deliver classroom instruction (Gonzalez et al., 2017)

The professional developments programs enhance teaching skills as they provide teachers with the opportunity to enhance their teaching skills by learning how to effectively integrate technology into their lesson plans and classroom activities. Furthermore, (Caulley, 2018a) notes that educational technology is evolving, and attending professional development programs allows teachers to stay current with the latest tools, trends, and best practices in the field of educational technologies. On the other hand, professional development programs often provide teachers with access to valuable resources such as workshops, training materials and networking opportunities which can further support teachers with their efforts to integrate technologies into their teaching practices (Caulley, 2021b).

2.4.3 Pre-service and in-service training

Ghavifekr and Rosdy (2015) say that it is a prerequisite nowadays that teachers undergoing training, should have basic computer skills that they will use in their entire teaching life to design the lessons, interact, and evaluate their students' performance through learning platforms. The pre-service training is designed to produce educators who are relevant to the modern ways of classroom instruction (Devers, 2017). The government and donors alike, sponsor short courses on the use of educational technologies, as part of the in-service training (Igbal, et al., 2023). On the other hand, in-service training is equally important as it allows practicing teachers to continuously improve their teaching skills, stay updated with the latest educational practices, and address specific areas of professional development (Jasi, 2018).

2.5 Strategies to integrate educational technologies in teaching and learning

Various strategies can be used to integrate technologies in teaching and learning. These are:

2.5.1 Technology enhancement instruction

This strategy involves using technology to support the delivery of instruction, such as using interactive whiteboards, educational software, and online platforms. These enable educators to facilitate and act as guides throughout the learning process (Musamba, 2018). According to Makumbe, (2015), training teachers on technology enhancement instruction is crucial for improved learning outcomes, as it has the potential to improve learning outcomes. This can only

be realized if the teachers are equipped with necessary skills to effectively apply it. On the other hand, schools can benefit from the technology enhancement instruction, by reducing the costs of physical instructional materials and enhancing educational program efficiency, (Mayer, 2016). This can also be realized if the teachers are equipped with necessary skills through technology enhancement instruction

2.5.2 Flipped learning

According to Dash (2019) flipped learning, or flipped classroom is a pedagogical strategy that inverts the traditional method of instruction. Garraway, (2016) further highlights that instead of lecturing in class and assigning homework for students to complete, under this approach, students watch their teacher or other instructional content outside of class through videos, e-books, or other digital resources and use classroom time for activities like problem solving, discussions, and hands projects. Koehler (2015) also noted that flipped learning increases students' engagement and learning by having them interacting with course content outside of the classroom, leading to higher levels of engagement. On the other hand, Jones, (2021) notes that flipped classroom approach promotes efficiency in learning and construction of knowledge through social interaction, emphasizing the need for teachers to be trained in this method. Furthermore, if teachers are trained on the flipped learning approach, it fosters in them, a positive student perception. According to Mendicino (2016), a case study in teacher training reported positive perception from the students and concluded that the flipped learning reported positive perceptions from students, and concluded that the flipped learning model should be embedded in teacher training programs, highlighting the importance of training teachers in this method.

2.5.3 Project-Based learning

Cleland (2017) says this approach involves educators assigning students projects that require them to use technology to research, design, and create solutions to real world problems. Training teachers to integrate Project based learning is crucial for the following reasons. According to Ramesh, (2017) teachers need training practice into larger projects within a PBL unit, ensuring students can develop essential skills while engaging in meaningful projects. On the other hand, Shute (2017) highlights that proper training equips teachers with knowledge and strategies to effectively implement PBL in the classroom, ensuring that students benefit from this approach.

Marion, (2020) notes that there is a need to prepare teachers for PBL, enabling them to design engage projects, facilitate learning and emphasize inquiry. Moroder, (2016) also says training teachers PBL does not only empower the students, but also ignites excitement for learning, discovering and questioning, which brings educators much fulfillment, hence, training teachers to facilitate this process is essential. allows real-world applications, where students work on projects that are relevant to the real world, designed to engage them in learning processes and develop skills that are relevant in their future careers. On the other hand, Project-Based Learning offers collaborative work, where students work in teams, from which they develop communication skills, team work and leadership skills (UNESCO, 2017).

2.5.4 Gamification

Gamification refers to the application of game design elements and principles in non-game context such as education to engage and motivate individuals (Soltani, 2020). This is one of the most important strategies employed in integrating technologies in teaching and learning (Gee, 2017). From the behaviorist perspective, reinforcement and punishment play a major role in the observable behavior of students (Toma & Gomez, 2019). On the other hand, Bryan, (2015) says gamification uses points, badges and leaderboards to provide positive reinforcement for learners who complete tasks or demonstrate mastery of skills, and that rewards act as a crucial component of the system, serving to motivate and reinforce desired behaviors. On the other hand, gamification includes points as a currency of reward system. According to Wilson and Taylor (2010) say points serve as the currency of the reward system in gamification. They are used to incentivize and reward specific actions or achievements within the gamified environment. Gamification also plays an important role by balancing the rewards against effort. Sharpe and Abrahams (2019) note that balancing the rewards against effort ensure that the rewards offered align with the level of effort exerted by the individuals, preventing unforeseen issues within the gamified system.

2.6 Challenges faced when integrating the educational technologies in Biology teaching and learning

Various challenges can stand in the way of infusing educational technologies in teaching and learning activities.

2.6.1 The need for regular update of gadgets' software

Regular updates of gadgets can impact the integration of technology, particularly in educational and professional settings (Nasution, 2021). Agustina et al (2022) say the need to constantly update gadgets to keep up with the latest technology can be financially burdensome for educational institutions and students. Technologies that require frequent updates may demand additional resources and efforts to ensure that users are equipped with the necessary knowledge and skills to effectively utilize the updated tools (Angga et al., 2022). Educational institutions, students, and teachers need to update regularly, whatever learning tools and applications they use. This puts an additional burden on them as they must continuously check software updates, upgrade their devices, buy new devices, among others, to keep pace with the current educational technology trends (Ferreira, 2017).

2.6.2 Resistance to change

Resistance to change can significantly affect the integration of technology in various settings. When individuals or organizations resist to adopt new technologies, it can impede the successful implementation and utilization of technological tools and solutions (Korstijens, 2018). On the other hand, Miladiah et al (2023) high light that fear of the unknown among stakeholders often makes parents, learners and teachers resist the integration of educational technologies in Biology teaching and learning. The teacher-centred approach still dominates, considering the nature of the long syllabi that need more time to cover (Mukandi et al., 2020). This makes the use of educational technology seem more time consuming than the traditional way of delivering classroom instruction, in terms of content coverage (Rosidah & Susiloningsih, 2021).

2.6.3 Resource or infrastructure support

Muchenje (2016) says educational technology applications or devices need internet support for functions like video streaming, online chat, video calling, and so on. On the other hand, Ondimu

(2018) says internet connectivity with higher bandwidth and reliable devices are necessary for operating any educational technology apps or tools. Thus, schools, teachers, and students need to have these resources support. At times, parents, guardians or even schools, cannot afford to purchase data bundles for a private Wi-fi, which has a negative impact on learning (Muneja, 2015).

2.6.4 Limited technical skills

Limited technical skills can pose a significant challenge to the integration of technology. According to, Nkya et al (2021) the ability of individuals to effectively use and adapt to new technologies is crucial for successful integration. Without adequate technical skills, the adoption and utilization of technology may be hindered (Wambua & Waweru, 2019). The education sector demands that teachers and students should have basic technical skills and expertise (Martin, 2013.)

2.6.5 Intermittent network blackouts

Poor network coverage is a contributory factor in hampering the effective infusion of educational technologies when using gadgets that require internet connectivity (Chivasa, 2018). In a rural setup, base stations are spaced and the network strength is affected by physical barriers such as mountains and valleys, further worsening the situation, (Devers, 2017). Poor quality service by Mobile Service Operators such as NetOne, Telcel, and Econet can be attributed to a lack of competition in the country (Ndiokubwayo et al., 2019). Furthermore, frequent power outages cause weak signals and unstable networks which can be experienced even in urban areas (Madzudzo, 2018).

2.7 Chapter summary

Chapter 2 has mainly focused on the theoretical framework, which is the foundation upon which the study stands. Furthermore, it has looked at the relevance of educational technology, the associated challenges, the methods used to prepare the teachers for its implementation, and the strategies to implement it. Chapter 3 will focus on the research paradigm and approach, the methods to generate data.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

Chapter 2 mainly focused on the theoretical framework of the research study, the strategies used in integrating educational technologies; and associated challenges. Chapter 3 will focus on the research methodology used to collect data. The main focus will be on the research design (research paradigm and approach), sample and sampling procedure, data generation procedure, data presentation and analysis procedure, research integrity, and chapter summary.

3.2 Research paradigm

Sitenei (2020) defines a research paradigm as a method, model, or pattern for conducting research. It is a set of ideas, beliefs, or understandings within which theories and practices can function (Omotayo et al., 2016). This research is guided by the interpretivist paradigm which believes that the world is complex, and is open to different interpretations, or multi realities, (Ndayambaje, 2018). An Interpretivist paradigm is valuable in this context as it focuses on understanding the meaning and interpretation of these experiences (Khanna & Mehrotra, 2019). According to Andiema (2020) an Interpretivist paradigm further allows researchers to understand phenomena through the meanings that people assign to them, facilitating a deeper understanding of social life and human experiences. The researcher used this paradigm for the following reasons. An Interpretivist approach allows researchers to delve into the subjective meanings and interpretations of individuals or groups, providing a deeper understanding of complex social phenomena (Corner, et al., 2019). On the other hand, an Interpretivist paradigm embraces the subjective and contextual nature of human experiences, acknowledging that individuals' interpretations are influenced by their unique perspectives and social contexts (Ramoupi & Ndille, 2017). Furthermore, Mwabora and O'Connor (2019) say it generates a rich understanding of the research questions being investigated, and it leads to nuanced insights that quantitative methods cannot capture.

3.3 Research approach

A research approach is a broad framework or perspective that guides the way a researcher conducts their study (Muneja, 2015). On the other hand, Sifuna and Obonyo (2019) further highlight that the approach emphasizes the importance of understanding the subjective experiences and perspectives of individuals, and seeks to uncover the meanings and significance of social phenomena from their perspective. This study used the qualitative approach to generate data and analyse them. This involved generating and analysing non-numerical data to understand concepts, participants' opinions and experiences (Jarodzka et al., 2017). This approach provided answers concerning the issue under investigation to who, where, what, and how questions (Allen & Seaman, 2019). In this regard, it helped the researcher to gain an in-depth insight into the issue under investigation.

3.4 Method

According to Madzudzo (2019) this involves reviewing and analyzing documents such as educational policies, curriculum, and statistics to gain insights into educational systems. Hence for this study, the researcher used the following methods:

3.4.1 Document analysis

Document analysis is a method used in qualitative research to gather and analyze information from written or printed documents, (Kizilcec et al., 2015). These include policy documents, government reports, textbooks, curriculum materials, diaries, letters, or other written materials. The researcher used documents such as the attendance registers, text books, and record of marks. These documents provided valuable insights into student attendance patterns, content taught, academic performance and overall engagement (Andiena, 2020). On the other hand, Acquah and Borkloe (2017) noted that the attendance registers, the syllabi, the record of marks and other professional documents are used to understand trends, identify correlations and make informed decisions related to educational practices and student support.

3.4.2 Interview

Kizilcec, et al (2015) define a structured interview as a type of interview where the researcher asks the same set of questions to all participants in the study. In support, Jasi and Shumba (2018) highlighted an interview as a key method used in a study to provide rich and detailed insights into the experiences, perspectives, and meanings of individuals and groups. The interview questions revolved around the following areas: educational technologies used in teaching and learning, challenges faced in the integration of educational technologies in teaching and learning activities, and the strategies to overcome such problems. Heffernan (2017) notes as a way of triangulating the data generated from the key informants, the school authorities should be interviewed. The researcher also interviewed the head and deputy head of the school as a way of triangulating the data generated. This method was included in this research study as it allowed the researcher to gain in depth understanding of participants perspectives, experiences and attitudes, providing rich qualitative data that can offer insights not easily obtained through other methods (Creswell, 2014). On the other hand, Amutabi (2019) notes that interviews provide the opportunity for probing and follow up questions, enabling researchers to delve deeper into specific responses and explore nuances in participants answers.

3.5 Sample and sampling procedure

A sample is the specific group of people or units (such as schools, classes, or countries) that are selected for participation in a research study (Koedinger, 2015). On the other hand, Hamond (2018) highlights that a sampling procedure is the method used to select the sample from the larger population under study. In this study, the researcher used a type of non-probability, sampling technique termed purposive sampling. Atikiya (2021) defines purposive sampling as a type of non -probability sampling method where units are selected for inclusion in the sample due to their characteristics, knowledge, experiences, or relevance to the research question. Purposive sampling is used in qualitative research to select a specific group of individuals or units for analysis (Chunga, 2020). As the study was based on integration of technologies into biology teaching and learning activities, 5 teachers in the areas of Combined Science, and with a sound knowledge in the use of educational technologies were selected for the study. Purposive sampling was used since it allows researchers to select participants based on specific characteristics that are relevant to the research objectives, ensuring that the sample aligns with

the study's focus and aims (Hipolite, 2017). On the other hand, Fein (2015) says purposive sampling enables participants who possess unique perspectives or experiences that are essential for addressing the research questions, leading to a more targeted and representative sample.

3.6 Data generation procedure

The researcher obtained an introductory letter from Bindura University of Science Education's Faculty of Education, which enabled him to seek permission from the Ministry of Primary and Secondary Education to carry out the study on the selected school. A meeting was then conducted with the head of Chadereka Secondary School and the targeted participants, with the view to share with them the objectives of the study. Furthermore, the researcher sought consent from the participants for their involvement in the study, which was put in writing. Moses (2015) says obtaining permission from the participants and the authorities is part of the ethical safe guards in research, as individuals feel respected. Five participants were selected using the sampling technique, and were assured of protection, given the subtle nature of the information some might give under such circumstances. The researcher requested all the relevant policy documents that guide the infusion of the educational technologies in science learning activities.

3.7 Data analysis

This involves a set of actions or steps that a researcher takes to analyze and interpret the data collected during a research study (Selwyn, 2017). It typically involves organizing, coding, and cleaning the data, as well as performing statistical or qualitative analysis (Edwards & Holland, 2016). This involves sorting and organizing the data, checking for errors or missing values, and cleaning or correcting the data as needed (Komba & Mwandanji, 2015). On the other hand, Makunja (2015), acknowledged that data organization and cleaning is an essential step in the data analysis process, because if the data is not organized or cleaned properly, it can lead to errors or incorrect interpretations of the findings. In this study, data analysis was qualitative in nature, and was checked for credibility and dependability. Data sourced through the application of the selected methods was analysed according to emerging themes or patterns. The researcher sort to identify and describe patterns and trends from the participants' perspective, with the aim of understanding and interpreting them (Knut, 2019).

3.8 Research integrity

In this study research integrity was grounded on the trustworthiness of the study and ethical considerations that are discussed in detail below:

3.8.1 Trustworthiness of the study

According to Mudhara (2019), trustworthiness refers to the extent to which the results of a research study can be relied on as true or accurate. This is a key consideration in research because if a study is not trustworthy, it may not provide dependable information (Momanyi & Rop, 2019). The researcher was aware of potential biases that could affect the study, such as selection bias, observer bias, or confirmation bias. In addition, the researcher triangulated document analysis, personal interviews, and focus groups discussion, to extract valuable information. In this research, trustworthiness was achieved by determining whether or not the findings satisfied all research questions by reflecting on the credibility of the original data, (Allen & Seaman, 2019). It was further assumed to be achieved through a thorough triangulation of narrations and interpretations of data from multiple sources of evidence (Wilson, 2015).

3.8.2 Ethical considerations

According to Jasi and Shumba (2018) ethics in research refers to the set of principles and standards that guide the conduct of scientific researchers. It involves the adherence to moral and professional norms to ensure the integrity, validity, and ethical treatment of all individuals involved in the research process.

3.8.2.1 Privacy and confidentiality

Privacy refers to the control over the extent, timing, and circumstances of sharing oneself physically, behaviorally or intellectually with others., while on the other hand, confidentiality pertains to the obligation to the researchers to prevent unauthorized access to data collected from participants (Hamond, 2016). On the other hand, privacy is crucial for maintaining ethical standards protecting the rights of the participants (Allen & Seaman, 2019). Nworgu (2016) highlights that confidentiality ensures that the information provided by participants is protected, not disclosed without their consent. This helps build trust researchers and the participants. Before the interview, the researcher assured the participants that their privacy would be respected, and if

they desired to be interviewed in privacy, it would be so (Johnson, 2016). The researcher first explained the purpose of the study, the data collection methods and how the participants' privacy confidentiality would be protected.

3.8.2.2 Anonymity

This refers to the state or quality of being anonymous where the identity of the acting person is unknown, (Der Berg, 2015). Eze (2019) further highlights that the researcher ensures anonymity and protection of participants' identities, often by collecting data without any identifying information or by removing identifying details from the collected data to prevent individuals from being personally identifiable. To ensure there was anonymity, no names were to be written on the questionnaires, and participants were to be identified as Teacher A or Teacher B. Anonymity encourages participants to open up (Devers, 2017).

3.8.2.3 Informed consent

Kivunja and Kiyini (2017) say that informed consent is a crucial ethical principle that ensures individual have comprehensive information about a study before deciding whether to participate. According to Kizilcec and Schneider (2015), its significance lies in several key aspects such as voluntary participation, understanding the research, promoting Patient autonomy, ethical safe guards and building trust and confidence. It was for these reasons that the researcher ensured there was informed consent among the participants. Through voluntary participation, the researcher ensured that participants entered the research freely and voluntarily, with full information about what it meant for them to take part (Cohen, 2015). On the other hand, the researcher ensured there was deep understanding of the research by explaining the purpose of the research to the participants, including their role and how the study would work. Informed consent also helped build trust and confidence, as individuals feel respected and involved in the decision-making processes (Christensen, 2018).

3.8 Chapter summary

The chapter focused on the methodology, research paradigm, research approach, methods, sampling procedure, data generation procedure, data analysis procedure, research integrity, and chapter summary. In the following chapter, generated data will be analysed and discussed according to the identified themes.

CHAPTER 4

DATA ANALYSIS AND DISCUSSION

4.1 Introduction

The previous chapter focused on the research design, approach and data analysis. In chapter Four, the researcher will present the data collected. The data presentation and analysis will be done with a view to finding answers to the research questions in chapter one. The findings are presented according to the emerging themes.

4.2 Characteristics of the participants

This section focuses on the demographic characteristics of the participants, that is 5 teachers have been selected for this research study.

Table 4.1 Demographic characteristics of the participants (n=5)

Attributes		(n)	(%)
Sex	Males	3	60
	Females	2	40
Professional qualifications	Certificate in Education	1	20
	Diploma in Education	3	60
	Degree in Education	1	20
Teaching experience (years)	3-8	3	60
	9-14	1	20
	15-20	1	20
	21-25	0	0
	Above 25	0	0

It is noted that males are dominating in terms of the number. They constitute 60% of the sample, as opposed to 40% females. In terms of professional qualifications, 20% are certificate holders, another 20% are degree holders; while the diploma holders, are making up 60% of the sample. Furthermore, it is noted that in terms of teaching experience, there are more less experienced teachers than those who were more experienced. For instance, those teachers in the (3-8) years of teaching experience bracket constituted 60%. The (9-14) years of teaching experience bracket make up 20%, a sharp decrease from 60%. The (15-20) years of teaching experience bracket also constitutes 20 %. It is also noted that the above 25 years bracket is 0%.

4.3 Educational technologies used in the Ordinary Level Biology teaching and learning activities.

In this section, data generated from participants is analyzed and then discussed with a view to findings answers to research question 1 in chapter 1. With respect to this theme, one of the participants noted the following:

I have to use my laptop and mobile phone to play tutorial videos to learners, or share those tutorial videos using Shareit (Interviewee 5)

Another respondent highlighted the following:

We share with our learners' digital textbooks using WhatsApp, learners cannot afford data bundles for Google Meet, Moodle and other digital learning platforms that require high internet connectivity (Interviewee 3)

Another respondent highlighted that:

Students have mobile phones which they are allowed to bring to school to surf the internet for learning purposes. At times we share tutorial videos and digital text books with them, (Interviewee 4)

In addition, it was noted that:

I use my laptop and projector to present notes and images on the whiteboard. At times when there is no power, I divide my students in groups and play DVDs on my computer, and the groups take turns to watch and make some notes, (Interviewee 1)

Another participant added by saying:

Wi-fi is good for learning as we use simulations and virtual laboratories in teaching science concepts. Simulations and virtual laboratories save money that would have been used for purchasing chemicals and equipment. For instance, when we have no money to buy the chemicals and we want to teach how to test for glucose in a food stuff, I download the videos on YouTube and play the simulations to my students (Interviewee 2)

From the answers given by the respondents, the researcher gathered information that the commonest educational technologies in use are a combination of hard ware and software based educational tools such as white boards, laptops, mobile phones, digital texts books, WhatsApp, virtual laboratories and simulations. Virtual laboratories and simulations enable students to explore complex biological phenomena, conduct virtual experiments and visualize abstract concepts (Murithi & Yoo, 2021). On the other hand, Koc, (2015) also notes that simulations enhance students' understanding of biological phenomena by providing interactive and immersive learning experiences.

Laptops are also among the most commonly used gadgets at the school, for a reason that they enable students to access digital resources, interactive simulations, collaborative projects, research and the creation of multimedia presentations related to science topics, (Sanchez, 2015). WhatsApp has been included among the most commonly used educational tool at the school because of its capacity to enhance student interaction and encourage their greater engagement, compared to traditional methods, (Lockie, 2021). While WhatsApp offers more convenience and accessibility as a widely used messaging App, than educational technology tools such as Google Meet and Moodle, which provide a more comprehensive and structured approach to managing educational content and interactions within a formal learning environment, they are not in use as they are more costly to use and demand more knowledge and a stronger internet connectivity, (Lavonen, 2016).

4.4 Approaches used to prepare teachers for the integration of educational technologies into Ordinary Level Biology teaching and learning

This segment focuses on the approaches that have been used to prepare educators for the integration of educational technologies into Ordinary Level Biology teaching and learning. This is done with a view to finding answers to research question 2 in chapter 1. With respect to that, one respondent said:

I attended a workshop that was funded by the Ministry of Primary and Secondary Education. The objective was to equip teachers with skills to integrate educational technology in the classroom (Interviewee 5)

Another respondent had this to say:

I once attended a technology conference hosted by the Zimbabwe Educational Technology Conference. The idea was to provide teachers with the opportunities to learn about the latest trends and best practices in educational technology (Interviewee 3)

Another responded also highlighted that:

I have attended a seminar for knowledge sharing and skill development in educational technology. I found the seminar really useful as we were given time to explore and share ideas on the use of a variety of educational technologies, and ways to combine three domains of knowledge, which are content knowledge, pedagogical and technology knowledge (Interviewee 4)

Another had this to say:

I did a module (Educational Technology) at Bindura University of Science Education. It helped me so much. I can use my laptop and the projector to present notes on PowerPoint, or even organize online lessons, resources permitting (Interviewee 1)

Another participant said:

I have attended so many school-based workshops where I have learnt how to use the available educational technologies such as laptops, how to organize a power point presentation, and how to connect a projector to my laptop. We are taught such basics (Interviewee 2)

From the above responses, the researcher has gathered information with respect to various approaches that are used to prepare teachers for the integration of educational technologies into Biology teaching and learning activities. Such approaches include staff developments programs like seminars, workshops, and Information Technology in teacher training colleges and universities. Hew, (2017) highlighted that seminars were important as educators gain new skills enhancement, and are an avenue to unlock student success through customized learning. Furthermore, Hogarty, (2016) notes that workshops and seminars offer educational technology specialist certification pathways, providing additional classroom teaching certificate designed for teachers.

4.5 Strategies used to integrate educational technologies into Ordinary Level Biology teaching and learning activities

In this section, the researcher focuses on the strategies that are used to integrate educational technologies into ordinary level biology teaching and learning activities. This analysis is done with a view to providing answers to the research question 3 in chapter 1. With respect to this, one respondent noted the following:

I have exposed my learners to Applications that involve game like elements. These applications make use of badges, points and leader boards. Number of points earned per each questions answered correctly motivates learners, and similarly, lower points discourage the learners (Interviewee 5)

Another participant highlighted the following:

I assign my learners simple projects that require them to use their mobile phones to research, design and create solutions, (Interviewee, 3)

In support another participant had this say:

I try by all means to use educational technologies to support and improve the delivery of instruction. This involves use of interactive white boards and online learning platform. (Interviewee 4)

In the same line a participant noted that:

I post videos of my self-giving tutorials and digital resources. At times I post instructional content to learners on WhatsApp, so that they attempt the assigned work at home, and then use the classroom time for problem solving and discussion. I also use a variety of multimedia tools such as interactive simulations, videos, and animations that complex biological processes to life, (Interviewee 1)

From the responses given, the researcher noted that quite a variety of strategies are being employed to integrate educational technologies into biology teaching and learning activities. These are the use of multimedia tools such as interactive simulations, videos, digital resources, eBooks, among others. Furthermore, to enhance learners' interest and retention of biology concepts, educators are making use of gamification applications. Praskeva, (2018) notes that gamification involves the application of game design techniques such as badges, points and rewards to make tasks more enjoyable and encourage active engagement. It is also noted that educators are incorporating the Project-Based Learning (PBL), by assigning learners projects which allow them to use technologies to do the research, design and create solutions to the day-

to-day challenges. PBL plays a significant role as educators emphasize inquiry and exploration, encouraging learners to ask questions, investigate, and explore topics deeply, promoting critical thinking and problem-solving skills (van Straaten, 2018).

4.6 Chapter summary

Chapter Four has analyzed and discussed data through interviews, which have been used as a valuable frame work to draw useful information from the respondents. The information gave the researcher a clue to provide answers to research questions in chapter 1. The next chapter will provide a summary of the study, general conclusion and recommendations

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

In the previous chapter, data were analyzed and discussed, with a view to finding answers to research questions in chapter one. Chapter five will focus on the summary of the project, conclusion, recommendations, areas for further research and finally the summary of the chapter.

5.2 Summary of project

In chapter one, the researcher looked at the problem and its setting, the focus being on the background of the study, statement of the problem, the research questions and significance of the study; delimitations of the study and limitations of the study, as well as the definitions of the key terms. Chapter two outlined the theoretical framework through which gaps were analyzed. In addition, in chapter three the researcher focused on the strategies for data generation, presentation, analysis and interpretation. In chapter four, the researcher focused on data generation, presentation, analysis and discussion. The findings of the research were presented and analyzed based on the research questions. The chapter came up with the following findings:

- It was noted that a number of educational technologies (smart phones, personal computers, interactive white boards, gamification software, projectors, among others) were integrated into Ordinary Level Biology teaching and learning.
- It can be acknowledged that teachers were prepared through seminars, workshops and teacher capacity development programme to integrate educational technologies into Ordinary Level Biology teaching and learning.
- It was revealed that educational technologies were integrated into Ordinary Level Biology teaching and learning through approaches such as PBL, Project-based learning, design-based learning, etc.

5.3 Conclusion

From the findings it was noted that numerous educational technologies were integrated into Ordinary Level Biology teaching and learning. In addition, it was noted that teachers were prepared to integrate educational technologies into Ordinary Level Biology teaching and learning. Further to that it was acknowledged that educational technologies were integrated into Ordinary Level Biology teaching and learning through the use of various learner-centered approaches. From these findings it was concluded that educational technologies to a certain were integrated into Ordinary Level Biology teaching and learning.

5.4 Recommendations

The researcher proposes the following recommendations:

- Encourage teachers to incorporate adaptive learning algorithms to cater for individual differences and deliver customized learning experiences, which are tailored to the unique needs of the individual learner.
- Promote staff development seminars and workshops to enable teachers to effectively integrate educational technologies into teaching and learning activities.

5.5. Areas for further study

The study was only confined to one school in Muzarabani District. To ensure validity of the results, there is need to extend the research to other areas or provinces of Zimbabwe.

5.6. Chapter Summary

In this chapter, the research study was summarized. The conclusion and recommendations were also given, basing on the generated and interpreted data in chapter four and the responses given by the respondents. The chapter finally ended by pointing out areas for further research.

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APPENDICES

Appendix 1: Approval letter

SAMED

P Bag 1020
BINDURA
ZIMBABWE

Tel: 0271 - 7531 ext 1038
Fax: 263 - 71 - 7616

 BINDURA UNIVERSITY OF SCIENCE EDUCATION

Date:

TO WHOM IT MAY CONCERN

NAME: MAKOSA, IAN REGISTRATION NUMBER: B1026771

PROGRAMME: HBS-ED BIOLOGY PART: 2.2

This memo serves to confirm that the above is a bona fide student at Bindura University of Science Education in the Faculty of Science Education.

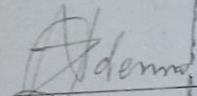
The student has to undertake research and thereafter present a Research Project in partial fulfillment of the

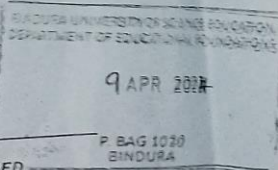
INTEGRATION OF EDUCATIONAL TECHNOLOGY INTO ORDINARY LEVEL BIOLOGY LEARNING ACTIVITIES AT CHADEREKA SECONDARY SCHOOL

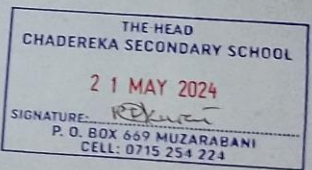
In this regard, the department kindly requests your permission to allow the student to carry out his/her research in your institutions.

Your co-operation and assistance is greatly appreciated.

Thank you


Zindemo (Dr.)
CHAIRPERSON - SAMED





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Appendix 2: Interview guide for teachers

I thank you for being part of this interview. The focus of this study is on the integration of educational technologies into the biology teaching and learning activities. Your contribution is highly appreciated as it offers valuable insights into the issue under investigation. I am going to ask you some questions which you must elaborate on, and in a way you deem necessary. In case you do not feel like you have to answer the question, you are free to say so. It is my pleasure to give you my assurance that any information given in this interview will be regarded as confidential, and moreover, no personal or school details will be published in the final report.

- 2 Could you please provide in brief your professional qualifications and teaching experience?
- 3 What hardware and software-based educational technologies are being integrated into the Ordinary Level Biology teaching and learning activities at your school?
- 4 Which factors have influenced your choice of the hardware and software based educational technologies in integrating them into the Ordinary Level Biology teaching and learning activities?
- 5 To what extent are you prepared to integrate named educational technologies into Ordinary Level Biology teaching and learning activities?
- 6 What professional development opportunities have been provided to prepare you in integrating the educational technologies into the Ordinary Level biology teaching and learning activities?
- 7 Which frame work are you using to integrate the educational technologies into Biology teaching and learning activities at your school?
- 8 In what way is that framework beneficial to Ordinary Level Biology teaching and learning activities?
- 9 Thank you for taking part in this interview.