INTEGRATION OF INFORMATION AND COMMUNICATION TECHNOLOGY IN TEACHING AND LEARNING OF BIOLOGY IN SECONDARY SCHOOLS IN SOUTHERN REGION, ERITREA

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REG. NO: E55F/32321/2015

A RESEARCH THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTERS DEGREE IN EDUCATION (EDUCATIONAL TECHNOLOGY) IN THE SCHOOL OF EDUCATION OF KENYATTA UNIVERSITY

MARCH, 2020

DECLARATION

I confirm that this research thesis is my original work and has not been presented for a degree in any other university/institution for certification. The thesis has been complemented by referenced sources duly acknowledged. Where text, data, graphics, pictures or tables have been borrowed from other sources, including the internet, the sources are specifically accredited through referencing in accordance with anti-plagiarism regulations.

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DEDICATION

This thesis is dedicated to my family especially my children for bearing with me during times I have been away not being able to give them the necessary attention and care they deserve.

ACKNOWLEDGEMENTS

First, my sincere gratitude goes to God the almighty for giving me aspiration, strength, resources and opportunity to go through my course of study and bringing it to completion.

My sincere thanks go to my supervisors Dr. David Wanyonyi Khatete and Dr. Bernard Chomba Mugo, who gave me invaluable guidance, expertise, encouragement and continuous professional support that I needed in this work.

I would also like to thank all my lecturers at the Department of Educational Communication and Technology for sharing their knowledge and experiences, especially late Prof. Ayot, for his continuous support in the course of my study.

I express my sincere thanks to the office of the National Commission of Higher Education, Eritrea, especially Prof. Zemenfes Tsighe, for giving me this opportunity and for the financial and moral support throughout the study.

My great appreciation goes to the office of Ministry of Education (MOE) Department of General Education, MOE of Southern Region, School Directors, Biology Teachers and Students of sampled schools who took part in this study for their cooperation during data collection.

Lastly, I would like to express my special thanks to my family and friends for their continued moral support and encouragement. For those not mentioned here by name, your support and contribution are highly appreciated.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

CD	Compact Disc
COE	College of Education
DVD	Digital Versatile Disc
ESECE	Eritrean Secondary Education Certificate Examination
ICT	Information and Communication Technology
MOE	Ministry of Education
NCHE	National Commission for Higher Education
SPSS	Statistical Package for Social Sciences
TPACK	Technological Pedagogical and Content Knowledge
UNESCO	United Nations Educational, Scientific and Cultural Organization

ABSTRACT

Technology has become indispensable in pedagogy world over. Integration of ICT in education improves the quality of education and academic performance. This study sought to investigate the integration of ICT in teaching and learning of Biology in secondary schools of Southern Region, Eritrea. The objectives of study were: to determine availability of ICT resources for teaching and learning Biology in secondary schools of Southern Region, Eritrea; to ascertain teachers' ICT integration skills; to establish teachers' attitude towards ICT integration in teaching and learning; to establish the instructional methods used by the teachers of Biology in classrooms; and to explore the challenges facing teachers and students in ICT integration in secondary schools of Southern Region, Eritrea. The study was guided by the Technology Pedagogy and Content Knowledge (TPACK) model. The study was carried out in secondary schools of the southern region, Eritrea. A descriptive survey research design was adopted. The study targeted 27 public secondary schools in the region. Stratified random sampling technique was used to get a sample of 12 secondary schools from 12 sub-regions. The sample of respondents of the study was drawn from these 12 secondary schools of 12 sub-regions. The respondents were 12 school directors, 34 Biology teachers and 175 grade eleven students. Questionnaires, interview and observation schedules were used as instruments for data collection. Questionnaire for Biology teachers and students, Interview Schedule for school Directors, were employed. Piloting and consultation were conducted to establish validity and reliability before the instruments were used for the actual data collection. The data collected included both qualitative and quantitative data. The quantitative data were analyzed using Statistical Package for Social Sciences (SPSS). The qualitative data obtained from the open-ended questions were analyzed thematically based on research objectives. The analyzed data was presented in the form of tables and figures. This study found that ICT resources were inadequate in the school; teachers were not well trained on how to integrate ICT in education, and the majority were using a teacher-centered approach in their teaching. The study also indicated that Biology teachers had a positive attitude towards ICT integration in education. Therefore, there was a low level of ICT integration. The study recommends that adequate ICT resources be available in schools for teaching and learning of Biology, teachers need to get adequate pre-service and in-service training on ICT integration in education, the learner-centered approach needs to be implemented in classroom instruction. Finally, ICT needs to be integrated into teaching and learning practices so that learning and performance of learners would be improved.

CHAPTER ONE

INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 Preamble

This chapter presents the basic components of the study on the integration of ICT in teaching and learning. It deals with the details on the background to the study, statement of the problem, the purpose of the study, objectives of the study and research questions of the study. In addition to these, the chapter describes the significance of the study, limitations and delimitations of the study, assumptions of the study, theoretical framework, conceptual framework and finally operational definition of key terms used in the study.

1.2 Background to the Study

In this age of information and technology, digital technology has influenced all aspects of human life (Vhanabatte and Kamble, 2014). In this digital era, almost every aspect of our life is affected by technology. Technology plays a vital role in the way we learn, communicate, work and live. Globally, technology is growing fast and is opening opportunities for human and economic development. It is raising productivity, enhancing education, creating job opportunities and rising incomes. Thus, technology is hoped to enhance development, alleviate poverty and improve living conditions.

One branch of technology which is very helpful in pedagogy is Information, Communication and Technology (ICT). It has opened new avenues like online

learning, and it also brings more rich and updated materials in the classroom for teachers and learners (Vhanabatte and Kamble, 2014). UNESCO (2007) defined ICT as, "forms of technology that are used to transmit, process, store, create, display and share or exchange information by electronic means." This broad definition of ICT includes such technologies as radio, television, video, DVD, telephone (both fixed-line and mobile phones), satellite systems, computer and network hardware and software, as well as the equipment and services associated with these technologies, such as videoconferencing, e-mail and blogs.

The role of ICT in schools is increasing dramatically. In developed countries such as the United States of America, United Kingdom, Norway and Singapore among others, ICT is becoming educational reforms endeavour, to bring changes in pedagogy, curriculum, teacher training and assessment. It is believed that ICT integration in teaching and learning can bring educational quality and set learners for 21st-century skills and digital learning society (Mugambi, 2015). Also, UNESCO (2007) stipulates benefits of integrating ICT in education such as helping to improve quality of education, expand access to educational opportunities, develop learner-centered teaching, improve learning outcomes and motivate learners. Moreover, Tinio (2003) asserts that the use of different technologies in combination helps to meet individual differences.

Integration of ICT in teaching and learning can be influenced by many factors such as the availability of ICT resources in the schools, preparedness of teachers

in ICT knowledge and skills, the attitude of school community towards ICT use in education, the way teachers teach in classrooms among others. Studies conducted in various parts of the world have presented the aforementioned factors as follows. A research conducted to investigate the developments of ICT and the need for blended learning in Saudi Arabia showed that, although there was adequate ICT equipment in the schools, need of training on ICT for teachers were found to be fundamental. Further, the findings also showed that the teaching and learning style was dominated by traditional methods (Alzahrani, 2017).

In Tanzania, (Kihoza et al., 2016) used a case study to assess classroom ICT integration opportunities and the challenges faced. The findings of the study showed that most of the teachers demonstrated low ICT competence in their teaching, and there was inefficient support on the use of ICT. Lack of infrastructure and readiness to change among teachers were significant challenges. Similarly, in Kenya, a study by Wanjala (2016) on ICT integration in instruction among secondary school teachers showed limited use of ICT in instruction. This was due to low self-confidence and incompetence in the use of ICT, inaccessibility to ICT resources and lack of adequate technical support. Furthermore, a study by Kamau (2012), in Kenya, findings demonstrated that in most schools, ICT facilities were inadequate and that there was little utilization of the available resources in the schools. Most students seemed to engage more in entertainment whenever they accessed the computers than using them for their

academic purposes. Most teachers lacked computer training and this made it difficult to incorporate ICT in the teaching and learning process.

Though numerous studies concerning the integration of ICT in pedagogy have been conducted world over, in some young developing countries like Eritrea, one might not find much of in-depth research. Eritrea officially called the State of Eritrea is a country in the horn of Africa, and its capital city is Asmara. It is bordered by Sudan, Ethiopia and Djibouti. It has a total area of approximately 124,000 square km and a population of about six (6) million. Eritrea is a multi-ethnic and multi-lingual country with nine recognized ethnic groups. The country is divided into six (6) administrative regions and 58 sub-regions. The economy of the people depends on agriculture, and about 70% of Eritrean people live in rural areas and are engaged in livestock and farming.

Eritrean education system follows 2-5-3-4 structure: two years in pre-elementary, five years in elementary, three in middle school, and four in secondary school. Education is compulsory and free between 6 and 13 years of age in elementary and middle school. Medium of Instruction is the mother tongue in elementary school and English in post-elementary school. Most of the schools in Eritrea are state-owned. Secondary school comprises students' age from 14 to 17 years.

Just like any other country, among subjects taught in secondary schools in Eritrea is Biology. The Biology curriculum in a secondary school in Eritrea

focuses on the structure, function, heredity, origin, evolution, growth classification and distribution of all living organisms. Biology is all about studying life and living organisms. It also helps in understanding the complex forms of life. Furthermore, it allows humans to understand their bodies and their environment better. In the Eritrean education system, Biology is taught, as an integrated part of science in elementary and middle schools and as a separate subject in secondary schools. Biology is one of the core subjects in secondary schools in Eritrea education system. Performing well in Biology is a pre-requisite to pursue studies in higher education in Biology and related fields like health sciences, agricultural sciences.

There are several topics or concepts in Biology that can be taught by integrating ICT, such as cell structure, cell division, organ systems, DNA and RNA, photosynthesis, respiration, food transport in plants, and others for better comprehension. Research has shown that the integration of ICT in pedagogy is vital if the learners master the content easily, retain it and retrieve it and use it in their real-life (Mugo, 2013). Moreover, in teaching and learning, ICT is very helpful in bringing up reality to the classrooms. Biology is one of the subjects that need learners to see reality for the subject is anchored on real things. For this reason, among others, Eritrea instituted education reform in 2003. The new national curriculum focuses on learner-centered outcome-based interactive pedagogy where ICT ought to be seriously considered for integration in

instruction (Ministry of Education, 2009). The Eritrean National Policy for ICT in Education was launched in July 2005. It states that:

> The Government of Eritrea recognizes that globalization is a reality and t hat Eritrea must develop the capacity to compete in a global market if she is to realize economic, social, and cultural prosperity. Two essential elements for realizing this vision are creating the human capacity and the technological infrastructure to meet the needs of a global market. (Ministry of Education, 2005).

ICT in education was first introduced in secondary and technical education in Eritrea in 2005. ICT is currently a subject at the secondary level and will be available at lower levels as resources allow (Ministry of Education, 2009). Secondary schools were given priority because they prepare learners to work or further studies in higher educational institutions (Ministry of Education, 2005). In the policy, it was articulated that to use ICT as a teaching and learning tool, training teachers with ICT was to be the primary focus of human capacity development for ICT in education. The Ministry of Education also planned to lay the necessary ICT infrastructure in the schools. In the National Curriculum framework, it is furthermore stated that teachers need to become ICT trained; ICT needs to be integrated across the curriculum in all subjects at all levels as a tool for teaching and learning (Ministry of Education, 2009). Is this national curriculum framework implemented in the ground? The researcher, therefore, sought to study whether the national curriculum framework was implemented on the ground in the schools.

Despite these efforts, there has been a concern in Eritrea due to the relatively low performance of students in the national examinations. Table 1.1 shows the national Eritrean Secondary Education Certificate Examination (ESECE) performance of Biology over a period of five years 2013 to 2017 in the southern region and national level.

Table 1.1

National ESECE Candidatures in Biology.

Year	Regional level	National level	Difference
2017	25.26	35.8	10.54
2016	17.83	22.88	5.05
2015	17.83	23.18	5.35
2014	16.85	22.23	5.38
2013	16.14	20.23	4.09

Source: Bureau of standard and evaluation, NCHE, Eritrea (2017)

Table 1.1 presents the percentage of students who scored pass marks 'C' and above (≥50%) in Biology national examination (ESECE) in Southern Region and nationwide from 2013 to 2017. Learners need to score 'C' and above to be enrolled for degree programs in higher education studies.

Learners who scored 'C' and above grades in Biology that would allow them to pursue a degree in the higher education colleges were only 25.3% in the

southern region and 35.8 % in the whole country, from the total population of those who did the secondary education national examination in March 2017. The result in the southern region was lower by 10.5 % than the result at the national level.

In the year 2015 and 2016, the percentage was lower, nearly 17% in the southern region and 23% nation-wide. The percentage of the students who scored a pass mark in Biology examination was even lower, almost 16% in the southern region and 20% in 2013. It is noticeable that the performance of Biology in the southern region was also lower than the performance of Biology at the national level. Generally, this trend shows that the performance in Biology in the national examinations in the southern region and countrywide was low.

One would construe that in Eritrea, the percentages of those who generally qualify for studies in a higher level of education are not many. From the Ministry of Education southern regional office (2017) report, the performance of sciences of which Biology is one of them requires thorough scrutiny. In spite this, in order to improve the performance, research has demonstrated that integration of ICT in pedagogy plays a great role in mastery of content and generally good performance (Koehler and Mishra, 2009). Going by this fact, a pertinent question one may ask is whether the ICT was being effectively integrated in classroom instruction in the secondary schools and particularly in the teaching of sciences including Biology. This question could only be

answered well if serious studies were conducted in this field in the country. As a contribution to the solution to the low performance and to endeavour to answer this pertinent question, this study focused on the integration of ICT in teaching and learning of Biology in secondary schools of Southern Region Eritrea.

1.3 Statement of the Problem

The use of technology has influenced all human aspects of life, and it has an impact on how education is delivered. The Government of Eritrea, through the Ministry of Education, has placed effort in introducing a new curriculum that focuses on learner-centered, outcome-based interactive pedagogy. The new curriculum allows learners to actively participate in their learning. In addition to this, ICT policy in education has been launched for integrating ICT in education. While studying Biology is important for it generally helps us to get a better understanding about ourselves, the world and its natural processes, the performance of this subject in secondary schools in Eritrea was not satisfactory in the last five years. The performance of Biology, as indicated in table 1.1, was poor in the last five years. This can have a serious implication for the quality of education and discourage students from studying Biology. This problem of low performance could be solved by integrating ICT in teaching and learning of Biology.

Various researches conducted on ICT integration in education have proved that integrating ICT in teaching and learning improves the quality of learning and

performance of learners. Moreover, ICT integration simplifies abstract and complex concepts, creates cooperative learning, and creates interest in learning among students. In essence, integration of ICT creates a learner-centered learning environment. Although the integration of ICT has many benefits that can be considered as opportunities, it also has numerous challenges. It demands educational transformation such as changing curriculum, assessment, and importantly changing role of teachers from being custodians of knowledge to being facilitators in pedagogy.

The effective integration of ICT in teaching and learning requires the availability of ICT resources, Teachers' preparedness on ICT integration, and attitude of teachers towards ICT integration in teaching-learning. However, it is not clear whether Biology teachers integrate ICT in the classroom instruction with the purpose of improving teaching and learning of biology. This study, therefore, intended to examine the integration of ICT in teaching and learning of Biology in the Southern Region of Eritrea.

1.4 Purpose of the Study

The purpose of the study was to investigate the integration of ICT in teaching and learning of Biology in secondary schools in the Southern Region, Eritrea.

1.5 Objectives of the Study

The study was guided by the following objectives:

1. To determine the availability of ICT resources for teaching and learning Biology in secondary schools in the Southern Region, Eritrea.
2. To ascertain teachers' skills for ICT integration in teaching and learning of Biology.
3. To establish teachers' attitude towards integrating ICT in classroom instruction.
4. To establish the instructional methods used by teachers of Biology in teaching.
5. To explore challenges faced by teachers and students in the integration of ICT in teaching and learning.

1.6 Research Questions

The study sought to answer the following research questions.

1. What ICT resources are available in schools for teaching and learning of Biology?
2. What types of skills do teachers have for the integration of ICT in classroom instruction of Biology?
3. What attitudes do teachers possess regarding the integration of ICT in teaching and learning process?
4. Which instructional methods do teachers use in teaching the subject?

5. What challenges do teachers face in integrating ICT in teaching of Biology?
6. What challenges do students face in learning Biology using ICT in classroom instruction?

1.7 Significance of the Study

The findings of this study could provide information that could be significant to the following groups of people: Policymakers in the Ministry of education would use it to train teachers on ICT literacy and ICT integration in teaching and learning. The findings of this study could be useful to curriculum developers in the course of developing and revising the curriculum that aims at integrating ICT. The findings may also be helpful to the College of Education (CoE) to mainstream ICT in delivering and designing courses that would enable the college to prepare new teachers with adequate ICT integration knowledge and skills. This study could provide information to the Ministry of Education in the Southern Region of Eritrea to monitor the implementation of ICT integration initiatives as well as organize ICT integration in-service training. The results of this study could also add to the already existing knowledge in the field of ICT integration in pedagogy. Finally, the findings might inspire other scholars to conduct similar research in this field in other subjects or in other regions of Eritrea.

1.8 Scope of the Study

The scope of the study incorporated 27 public secondary schools in the Southern Region of Eritrea. The implication of this scope was that generalizations of the findings would be limited to only secondary schools in the Southern region of Eritrea. The study focused on the integration of ICT in Biology teaching and learning that would help to improve the performance of students and the quality of teaching and learning.

1.9 Limitations of the Study

The study was carried out only in the southern region, one of the regions in Eritrea. The study also focused integration of ICT in Biology, not in other subjects. The extension of the study to other regions of the country and to other subjects would be limited by the time and finance constraints. The study would also depend mostly on the respondents' opinions about the integration of ICT in the instruction of Biology. People's views might not be taken as complete truth and adequate. Therefore, it would be imperative for one to consider the generalizations of this study carefully. In this study, there was limited literature on ICT integration in education in Eritrea. Hence, the study used much of the kinds of research from outside of the country.

1.10 Assumptions of the Study

This study was conducted under the following assumptions:

a. Respondents would give truthful and honest responses to the required information.

b. Teachers had trained on how to use ICT for teaching and learning of Biology.

c. Teachers had certain attitudes towards the integration of ICT in teaching and learning.

d. There would be available ICT resources in the schools for teaching and learning of Biology.

1.11 Theoretical Framework

The study was underpinned on the Technological Pedagogical Content Knowledge (TPACK) model. TPACK is a framework proposed by Koehler and Mishra in 2009. It identifies the knowledge teachers need to teach effectively with technology. Teacher' knowledge for technology integration was called originally technological pedagogical content knowledge (TPCK), and now it is known as Technology Pedagogy and Content Knowledge (TPACK). It helps to understand and describe the kinds of knowledge needed by a teacher for effective pedagogical practice in a technology-enhanced learning environment. It combines three knowledge areas: technological knowledge, content

knowledge, and pedagogical knowledge. This looks at how these trios work together to increase students motivation and make the content more accessible to learners Koehler and Mishra,(2009). The TPACK framework extends Shulman's (1986) idea of Pedagogical Content Knowledge (PCK). In the Shulman's PCK model, technology was not included.

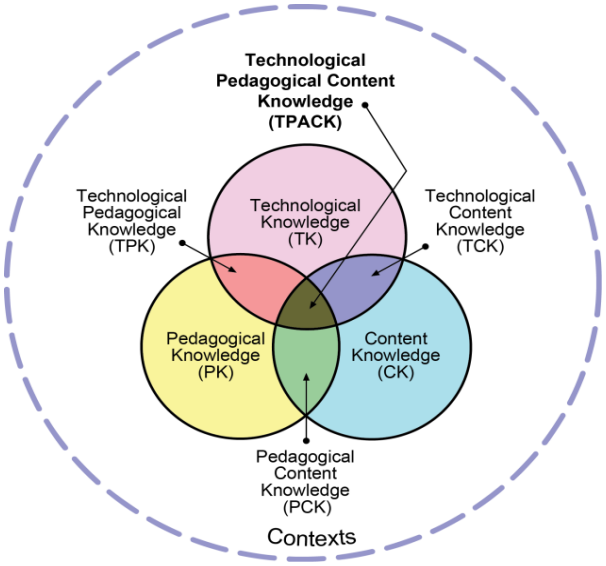

Figure 1.1. The TPACK Framework illustration.

According to Koehler and Mishra, (2009), at the heart of the TPACK framework, is the complex interplay of three primary forms of knowledge: Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK). The TPACK approach goes beyond seeing these three knowledge bases in isolation. TPACK also emphasizes the new kinds of knowledge that lie at the intersections between them. Intersections represent the four more knowledge teachers apply to teaching with technology: Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK),

Technological Pedagogical Knowledge (TPK), and the intersection of all three circles, Technological Pedagogical Content Knowledge (TPACK).

Effective technology integration for pedagogy around specific subject matter requires developing sensitivity to the dynamic, transactional relationship between these components of knowledge situated in unique contexts. Individual teachers, grade-level, school-specific factors, demographics, culture, and other factors ensure that every situation is unique, and no single combination of content, technology, and pedagogy will apply for every teacher, every course, or every view of teaching.

Although the integration of ICT in classroom instruction requires many variables, teacher's role is the most important. If teachers are prepared with the knowledge of technology, content and pedagogy, technologically enhanced student-centered learning will be realized in the schools with ICT resources. When teachers of Biology in Southern Region, Eritrea integrate technology in their lessons, the quality of teaching and learning improves and performance of learners in Biology would be enhanced.

1.12 Conceptual Framework

The interaction of variables in this study was conceptualized as visualized in figure 1.2 below.

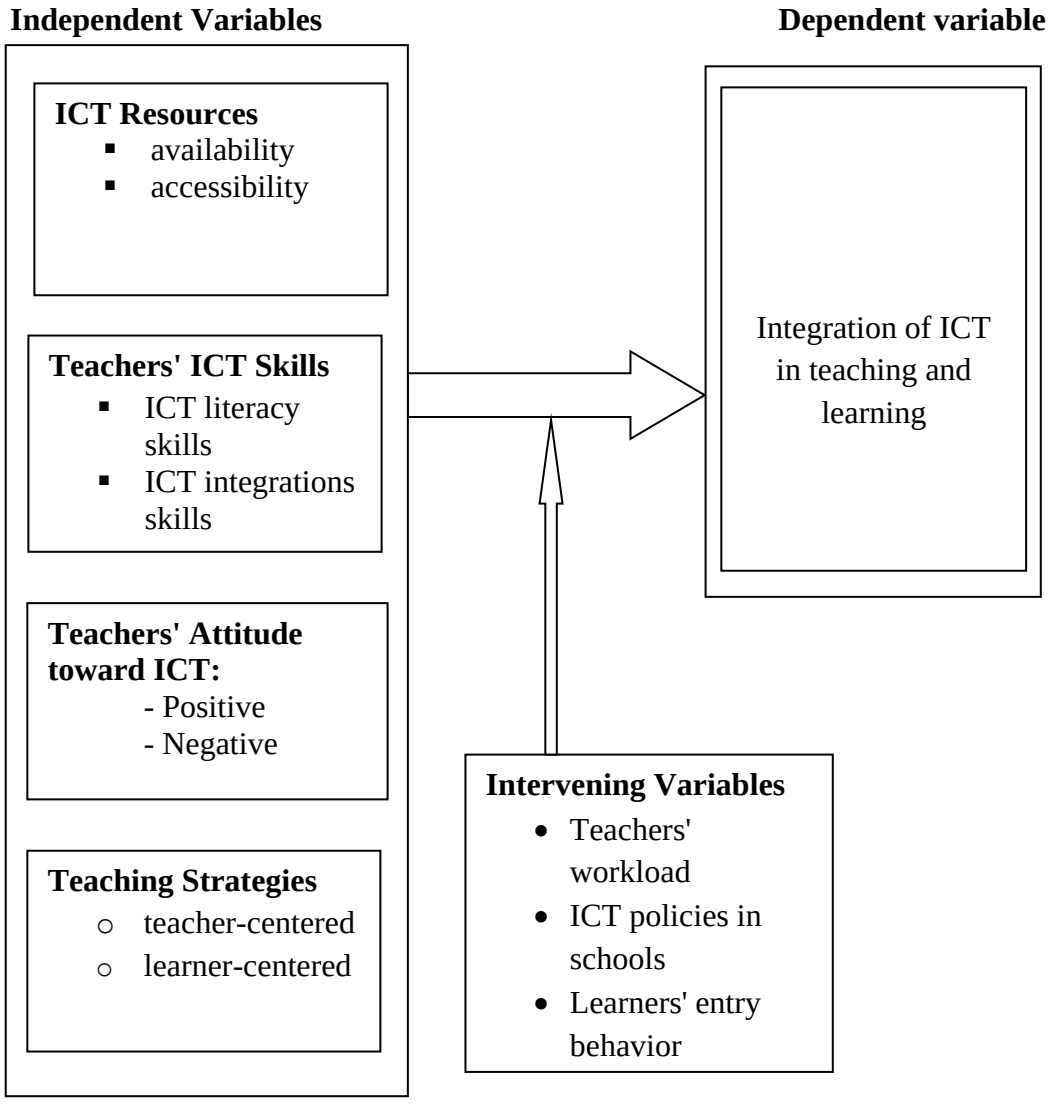

Figure 1.2 Integration of ICT in teaching and learning

Source: Researcher's design

The independent variables of the study were availability of ICT resources in secondary schools for teaching and learning of Biology, teachers' skills for ICT integration in teaching and learning, teachers' attitude towards integrating ICT in classroom instruction. At the same time, the dependent variable in this study was actual integration of ICT in teaching and learning, which ultimately led to improved learning and learners' performance in Biology. Having adequate ICT resources, ICT competent teachers, and positive attitude of teachers toward ICT does not mean ICT would be well integrated into classroom instruction. Intervening variables could also influence the integration of ICT in teaching and learning. The intervening variables of the study were the workload of teachers, learners' entry behavior and ICT policies in schools. These intervening variables were not used in this study.

Availability of ICT resources' variable describes various ICT tools, internet, and digital content availability and accessibility by Biology teachers for teaching and learning in secondary schools of the Southern Region. Teachers' skills for ICT integration variable is concerned with the training received by teachers on ICT literacy and on how to integrate ICT in teaching and learning and teachers use of ICT in their Biology instruction.

Teachers' attitudes towards ICT integration variable explains Biology Teachers' attitude towards integrating ICT in classroom instruction explains how Biology teachers think and feel on the importance of ICT integration in teaching and

learning. Instructional methods cover the teaching methods used in Biology lessons and their implication to the integration of ICT in instruction. The use of learner-centered teaching methods increases the level of learner activation and attention in their learning (Mykrä, 2015). Learner-centered approach allows learners to be active in learning, and this can enhance the integration of ICT in instruction.

1.13 Operational Definition of Key Terms

Attitude: the way teachers think or feel about ICT integration in instruction

Blended learning: An approach to education that combines technology and face-to-face instruction, it is a mixture of classroom learning and online learning.

Biology: A branch of natural science that studies about life, living organisms and their interactions with the environment

Computer Literacy: Having basic knowledge and skills of computer and related technology

Grade: Class or level where students learn. Grade is the same as form. Example a student who learns in Grade-11 is like a student who learns in form-3.

Information and Communication Technology (ICT): Variety of forms of technology tools and resources used to communicate process, disseminate, create, manage, display, store and retrieve information by electronic means.

ICT Integration: Effective application of ICT in teaching and learning process.

ICT Resources: ICT tools, equipment and facilities that are important to facilitate learning.

ICT tools: Technological devices that use to communicate, create, disseminate, store, and manage information in the facilitation of teaching and learning

Instruction: Purposeful transfer and direction of the learning process

Instructional Methods: Methods of teaching used by teachers to enable students learning

Pedagogy: The proper and correct use of teaching methodology strategies; it is the method and practice of teaching.

School Director: School principal, head teacher, school leader

Section: classroom where students are assigned to learn. It is equivalent to stream. Example section-B is like stream-B.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

The review of related literature was an important part of the study. It helped the researcher to look at up-to-date information about the studies done by others related to the area that the researcher studied. Review of related literature also avoided repetition of research work and efforts that had already been done by others. It further helped the researcher to build an in-depth understanding of the problem of the study and acquired valuable information on research methods and techniques used in the reviewed studies.

This chapter reviewed literature related to this study that could give an understanding of the ICT integration in education. The literature was reviewed based on the study objectives under the following themes: the importance of ICT integration in education, the availability of ICT resources in secondary schools, teachers' ICT integration skills, attitude of teachers towards ICT integration, the instructional methods used by teachers and finally the challenges facing teachers in integrating ICT in teaching and learning.

2.2 Importance of ICT Integration in Education

Information and communication technology (ICT) is becoming very important in the education sector. To understand the importance of ICT in Education, there

was a need to explore the meaning of ICT. ICT is defined as a diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information. These technologies include broadcasting technologies (radio and television), telephony, computers and internet (Yadav and Mehta, 2014). Tinio (2003) also similarly defined ICT as a set of diverse technological tools and resources used to communicate and manage information. Information and Communications Technology (ICT) offers innovative tools for restructuring teaching and learning processes in preparing students for the 21st Century skills (Moluayonge and Innwoo, 2017). ICTs are used at homes, schools, workplaces and so on. Integration of ICT in education can enrich teaching and learning processes in many ways. It can improve the quality of teaching, learning and management in schools and so help raise standards (Livingstone, 2012).

Yassanne (2014) ascertains that the integration of computer technology into the teaching of Biology improves students' academic achievement. The study used a quasi-experimental non-equivalent control group design. The findings of the study revealed that the performance and participation of students in the experimental group were better compared to the control group in the post-test results. This result indicates a significant difference between the academic performance of students in Biology who were exposed to computer technology and those exposed to the traditional method of teaching. According to Nyaga (2016), although all teachers and learners were not able to access and utilize

Biology digital content, the digital curriculum content had a positive influence on both assessment and achievement of learners of the sampled secondary schools.

In his analysis on the role of ICT in Teaching Science Education in Schools, Abdullahi (2014) revealed that ICT promotes students' intellectual qualities through a higher order of thinking, improved communication skills, problem-solving, and deep understanding of the learning tools and content. He further confirmed that ICT ensures more effective interactive learning environment and empowers learners with ICT awareness and skills.

Zakaria and Khalid (2016) conducted a study on the benefits and constraints of the use of information and communication technology (ICT) in teaching Mathematics. The findings revealed that the benefits of applying ICT in teaching and learning Mathematics were interaction among students, knowledge-sharing, increased motivation and interest, generation of higher-level thinking skills, increased student achievement.

Rabah (2015) noted that the benefits of ICT integration in teaching and learning are higher students' engagement level; grasp the attention of students; aid diversified instruction; enhance learning process; cooperative based learning; and prepares students for the digital world. There is a scarcity of study on the integration of ICT in education in Eritrea. Therefore, the researcher was

interested in studying whether the secondary schools of Southern Eritrea were taking the advantages of ICT in classrooms.

2.3 Availability of ICT Resources for Integration of ICT in Classrooms

Availability of ICT resources is one of the main factors for ICT integration in teaching and learning. If these resources are not available in schools, it can prevent effective use of ICT in classrooms. A study conducted in Chile on the availability and use of ICT revealed that even though favorable conditions were set, ICT integration was limited to a few specific resources like computer and projector (Brun and Hinostroza, 2014). Availability of ICT resources in the integration of technology in the classroom plays a vital role. Lack of ready access to technologies by teachers is a key barrier to technology integration in most developing countries. The finding of a study carried out in rural areas of South Africa showed that the main challenges that teachers had in using ICT in classrooms were scarcity of resources (Mathevula and Uwizeyimana, 2014).

A study to analyze the technological integration in teacher education was conducted in Ghana. The findings of the study showed that one of the challenges of Gahanna education system on integrating ICT was the lack of technological resources (Agyei, 2013). A similar result was also found by Manu (2014) in Nigeria. Finding revealed that challenges facing ICT usage were inadequate infrastructures like electricity and telecommunication services. Another study in

Nigeria indicated that the level of availability of ICTs for effective use in teaching and learning was low in educational institutions (Asiyai, 2014).

A study was carried out to assess the availability, utilization and management of ICT facilities in teaching the English language in secondary schools in Kaduna State, Nigeria. The study showed that there was a dearth of ICT facilities in schools, absence of internet in most schools, very poor level of utilization of the available ICT facilities and constant electricity power failure during the instructional time. The study also revealed that most of the teachers lacked the knowledge and skills to use ICT in teaching. The majority, (78%) of the teachers considered their ICT training to be at a poor level, and this affected productivity. This study demonstrated that teachers have positive views on the use of ICT for teaching English (Yusuf et al., 2013).

A study to examine Availability and Utilization of ICT Resources in Teaching and Learning in Secondary Schools in Ardo-Kola and Jalingo, Taraba State, Nigeria, found out that: the availability, accessibility and utilization of ICT resources in secondary schools for teaching and learning was very poor. According to the responses of more than 80% of the respondents, ICT resources were not available in the schools under study; ICT resources can only be accessed and utilized by teachers and students if they are available in the schools for teaching and learning (Onwuagboke et al., 2014).

A study conducted to assess the availability and utilization of ICT for teaching and learning and to establish hindering factors for the use of existing ICT resources in secondary schools in Kwekwe, Zimbabwe. The findings showed that most of the ICT resources required for training were not available in the sampled schools, and those that were available were inadequate. The study also revealed that the available ICT resources were utilized to a very low extent. The research further identified the factors that were hindering the ICT utilization in these schools, among which were lack of power supply, insufficient resources, fear of technology, lack of interest, ICT skills deficiency, higher ICT cost and poor physical infrastructure (Mavellas et al., 2015).

A research conducted in Ethiopia about integrating ICT in teaching and learning practice showed that some of the critical factors that have prevented integrating ICT in teaching and learning were lack of proper access to ICT resources, insufficient technical and pedagogical support. The analysis of the data indicated that integrating ICT into teaching-learning was yet to be realized (Alemu, 2015).

Eritrea has made a significant effort to reform its education system. The government of Eritrea believes that ICT has a role to play in improving both access and quality of education. Eritrea National ICT policy in education was prepared in 2005. However, as a study conducted ten years ago by hare 2007 indicated, Eritrea had low penetration level of ICT infrastructure like the internet, mobile phones and television; as a result, ICT access is limited to few

people in urban areas. The hindering factors for the implementation of ICT in education in Eritrea were: poor ICT infrastructure and electricity, lack of ICT trained teachers and low literacy and awareness on ICT in education (Hare, 2007). It is not yet clear if the situation has improved or not. The researcher had, therefore tried to examine the availability of ICT services in Eritrea's secondary schools.

2.4 Teachers' Skills for ICT Integration in Teaching and Learning

ICT has become an important part of education in many countries of the world. Samuel and Zaitun (2007) study findings in Malaysian schools revealed that, for the effective integration of ICT in education, teachers need to have the skills on how to integrate ICT in the teaching and learning activities. Training teachers in ICT skills is central in implementing ICT integration in teaching and learning practices. As teachers become more competent in ICT tools, there would be more ICT integrated activities in the classroom.

Integration of Information Communication and Technology (ICT) assists teachers to adjust more with best global practices. Teachers' preparedness nowadays has replaced traditional teaching methods with technology-based teaching and learning tools and facilities (Ghavifekr, 2015). As a result, preparation by capable teachers makes the core for the integration of ICT in instruction.

A study on the educational use of IT by Finnish teachers was conducted with 292 participants. The researcher used a survey design to investigate ICT use in the classroom. The result showed that teachers who have advanced ICT competence used ICT frequently in education. However, for those teachers who did not have adequate knowledge and skills in ICT, integration was not fully achieved. In developed countries, there are contradictions between the formal structures of educational institutions and daily practices in the classrooms (Sipilä, 2014).

According to Ghavifekr (2015), a study carried out in Malaysia on the effectiveness of ICT Integration in Schools; the researcher used a survey questionnaire with a sample of 101 participants. The findings of the study indicated that one of the major factors that influenced the success of technology-based teaching and learning was well-prepared teachers on ICT integration.

Another study was conducted to examine the levels of ICT skills and ICT use in the classrooms among technical and vocational teachers in Malaysia. In the study, Quantitative technique was applied. Data were collected through a questionnaire from 329 teachers using survey method. The findings of the study revealed that the level of teachers' ICT skills was moderate, and the majority (70%) of the teachers studied were frequent users of ICT in classroom teaching. That is, teachers were moderate users of ICT in classroom teaching. Furthermore, the study found out a significant correlation between the ICT skills

of teachers and ICT integration in classroom teaching (Alazam et al., 2012). The study went in line with the study of Samuel & Zaitun (2007) that found out a large number of English teachers had the necessary ICT skills even though the utilization of the available resources were far from satisfactory in Malaysian schools.

Sulaiman, Hindatu and Lawal (2017) investigated teachers' awareness of the utilization of ICT for Biology teaching in secondary schools in Matazu Local Government Area, Katsina State, Nigeria. The study used a survey method, and a questionnaire was administered for 18 Biology teachers and five school principals. The result of the research showed that teachers were aware of the usefulness of ICT in the teaching and learning process. However, the majority of them were not using ICT for Biology teaching. The hindering factors for the integration of ICT in classrooms were inadequate ICT facilities and power failure.

Moluayonge and Innwoo (2017) carried out research on teachers' use of information and communications technology in education in Cameroon secondary schools. The study used a survey method to collect data from 320 teachers. The result showed that low usage of ICT in teaching and learning partly due to poor ICT infrastructure in secondary schools of Cameroon. Further, the study found out that there were low competence and confidence of teachers,

low access to available resources and insufficient ICT support for teachers in using ICT in their teaching.

Agyei (2013), in analyzing the technological integration in teacher education in Ghana, the result revealed that shortage of skilled human resources and other institutional factors were the challenges of ICT integration in Ghana. According to Tedla (2012), most teachers in East African countries do not integrate ICT into their instruction as expected. The reason could be due to several interrelated factors, one of which could be the teacher factor.

A study was conducted in Kenya on the Influence of Teacher Competency on Integration of ICT in Teaching and Learning in Public Secondary Schools. The findings revealed that majority of the respondents received ICT training to literacy level, and they showed limited ICT competence and confidence to use ICT for teaching and learning process. The result also indicated that teachers believe ICT enhances learning (Michael et al., 2016).

Another study was also conducted in Kenya about the opportunities and challenges influencing integration of ICT in teaching and learning, using descriptive survey design in 12 secondary schools in Nairobi County. The finding of the study showed that teachers face significant challenges, such as developing their own technical skills and knowledge as well as for self-training in the use of ICTs in their teaching (Amuko, 2015).

Teachers' skills for ICT integration in Eritrean secondary schools are imperative. However, least is known if secondary school teachers in the Southern Region in Eritrea are trained on the integration of ICT in classrooms. Hence, this study developed an interest in this issue.

2.5 Attitude of Teachers towards ICT Integration in Education

Attitude is one of the teacher's factors that affect the use of ICT in the classroom. Having a positive attitude is crucial in integrating ICT in education. Muslem, Yusuf and Juliana (2018) conducted a study on attitude and barriers to ICT use among English teachers in Indonesia. The study used a questionnaire and interview for 26 teachers selected by purposive sampling technique. The findings of the study showed that participant teachers had positive perceptions of the implementation of ICT in classroom teaching and learning. Teachers believe that ICT support them in their lessons as well as helps them to find information that enriches their lessons easily and quickly. They also think that ICT makes teaching in the class more interesting.

Hong (2016) carried out a study on teachers' views of ICT integration using open-ended, semi-structured interview for 23 teachers from different parts of Colorado, USA. The study revealed that teachers involved in the study had a positive attitude towards ICT as an instructional tool**.** They liked ICT as a pedagogical tool and as a resource bank for their teaching. Teachers wanted to learn new ways of using ICT to deliver instructional materials to students

effectively and showed their willingness to incorporate ICT in their lessons frequently. This is because they believed that ICT is a current trend, and it has many benefits for students. Further, the study found that low availability of ICT resources, especially the availability of computers and unreliable internet connection were major barriers that limited the implementation of ICT in the classroom.

Daher, Baya'a and Anabousy (2018) conducted an experimental study on in-service Mathematics teachers' integration of ICT as innovative practice in lower secondary and found out that the teachers had positive attitudes and beliefs. Despite their positive feelings, teachers were reluctant to integrate technology in their lessons due to their little experience and different obstacles they encountered in the integration of ICT in education.

According to the study carried out by Semerci and Aydın (2018) on examining high school teachers' attitudes towards ICT use in education, applying descriptive research design and questionnaire for 353 teachers working in different schools of Ankara, turkey. Teachers displayed a high level of positive attitude towards ICT use in education and low level of anxiety towards ICT use in education.

Adegbenro, Gumbo and Olakanmi (2017) investigated in-service secondary school teachers' technology integration needs in an ICT enhanced classroom in Pretoria, South Africa using Questionnaire and focus group discussion. The

finding of the study revealed that teachers had positive attitudes towards using computers in their classrooms. Teachers were willing to learn more about how to integrate computers in the teaching and learning processes. However, teachers faced difficulties in the implementation of ICT in classroom practices due to their inadequate knowledge and lacked skills to use ICT in their pedagogical practices. According to Ottestad (2013), an online survey was done on 247 school leaders, and 386 teachers from Norwegian primary and lower secondary schools revealed that there was a correlation between the attitude and behavior of school leaders and the attitude and behavior of teachers regarding ICT integration in classroom practices.

A study conducted by Msila (2015) in South Africa, using an interview to explore the view of teachers on digital technology use in instruction. Findings showed that younger teachers were more open-minded than the older teachers who found the introduction of ICT discouraging. In the end, the study concluded that the success of digital technology in classrooms depends more on teacher competence as well as positive attitudes towards ICT. Similarly, a study conducted on pre-service Biology teachers attitude toward the use of ICT in Biology teaching revealed that pre-service Biology teachers had a positive attitude with no difference in gender or class (Yapici and Hevedanli 2012). The presence of a positive attitude in teachers enhances the use of ICT in instruction. However, least was known about Biology teachers' attitude towards the

integration of ICT in teaching and learning in the Southern Region's secondary schools in Eritrea.

2.6 Instructional Methods Used by Teachers in Teaching Biology

The instructional approaches of teaching need to be changed from traditional teacher-centered to learner-centered, which ICT could facilitate and make students active in learning. Expository and heuristic are the two well known approaches in teaching process . Expository approach, recognized as teacher-centered approach includes lecture method, demonstration method and the rest. Teachers dominate the classroom activities. Heuristic or discovery approach, also known as learner- centered includes discussion method, problem-solving methods and the like, enable learners to actively participate in the classroom (Twoli et al., 2007).

The emphasis in education has shifted from a conventional teacher-centered to a current learner-centered approach. Teacher-centered has been based on a passive way of learning where teachers dominate the activities of learning and learners passively interact in their learning. Learner-centered approach focuses on active and reflective learning where learners actively participate in their learning, and teachers' role is to facilitate learning and to guide learners to learn. The shift to leaner-centered approach requires a change in attitude toward knowledge and practices demonstrated in learning (Smart, Witt and Scott 2012).

Teaching is a process of facilitating learning. Effective teaching is a complicated Endeavour involving many interacting components. Teaching is not just about content; it is also about strengthening learner´s self-efficacy, motivation and engagement. Teachers can choose and use different teaching methods to help their learners to learn. The use of learner-centered teaching methods increases the level of learner activation and attention in their learning (Mykrä, 2015). Technology is helpful for incorporating learner-centered approaches of teaching and learning. Teachers can combine classroom learning and online learning, using a blended learning approach. Blended learning was a more active approach than traditional teaching methods for teaching human anatomy (Pereira et al., 2007). When learner-centered methods are applied using blended learning, they have many benefits to educational quality. According to Pereira et al.,(2007), the benefits of blended learning in the teaching of human anatomy were to modernize teaching methods, to improve academic performance, to increase interaction and communication among teachers and students, and among students themselves and to provide students with solid, reliable, continuously Accessible and updateable materials.

A study conducted on the teaching of English as a foreign language by comparing the teacher-centered and learner-centered revealed that both approaches have their strengths and weaknesses and their advantage and disadvantages; but learner centered was found more advantageous (Al-Zu’be, 2013). An online survey study was done, on creating technology-enhanced,

learner-centered classrooms, and information gathered from 126 teachers in northeast Texas and Arkansas. "A majority of teachers believed that learner-centered Instruction is challenging but rewarding." Respondents also showed positive attitudes towards learner-centered approach and integrating technology in classrooms (An and Reigeluth, 2011).

It has been studied and recognized that learner-centered approach makes learning more interesting, constructive and meaningful. It is also favorable for the use of ICT in instruction. It has been a while since Eritrea introduced leaner-centered approach. However, limited research was conducted on the implementation of learner-centered approach in Eritrean schools. Therefore, the study sought to explore the methods of teaching practiced by teachers of Biology.

2.7 Challenges Facing Teachers in the Integration of ICT in Teaching

Teachers face numerous challenges when they try to integrate ICT in classroom teaching.

Although there is no doubt about the benefit of ICT in education, several challenges have been highlighted by participants in Québec English Schools, Canada. These challenges include lack of supporting school leadership, inconsistent investments in ICT equipment, infrastructure and resources, the inflexibility of funding, the need for additional professional development and support and incorporation of technology in evaluations and curricular plans (Rabah, 2015). In addition to these challenges, Yadav and Mehta (2014) asserted

that many teachers were reluctant to use ICT especially computer and internet. Some of the reasons include poor software design, skepticism about the effectiveness of computer in improving learning outcome, lack of administrative support, inadequate training, fear of losing their authority in class as it become learner-centered.

In a study carried out in rural areas of South Africa, by applying structured questionnaire on 146 participants, findings showed that the main challenges that teachers had in using ICT in classrooms were scarcity of resources and low ability and confidence of teachers (Mathevula and Uwizeyimana, 2014).

According to Zakaria and Khalid (2016), the constraints when applying ICT in teaching Mathematics were limited teaching time, insufficient training, lack of technical support, limited resources of students and lack of pedagogical knowledge on how to integrate ICT in teaching. In support to this study, Bairagi, Rajon and Roy (2011) revealed that the major constraints in the application and implementation of ICT in education in Bangladesh schools are High Cost of the Internet, poor ICT infrastructure in schools, lack of qualified teachers and shortage of ICT trained teachers.

According to Muslem et al., (2018) the significant challenges cited by English teachers were limited ICT tools and poor internet connection in schools and lack of knowledge and skill that enable them to use ICT in teaching and learning. The perceived challenges of effective integration of ICT teaching and learning were

poor electric power supply, lack of knowledgeable ICT support staff, and inadequacy of trained teachers in the use of ICT. Furthermore, the study found out that insufficient funds, high cost of ICT equipment, materials and accessories, inadequate telephone services, inability to replace broken-down equipment and facilities and lack of ICT equipment were major challenges (Onwuagboke et al., 2014).

Among the barriers to the implementation of ICT use by teachers and students in the northeast African countries include lack of electricity and frequent power outages, poor technology infrastructure, over-crowded computer labs, low bandwidth, high costs of internet connectivity, software licenses, equipment maintenance, insufficient and inappropriate software. Further challenges to be faced for the use of ICT in pedagogy include optional status of ICT integration in across the curriculum, more emphasis on teaching basic computer skills rather than ICT as a tool of teaching other subjects through printed and non printed media such as audio, video technologies (Nirmala et al., 2013).

According to Tedla (2012), the integration of ICT in classroom instruction in East African countries remains far behind because of several inhibiting factors. The main factors are inadequate infrastructure, lack of realistic policy, vision and strategies on ICT use in education, lack of pre-service and in-service teachers' training, poor teachers' welfare and morale, lack of parent and community participation, political and social conflict among others. There is a

scarcity of documented information on the challenges faced by teachers and students in secondary schools of Eritrea in the integration of ICT in teaching and learning processes. Hence, this study sought to explore the challenges faced by teachers and students in the integration of ICT in secondary schools of the Southern Region, Eritrea.

2.8 Summary

Various studies showed that ICT plays an integral part in improving the quality of education. Integrating ICT in education has been a popular topic everywhere in the world. In developed countries, it has shown better use of ICT in education, but in developing countries like the majority of African countries, the use of ICT needs consideration. Many researchers have studied and identified factors that influence ICT integration in education. From the reviewed literature, it is evident that the integration of ICT in instruction could be influenced by the availability of ICT resources in secondary schools; teachers' skills for ICT integration in classrooms; teachers' attitude to the use of ICT in their teaching and the instructional methods used by teachers in the classroom instructions. If these factors were put in place, ICT integration in the classroom of the schools would be practical.

Based on the literature reviewed, most of the studies conducted on the integration of ICT were from outside Eritrea. In most developing countries, preparing teachers with the necessary ICT knowledge and skills and providing

adequate ICT resources were the key challenges for ICT use in classroom instruction.

In Eritrea, there is a scarcity of documented kinds of literature about the availability of ICT resources for teaching and learning in secondary schools and the level of training of teachers on how to integrate ICT in education. Furthermore, little is known about the attitude of secondary school teachers towards ICT in education and the methods of teaching practiced by teachers. The study, therefore, sought to bridge these gaps by studying the integration of ICT in teaching and learning of Biology in secondary schools of the Southern Region of Eritrea.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the procedures and methodology that was used in this study. It covers research design, area of the study, target population, sampling design and procedure, research instruments, reliability and validity of the research instruments, data collection and analysis procedures.

3.2 Research Design

This study used a descriptive survey research design. The descriptive research design was appropriate since it allows describing events as they are at the time of the research and this study required original data from the respondents to describe the integration of ICT in teaching and learning of Biology in secondary schools of Southern Region, Eritrea.

According to Orodho, Khatete and Mugiraneza, (2016), descriptive research design is defined as a plan for describing a given situation. It attempts to provide an accurate description of the parameters of the study. Besides, survey design is used to collect data from members of a population to determine the existing status of that population in one or more variables (Mugenda and Mugenda, 2003). The descriptive survey design used to collect data using various instruments to describe the characteristics of the population under study.

The researcher collected quantitative and qualitative data from teachers' questionnaire, students' questionnaire, observation checklist and school directors' interview.

3.3 Research Variables

In this study, the independent variables were availability of ICT resources in the schools, skills of teachers for ICT integration in the classroom teaching and learning, teachers' attitude towards integrating ICT in instruction and methods of teaching used by Biology teachers in their lessons. The dependent variable was the integration of ICT in teaching and learning of Biology.

3.4 Location of the Study

The study took place in the Southern Region Eritrea. This region is located in the southern part of the country bordered by Central region in the north, Northern Red Sea in the east, Gash-Barka region in the west and Ethiopia in the south. The total area of the region is 8,000 square kilometres. It has a population of about 1.5 million, and its population density is 180/km^2. Its capital is Mendefera. It is the largest region by population in the country. There are three ethnic groups, Tigrigna, Saho and Tigre. The region is divided into twelve (12) administrative sub-regions. The sub-regions are Adi-Keyh, Adi-Quala, Areza, Debarwa, Dekemhare, Emni-Haili, Mai-Ayni, Mai- Mne, Mendefera, Segheneyti, Senafe and Tsorona (See Appendix V).

The economy of the majority of people depends mainly on subsistence agriculture. The region is predominantly rural, but its urban population is increasing as the towns are growing rapidly. The region was chosen because the performance of learners in Biology national examinations was low as compared to the national level. It also has the highest population where the majority of the people depend on agriculture and studying Biology is highly related to agriculture. As well as low performance in Biology may discourage students of the region from studying Biology. The region also has the highest number of secondary schools in a smaller area where it can give a better picture of the secondary schools' condition of ICT integration in instruction. The researcher's familiarity with the region could also help in the collection of accurate and in-depth data for the study. Finally, there was limited research of such kind conducted in the region.

3.5 Target Population of the Study

The target population for the study comprised 27 public secondary schools of the southern region, 27 school directors, 78 Biology teachers and 1664 grade eleven Biology students of secondary schools of the southern region, Eritrea. The research targeted secondary school Biology teachers since the study was to investigate the integration of ICT in Biology. School Directors were targeted because they are responsible for the provision, administration and utilization of teaching-learning resources within their schools. Science/Biology Students of grade-11 were targeted because they had better knowledge and experience about

their schools' teaching and learning practices compared to the students of grade 9 and 10 in their respective schools.

3.6 Sampling Technique and Sample Size

3.6.1 Sampling Technique

Sampling is defined as the process of selecting a subset of cases in order to draw conclusions about the entire set (Orodho, 2017). In this study, stratified, purposive sampling and simple random sampling techniques were used. Stratified sampling was used to determine a sample of 12 schools from 27 public secondary schools. It was done to make sure all schools in the sub-regions were represented in the study. The region is divided into 12 sub-regions. Schools were stratified or grouped by sub-region then one school was selected randomly from each sub-region. In the sub-regions that had one secondary school, the schools were purposively selected.

The school directors of the sampled schools were purposively selected to participate in the study. Simple random sampling technique was further applied to obtain Biology teachers and 10.5% of students of grade eleven, making 175 students from the sampled school. From the sampled school, three (3) Biology teachers, one teacher from the list of teachers who teach grade 9, grade 10 and grade 11 was randomly picked to participate in the study. According to Ary, Jacobs and Razaviel(1972), a sample size between 10-20 percent of a population is acceptable to represent the population of a study is descriptive research.

3.6.2 Sample Size

The sample size of the study comprised secondary schools, school directors, Biology teachers and students. This is summarized in Table 3.1

Table 3.1

Sampling Grid

Category	Target Population	Sample Size	Percentage (%)
Schools	27	12	44
School Directors	27	12	44
Biology Teachers	78	34	46
Students	1664	175	10.5
Total	1769	221	12.5

3.7 Research Instruments

In this research, three-research instruments were used for data collection: questionnaire, interview and observation schedule.

3.7.1 Questionnaires for Teachers

Questionnaire is commonly used to obtain information about the population under study and each item in the questionnaire is designed to address a specific objective and research question of the study (Mugenda and Mugenda, 2003 and

Orodho, 2017). It is cost effective and enables the researcher to collect much information from large number of participants within a short period. It is also easier to manage and analyze since the items are set to meet the objectives of the study. Furthermore, it gives freedom to the respondents to express their views freely. In the study, two types of questionnaires were prepared by targeting the Biology teachers and students.

Questionnaire for Biology teachers was designed such that each question was related to a given study objectives, and a semi-structured questionnaire was applied in the study. The questionnaire contained items that address the availability of ICT resources, teachers' skills for integration of ICT in instruction, teachers' attitude towards ICT integration, methods of teaching used by teachers of Biology in their lessons and finally items that address the challenges of ICT integration in secondary schools of the Southern Region of Eritrea.

3.7.2 Questionnaire for Students

The students' questionnaire included both closed-ended and open-ended questions. Open-ended questions were to help complement the information given in the closed-ended questions. The information from students verifies the consistency of the data obtained from Biology teachers on the integration of ICT in teaching and learning. The student questionnaire focused on the use of ICT in teaching and learning of Biology and the challenges faced by teachers and students in the integration of ICT in classrooms.

3.7.3 Interview Schedule for School Directors

Interview is a research instrument used to obtain direct information by a face-to-face encounter with the interviewee. Sometimes it can also be done by telephone if meeting face to face is not possible. Interview schedule allows the researcher to collect complete, detailed and deeper information by further probing toward the issues that may arise during the interview (Orodho, 2017). Semi-structured interview for school Directors was used to gather more information about ICT integration in Biology lessons and to verify the responses given by teachers and students in the questionnaire. The interview helped get more and detailed information since it allows probing questions.

3.7.4 Observation Schedule

Observation schedule is an instrument where the researcher utilizes an observation checklist or form to record what he or she observes during data collection (Mugenda and Mugenda, 2003). In this study, there was a checklist for ICT resources and their use in teaching-learning Biology sessions. The researcher visited one classroom in each sampled school to observe ICT resources, the integration of ICT in Biology lessons and the methods of teaching used in Biology classrooms. In each school, one lesson was observed, and the information obtained from observation was compared with the information gathered through questionnaire and interview to discuss and describe the use of ICT and the teaching methods used in the schools.

3.8 Piloting Study

A pilot study was carried out before the actual collection of data. Piloting was done to ensure the validity and reliability of the instruments. Ambiguous items were revised and framed. The pilot was conducted in one secondary school of the Southern Region, which had the same characteristics as the sampled schools. The school was selected randomly from the sub-regions, which had more than one secondary schools. School director, randomly selected three Biology teachers and fifteen Biology students participated in the pilot study. The piloted school was excluded from the actual study since the items were already familiar with the respondents, and the responses would affect the reliability of the information.

3.8.1 Validity of the Research Instruments

Validity refers to the degree of accuracy of an instrument, and it concerns whether or not the instrument measures what it is supposed to measure (Orodho,2017). The validity of the instruments was established through the discussion and assistance with supervisors and colleagues' opinions. The suggestions and clarification obtained were incorporated into the research instruments. Piloting was also held to determine the content validity of the instruments in the study. Vague items were revised when the instruments were tested during the pilot study.

3.8.2 Reliability of the Research Instruments

Assessing the reliability of an instrument of the study is essential before using it to collect the actual data. According to Mugenda and Mugenda (2003), reliability is defined as a measure of the degree to which research will yield consistent results after repeated trials. If the instrument is to be reliable, the test done over a repeated period should demonstrate similar results. The reliability of the instruments was established by test-retest technique. Three Biology teachers and fifteen students were asked to respond to the questionnaires. After two weeks, the researcher distributed these questionnaires to the same respondents. The two sets of responses were correlated, and a correlation coefficient was calculated. Pearson correlation coefficient was applied to establish the reliability of the instruments. The completed questionnaires of the two tests were computed using Pearson correlation. A correlation coefficient (r) of 0.78 was obtained. According to Orodho, Nzabalirwa, Odundo, Waweru and Ndayambaje, (2016), a correlation coefficient (r) of 0.75 and above will be high enough to judge the reliability of an instrument. Since the obtained result was higher than 0.75, the instruments can be considered reliable to the study. Triangulation using the data from students' questionnaire, teachers' questionnaire, interview of the school director and observation schedule was also used to ensure the reliability of the information collected from the sampled schools.

3.9 Data Collection Procedure

3.9.1 Logistical and Ethical Considerations

In the study, a number of ethical considerations were underlined. The researcher informed the purpose and objectives of the study to participants. Participants of the research were not forced to participate without their consent. The researcher also informed the participants that their responses' confidentiality and anonymity would be preserved. They were also assured that no name or personal data would be disclosed. The research did not involve any sensitive and harmful information during the data collection. Participants were also assured that the data collected were to be treated confidentially, and the information obtained will only be used for academic purpose.

The researcher was able to visit the sampled schools., after getting the research permit for data collection from Kenyatta University (See Appendix VI) and National Commission of Higher Education (NCHE) Eritrea (See Appendix VII). The researcher visited and communicated with the Southern Region MOE officers and school directors of the sampled schools before the time of actual data collection to create a rapport with them and reduce the Hawthorne effect during the actual data collection. According to Mugenda and Mugenda (2003), the Hawthorne effect refers to a situation where awareness motivates participants to respond and perform well during the data collection.

3.9.2 Data Collection

The researcher, with the assistant researcher, distributed the questionnaires to teachers and students. Ample time was given to fill in, and the filled questionnaires were collected on the same day. After collecting the questionnaire, the classroom observation was done by the researcher focusing on the methods of teaching used by Biology teachers and use of ICT resources in their lessons. The computer laboratory and Biology laboratory rooms were visited to see whether they were equipped with ICT resources. Finally, School directors were interviewed in the respective director's offices. The information was gathered through school directors interview, Biology teachers' questionnaire, Biology students' questionnaire, and observation schedule to investigate the integration of ICT in secondary schools of the Southern Region of the country.

3.10 Data Analysis

The data collected included both qualitative and quantitative data. The qualitative data obtained from the open-ended questions whereby categorized and analyzed thematically based on research objectives.

The quantitative data collected from the sampled secondary schools using teachers' questionnaire, students' questionnaire interview and observation schedules were organized, cleaned, coded and entered into a computer program Statistical Package for Social Sciences (SPSS) for analysis. The quantitative data

were analyzed using descriptive statistics such as mean and percentages. The data were presented in the form of tables and figures such as percentages, bar graphs and pie charts. Finally, the analyzed data was discussed and used for making conclusions and recommendations, as demonstrated in the following chapters.

CHAPTER FOUR

DATA PRESENTATION ANALYSIS AND DISCUSSION

4.1 Introduction

The purpose of the study was to investigate the integration of Information and Communication Technology in teaching and learning of Biology in secondary schools of the Southern Region of Eritrea. This chapter presents the study results, analysis, interpretation of the data collected from the field and discussion of the research findings based on the study objectives. The study was guided by the following five objectives: to determine availability of ICT resources for teaching and learning of Biology in secondary schools of Southern Region, Eritrea; to ascertain teachers' skills for ICT integration in teaching and learning of Biology; to establish the teachers attitude towards integrating ICT in instruction; to establish the instructional methods used by the teachers of Biology, and to explore challenges faced by teachers and students in the integration of ICT in teaching and learning.

4.2 Response Rate

In this study, the participants were school directors, Biology teachers and students. Questionnaires were distributed to Biology teachers and students. Table 4.1 shows the return rate of respondents.

Table 4.1

Response Rate

Respondents	Targeted	Obtained	Response rate (%)
School Director	12	12	100.0
Teachers of Biology	36	34	94.4
Students	180	175	97.2
Total	228	221	96.9

Source: Teachers' and Students' Questionnaires

As shown in table 4.1, from the targeted respondents, two questionnaires from teachers and five questionnaires from students were not returned, so the participation rate was reduced to 34 (94.4%) of the teachers and 175 (97.2%) of the students. Regarding school directors, the study sampled 12 school directors from 12 secondary schools and 12 of them interviewed; therefore, the response rate was 100%. Overall, the response rate of respondents was 96.9%.

4.3 Demographic Information of Respondents

This section provides the demographic data of the respondents who participated in the study. The demographic information of school directors, Biology teachers and students are described in the following sub-sections.

4.3.1 Demographic Information of School Directors

This section presents the demographic information of the school directors who participated in the study. The demographic data explored in the study were gender, computer literacy and professional experience.

a) Gender of school directors

In the study, 12 school directors participated in the interview, and all the school directors were males. This shows that in the sampled school, there were not female school directors.

b) Computer training of school directors

The findings of the study show that all the school directors were computer trained and could able to play a role in supporting other teachers to use ICT in classroom teaching in their schools.

c) Professional experience of the school directors as principals

The distribution of school directors based on their professional experience was as described in table 4.2.

Table 4.2

Professional Experience of the School Directors as Principals

Years of experience	Frequency	Percentage (%)
1-5	4	33. 3
6-10	5	41.7
11-15	2	16.7
16-20	1	8.3
Total	12	100.0

Source: School Directors' Interview

The sampled school directors had varied professional experience in the current post as indicated in table 4.2. One-third of the directors (33.3 %) had less than or equal to five years of experience, 41.7% had between 6 and 10 years of experience. Other 16.7% of the directors had between 11-15 years of experience, and 8.3% had between 16 and 20 years of experience. This shows that most of the school directors (75%) had professional experience of less than ten years.

4.3.2 Demographic Information of Biology Teachers

This section presents the demographic information of Biology teachers involved in the study. Teachers were the main targets of the study because teachers mainly implement ICT integration. The demographic data explored were gender, age, teaching experience, computer literacy, class size and workload of teachers.

a) Gender composition of teachers

The composition of teachers based on their gender was as presented in figure 4.1

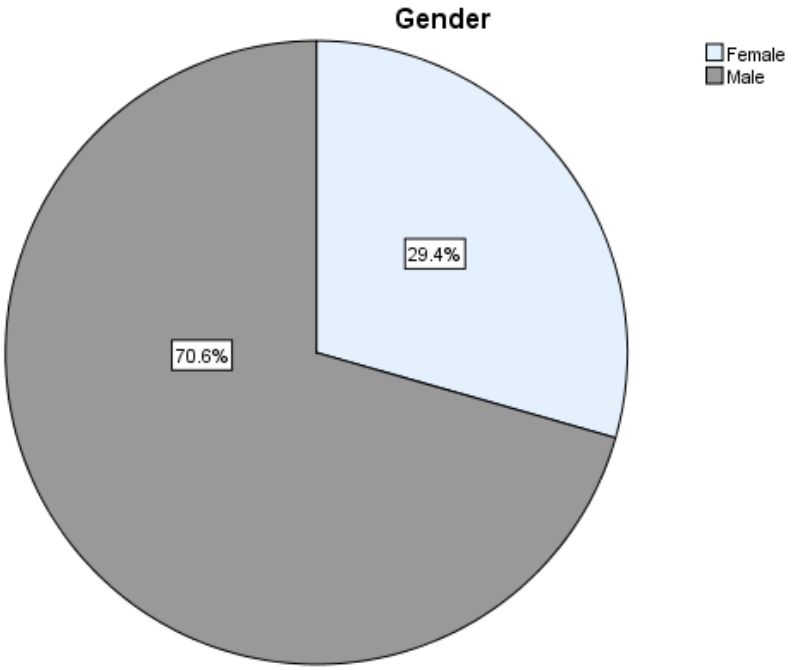

Figure 4.1. Gender composition of teachers

Source: Teaches' Questionnaire

The finding in figure 4.1 shows the gender composition of teachers who participated in the study. The greater part (70.6%) of the respondents were male teachers, and the remaining (29.4%) were female teachers. This shows that both male and female teachers participated in the study.

b) Age distribution of teachers

Age distribution of teachers was integrated into the study. The sampled teachers of Biology had varied distribution of age, as indicated in figure 4.2.

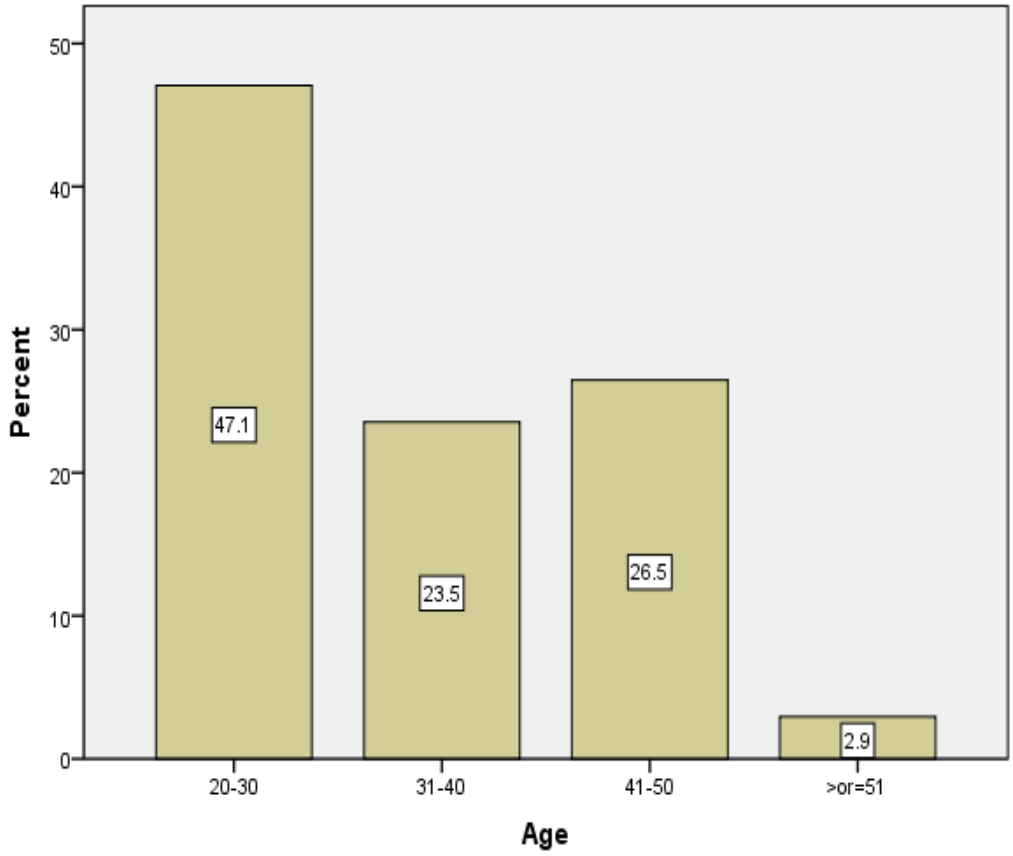

Figure 4.2. Age distribution of teachers

Source: Teachers' Questionnaire

Figure 4.2 shows 47.1% of the teachers were aged between 20 and 30 years, followed by 26.5% aged between 41 and 50 years. Another 23.5% were aged between 31 and 40 years. There was only one teacher aged above 50 years in the sampled schools. Majority of the teachers (70.6%) fall in the age range of 20 and

40 years. This shows most teachers that participated in the study were at young were they could easily accept the use of technology in their teaching.

c) Teachers' professional experience

The experience of teachers in their teaching profession was considered in the study. The distribution was as presented in table 4.3.

Table 4.3

Teachers' Professional Experience

Experience	Frequency	Percent
1-2	10	29.4
3-4	5	14.7
5-6	6	17.6
7-8	4	11.8
>9	9	26.5
Total	34	100.0

Source: Teachers' Questionnaire

Table 4.3 shows 29.4% of respondent teachers had between 1 and two years of experience, seconded by 26.5% of the teachers who had nine and above years of teaching experience. Furthermore, 17.6% of teachers had the experience of between 5 and 6 years, and 14.7% of the teachers had experience of between 3 and 4 years, and 11.8% of teachers had the experience of between 7 and 8 years. The study found that the majority of the participant teachers were novice of 1-2 years and above 9 years of experiences. This shows that the teachers had different years of experiences in teaching.

d) Computer Literacy of teachers

The researcher sought information on computer literacy levels among Biology teachers. The Findings were as illustrated in Table 4.4.

Table 4.4

Computer Literacy of Teachers

Literate	Frequency	Percent%
No	3	8.8
Yes	31	91.2
Total	34	100.0

Source: Teachers' Questionnaire

From table 4.4, out of the 34 teachers of Biology, 91.2% had computer literacy training, while 8.8% had no computer literacy training. This shows that majority of Biology teachers had received computer literacy training, though the training was not adequate to have competency in computer.

e) Teachers' workload

The workload is the number of periods the teacher teaches in a week. The lowest and highest periods that the teachers had were 15 and 32, respectively. The mean of periods that a teacher had was 23 in a week. If teachers have a heavy workload, it can be a barrier to prepare ICT based classroom lessons.

f) Class size in Biology classrooms

Class size is the number of students in a classroom in a Biology lesson. From the sampled schools, the minimum class size was 46, and the maximum was 73 students in a Biology classroom. The average number of students per class in the sampled schools was 64. This is too large to manage the students' activity in the technology-enhanced learner-centered classroom instruction. In large class size, to use ICT and leaner-centered learning could be a challenge.

4.3.3 Demographic Information of Students

This section presents the demographic information of students involved in the study. The demographic data explored were gender and computer literacy.

a) Gender Distribution of Students

The gender distribution of students involved in the study was as presented in figure 4.3.

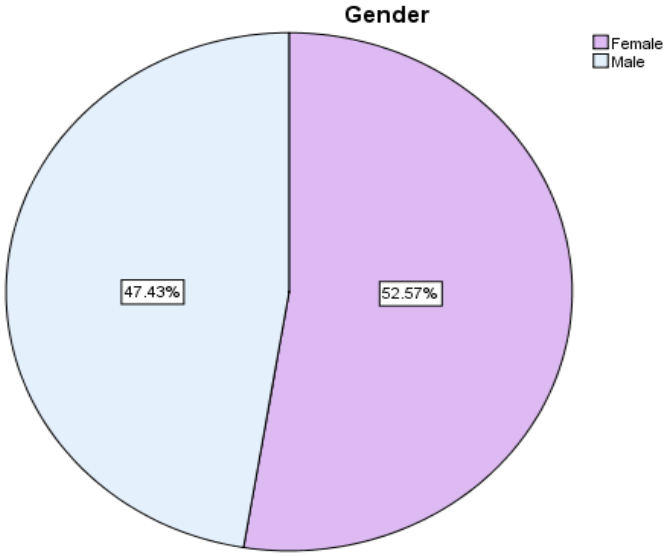

Figure 4.3. Gender distribution of students

Source: Students' Questionnaire

Figure 4.3 illustrates the gender composition of students participated in the study. Ninety-two representing 52.6% of the respondents were female students while eighty-three representing 47.4% were male students. This shows that both male and female students participated in the study.

b) Computer Literacy of Students

The level of computer literacy of students was also included in the study. The level of computer literacy of the sampled students was as presented in figure 4.4.

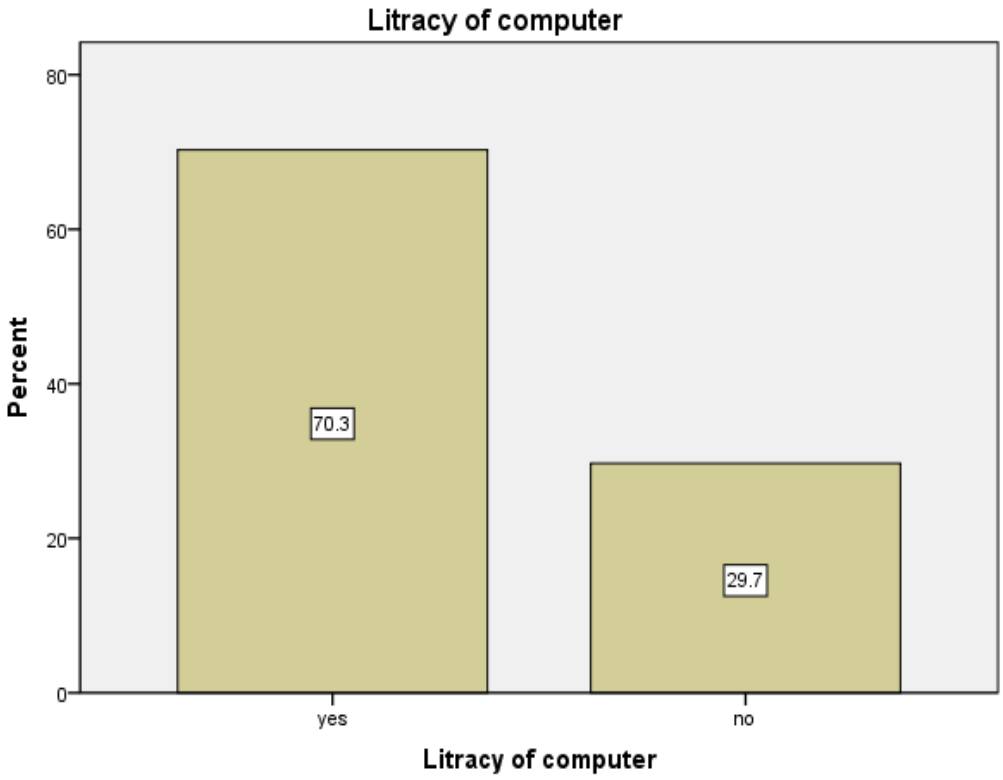

Figure 4.4. Computer literacy of students

Source: Students' Questionnaire

From figure 4.4 out of the 175 sampled students, one hundred and twenty-three representing 70.3% had computer literacy, while fifty-two representing 29.7% had no computer literacy. The finding shows that majority of the students had attended in computer training.

4.4 Availability of ICT Resources in Schools

This was the first objective of the study, which sought to determine the availability of ICT resources for teaching and learning of Biology in secondary schools of the Southern Region of Eritrea. To achieve the objective, data was obtained from an interview of school directors, observation checklist and from the questionnaires of teachers.

Using the observation checklist, the researcher visited and observed the sampled twelve schools. The results of the availability of ICT resources in these schools are presented in table 4.5. This indicates any ICT resources available in the school that was used for teaching ICT and other purposes.

Table 4.5
Availability of ICT Resources in the Study Schools

NAME OF ITEMS	AVAILABLE	
	Frequency	Percentage (%)
Desktop Computers	12	100
Computer laboratory	10	83.3
Laptops	6	50.0
Projectors	7	58.3
Printers	11	91.7
Photocopier	4	33.3
Radios	3	25.0
Televisions	11	91.7
Video players	7	58.3
CDs, DVDs/VCDs	8	66.7
Storage of ICT resources	3	25.0
Digital content of biology	5	41.7

Source: Observation Checklist of Researcher

As shown in table 4.5, all schools had desktop computers on average of 20 computers per school. The available computer in the schools, however, were mainly used for teaching ICT as a subject. Majority (83.3%) of the schools had Computer laboratory (ICT lab). Ventilated and separate ICT storage was present in 25% of the schools. Half (50%) of the schools had laptops, 58.3% of the schools had projectors (overhead or LCD projectors). In addition to these, 91.7%

of the schools had Television (TV), 66.7% of schools had digital storage devices like CDs, DVDs, VCDs. Video players were available in 58.3% of the schools. Majority of the schools had printers whereas only 33.3% of the schools had photocopiers. The digital content of Biology was available in 41.7% of the schools. Internet services were not introduced in the schools, and resources like tablets, smart phones and educational games were absent in the schools. These resources are very few and inadequate for teaching and learning of Biology. This finding was in tandem with a study conducted to analyze the technological integration in teacher education conducted in Ghana that showed one of the challenges of Gahanna education system on integrating ICT was lack of technological resources (Agyei, 2013).

These findings are also in tandem with a study conducted to assess the availability and utilization of ICT for teaching and learning and to establish hindering factors for the utilization of existing ICTs in secondary schools in kwekwe, Zimbabwe. The research showed that most of the ICTs required for training were not available in the sampled schools, and those that were available were inadequate. The study also revealed that the available ICT resources were utilized by teachers to a very low extent (Mavellas, Wellington and Samuel, 2015).

The power supply in schools is fundamental in the use of ICT resources in teaching and learning. Table 4.6 illustrates the distribution of power supply in the sampled schools.

Table 4.6

Power Supply in the Schools

Source	Frequency	Percentage
Electricity	6	50
Solar	5	41.7
Generator	1	8.3
Total	12	100

Source: School Directors' Interview

As indicated in table 4.6, all the sampled schools had power supply from different sources. Half (50%) of schools had electricity connection, whereas the remaining half were relying on solar energy and generator. The respondents revealed that there was frequent interruption and irregularity of power supply and this created inconveniences for the use of ICT in schools. Similar result was also found by Manu, (2014) in Nigeria. Research finding revealed that challenges facing ICT usage were inadequate infrastructures like electricity and telecommunication services.

In the availability of ICT resources, qualitative data gathered from school directors interview also corroborated the data found from observation. All the school directors revealed that majority of the schools had computer laboratory which was equipped with computers, laptops and projectors. In addition to that, printers, TV set, digital storage devices and photocopiers were available either in the offices or in stores. Internet services were not yet introduced in schools.

Besides the availability of resources, school directors had a concern on the adequacy of the resources. A school director from one of the sampled schools described that:

> As per the question to mention the availability of resources majority of our schools are equipped with ICT resources such as computers, computer laboratories, projectors and laptops for teaching ICT subject. However, the resources are inadequate for teaching other subjects. In addition to that, electricity is available in our school, but it is not regular. (School director No. 5, 2018).

As per the school director quotation, the ICT resources available in the schools are inadequate and were accessible only for teaching ICT subject. Based on the data from school directors even in ICT lessons, the ratio of computers to students in the computer laboratory was 1:3 on average. In the computer laboratory, three students shared one computer in ICT subject lessons.

Teachers' response to the availability of ICT resources for Biology teaching and learning in the schools were reported as illustrated in figure 4.5 for ICT resources accessible for teaching ICT as a subject and table4.7 for the ICT resource center for teaching Biology.

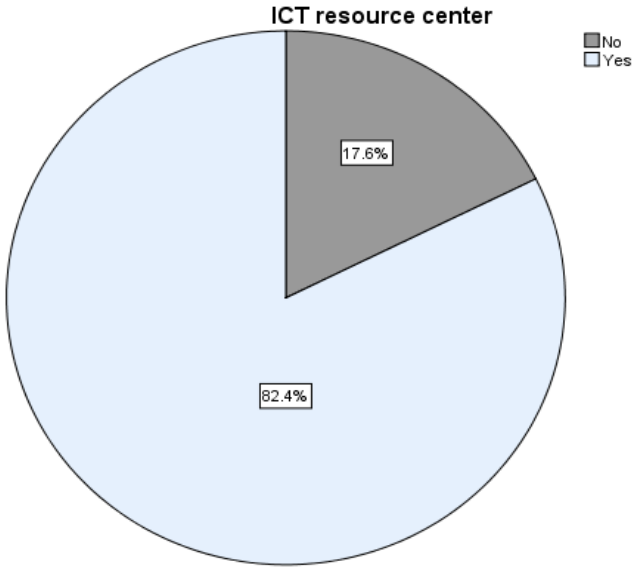

Figure 4.5. Availability of ICT resource center in schools

Source: Teachers Questionnaire

Figure 4.5 illustrates that 82.4% of teachers confirmed the availability of ICT resources center in the schools and the remaining 17.6% of teachers said there was no ICT resource center in their schools. The ICT resources commonly mentioned by teachers were computers, TVs, video players, printers, laptops, projectors. This finding shows that in the majority of the schools ICT resource center were available. Various studies ascertained that the availability of ICT resources is one of the main factors for ICT integration in teaching and learning. If these resources are not adequate in schools, it can prevent effective use of ICT in classrooms. A study conducted in Chile on the availability and use of ICT revealed that even though favorable conditions were set, ICT integration was

limited to a few specific resources like computer and projector (Brun and Hinostroza, 2014). ICT resources for Biology were as described in table 4.7.

Table 4.7
ICT Resources for Teaching Biology

ICT for Biology	Frequency	Percent
No	30	88.2
Yes	4	11.8
Total	34	100.0

Source: Teachers' Questionnaire

As shown in table 4.7 majority (88.2%) of Biology teachers reported there were no ICT resources for teaching and learning of Biology. Teachers of Biology also revealed that internet service was not introduced in schools, and the supply of electricity was irregular during schooling time. Biology teachers had no access to available resources. The available ICT resources were accessible only for ICT teachers teaching ICT as a subject. So that secondary school biology teachers reported that they do not use ICT resources in Biology lessons on a weekly basis. Few teachers (11.8%) said they use ICT resources in summarizing the topic at the end of chapters. This finding is in agreement with Onwuagboke, Singh and Onwuagboke, (2014) that the extent of availability, accessibility and utilization of ICT resources in secondary schools for teaching and learning was very poor. According to the responses of more than 80% of the respondents, ICT resources were not available in the schools under study; ICT resources can only

be accessed and utilized by teachers and students if they are available in the schools for teaching and learning.

4.5 Teachers' Skills for ICT Integration in Teaching and Learning

The second objective of the study was to investigate teachers ICT skills for integration in teaching and learning of Biology. To achieve this objective, the researcher collected data from the interview with school directors and a questionnaire distributed to teachers. Before reviewing the knowledge and skills of teachers on how to integrate ICT in teaching and learning, it is vital to look at the teachers' literacy level on computer or ICT. This is because literacy in computer is a prerequisite to ICT integration skills in instruction. Inadequate computer literacy may lead to spending time in learning technology than using technology for teaching and learning (Mwanaszumbah, 2015). Figure 4.6 describes computer training level of teachers.

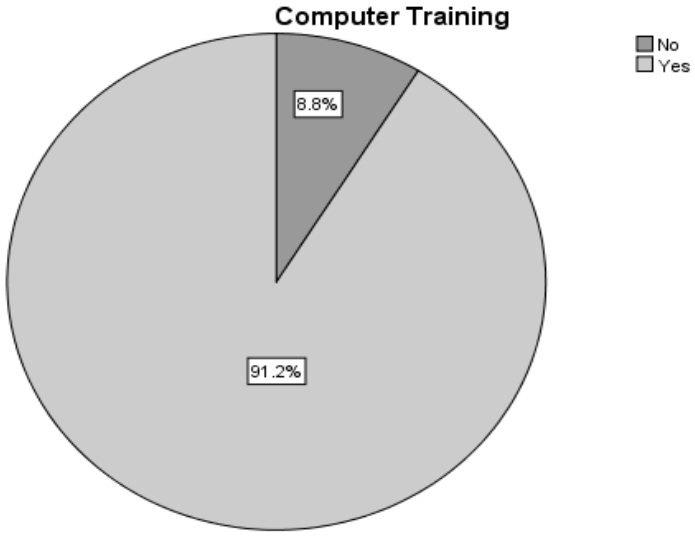

Figure 4.6. Computer training of teachers

Source: Teachers' Questionnaire

Concerning computer literacy, majority (91.2%) of the Biology teachers were computer literate whereas few (8.8%) of the teachers were not computer literate. This finding aligns with Michael, Maithya and Cheloti, (2016) that majority of the respondents received ICT training to literacy level and they showed limited ICT competence and confidence to use ICT for teaching and learning. This shows that majority of Biology teachers had computer literacy training, though the training was not adequate to have competency in computer.

On the other hand, all school directors confirmed that majority of the teachers had received computer literacy training at least once in their previous studies. This computer training was an introductory level. The computer class was dominated by theory due to the limited ICT resources, and trainees use on the computer for three students. However, having computer literacy does not imply having the knowledge and skill of ICT integration in teaching and learning.

Apart from ICT or computer literacy, Biology teachers were asked whether they had received any specific formal training on how to integrate ICT in teaching and learning. When teachers undergo formal and adequate training on how to use ICT in education in addition to computer training, it enables them to use ICT in their teaching. Table 4.8 illustrates the Biology teachers' ICT integration skills.

Table 4.8

Teachers' Formal training on ICT integration Education

Training	Frequency	Percent
No	29	85.3
Yes	5	14.7
Total	34	100.0

Source: Teachers' Questionnaire

From table 4.8, the majority (85.3%) of Biology teachers reported that they had received no formal training on how to integrate ICT in education. In comparison, 14.7 % said they had participated a training on ICT integration in instruction. School directors also confirmed that there was no formal training given to teachers on how to integrate ICT in teaching and learning. Therefore, teachers were not aware of how to integrate ICT in Biology classrooms. The findings were in tandem with the study that showed teachers face major challenges such as developing their own technological skills and knowledge as well as self-training in the use of ICTs in their teaching (Amuko, 2015). However, this result was in contrast to the findings of Sulaiman, Hindatu and Lawal (2017) that revealed Biology teachers were trained and aware of the usefulness of ICT in the teaching and learning process. However, the majority of

them were not using ICT for Biology teaching due to other hindering factors such as inadequate ICT facilities, power failure and allocation of time in the timetable of the lessons. This finding was also in contrast to Mwanaszumbahs' (2015) study, whereby majority (72%) of the teachers in Nairobi had received some form of formal training on how to integrate ICT in classroom teaching and learning.

Use of ICT in the classroom can be influenced by several factors. ICT competency of teachers is one among other factors (Makanda, 2015). When teachers have adequate knowledge and skill of ICT, they can easily use ICT in their classroom teaching. Table 4.9 illustrates the use of ICT in Biology classrooms.

Table 4.9

Use of ICT in Biology Classrooms from Teachers' Responses

Statement	**SA**	**A**	**N**	**D**	**SD**
Teachers of Biology in this school can	3	5	2	9	15
easily access the various ICTs.	8.8%	14.7%	5.9%	26.5%	44.1%
Students of Biology in this school can	1	6	3	13	11
easily access the various ICTs	2.9%	17.6%	8.8%	38.2	32.4%
Teachers of Biology in this school	0	1	2	10	21
always use the ICT resources in every	0	2.9%	5.9%	29.4%	61.8%
Biology lesson					
All teachers of Biology allow students	0	2	5	8	19
to perform tasks using the ICT	0	5.9%	14.7%	23.5%	55.9%
resources					
Teachers of Biology in this school use	2	4	3	9	16
laptops and projectors in teaching	5.9%	11.8%	8.8%	26.5%	47.1%

Source: Teachers' Questionnaire

Key: SA= Strongly agree, A= Agree, N= Neutral, D= Disagree, SD= Strongly Disagree

Teachers were asked to rate the use of ICT in biology lessons by teachers and students on the provided likert scale. Teachers had to answer strongly agree, agree, neutral, disagree and strongly disagree for each statement.

For the statement "Teachers of Biology in this school can easily access various ICT resources," 70.6% of the teachers were aware that no access to available ICT resources for Biology teachers.

In the second statement, 38.2% of teachers disagreed, 32.4% of them strongly disagreed that students in this school can easily access the various ICT resources. Few teachers (8.8%) were neutral whereas 17.6% of teachers agreed to that.

The study indicated that the majority (61.8%) of teachers strongly disagreed that teachers of Biology in this school always use the ICT resources in every Biology lesson.

For the statement "All teachers of Biology allow students to perform tasks using the ICT resources," 79.4% of Biology teachers were aware that students not allowed performing tasks using ICT resources.

Lastly, 73.6% of the teachers did not agree that teachers of Biology in this school use laptops and projectors in teaching. These findings show that Biology teachers were not using ICT resources in their teaching. The findings were congruent with Yusuf, Maina and Dare (2013) that revealed there were very poor level of utilization of the available ICT facilities and constant electricity power failure during the instructional time. The study also revealed that most of the teachers lacked the knowledge and skill to use ICT in teaching. Majority, (78%) of teachers considered their ICT training to be at poor level.

Students were also asked whether their Biology teachers use ICT in classes. The following table shows students responses to the use of ICT in Biology classrooms.

Table 4.10

Use of ICT in Biology Classrooms from Students' Responses

Statement	**SA**	**A**	**N**	**D**	**SD**
Students can easily access the various ICT resources in this school.	13 7.4%	15 8.6%	24 13.7%	57 32.6%	66 37.7%
Teachers of Biology always use ICT in each Biology lesson	3 1.7%	11 6.3%	11 6.3%	41 23.4%	109 62.3%
Teachers of Biology allow students to perform tasks using the ICT	11 6.3%	16 9.1%	22 12.6%	65 37.1%	61 34.9%
Biology teachers give reference to the internet as source of information	8 4.6%	9 5.1%	7 4.0%	57 32.6%	94 53.7%

Source: Students' Questionnaire

Key: SA= Strongly agree, A= Agree, N= Neutral, D= Disagree, SD=Strongly Disagree

As in table 4.10, greater part (70.3%) of the students indicated that students were not accessing various ICT recourses in the schools.

Majority (85.7%) of students responded that teachers do not always use ICT in each Biology lesson.

For the statement "Teachers of Biology allow students to perform tasks using the ICT," 72% of students were aware that Biology students do not perform tasks using the ICT.

On the same note, the finding of the study showed that 86.3% of students did not accept that Biology teachers give reference to the internet as a source of information. These findings of the study show that majority of the teachers and students either strongly disagreed or disagreed to the use of ICT resources by Biology teachers in the school.

All school directors reported that Biology teachers did not fully use ICT in their lessons; only a few teachers show video and still pictures related to their topics when summarizing the topic or the chapter. Classroom observation by the researcher also confirmed ICT was not used in Biology lessons of the schools involved in the study. Teachers and students of Biology have not engaged in any ICT integrated lessons. This shows that majority of teachers were not well trained on how to integrate ICT in classroom instruction.

The findings from teachers' and students' questionnaires, school directors interviews and classroom observations confirmed that ICT was not effectively used by Biology teachers and students in Biology classrooms. This study is in agreement with Mavellas, Wellington and Samuel, (2015) that found out that most of the ICTs required for training were not available in the sampled schools and those that were available were inadequate, the available ICT resources were

utilized to a very low extent. The study also identified lack of power supply, insufficient resources, fear of technology, lack of interest, ICT skills deficiency, higher ICT cost and poor physical infrastructure were the factors hindering the ICT utilization in these schools. The research findings of Alzahrani (2017) also showed that although there were adequate ICT types of equipment in the schools, the need for training on ICT for teachers was found to be fundamental. This indicates that there should be an emphasis on training of Biology teachers on how to use ICT in teaching and learning and on providing ICT resources for teaching and learning activities.

4.6 Teachers Attitude towards Integrating ICT in the Instruction of Biology

The third objective of the study was to establish the attitude of Biology teachers towards the integration of ICT in teaching and learning of Biology. The attitude of teachers was measured in Likert scale, ranging from strongly agree, agree, neutral, disagree and strongly disagree in the statements that determine the teachers' attitude as illustrated in table 4.11.

Table 4.11

Teachers' Attitude towards ICT Integration in Teaching Biology

Statement	SA	A	N	D	SD
Teachers of Biology in this school like using ICT in teaching	16 41.7%	11 32.4%	4 11.8%	1 2.9%	2 5.9%
Students understand Biology very well when ICTs are used	21 61.8%	9 26.5%	3 8.8%	1 2.9%	0 0%
ICT makes teaching and learning more interesting	28 82.4%	6 17.6%	0 0%	0 0%	0 0%
Integration of ICT in Biology lessons improves students' performance in Biology national examinations.	20 58.8%	12 35.3%	2 5.9%	0 0%	0 0%
Students in this school like the use of ICT in Biology lessons	10 29.4%	13 38.2%	7 20.6%	2 5.9%	2 5.9%
ICT makes the students to be active in the Biology lessons	19 55.9%	12 35.3%	3 8.8%	0 0%	0 0%
Much content is covered within a short time when ICT are used in Biology lessons	12 35.3%	15 44.1%	4 11.8%	2 5.9%	1 2.9%

Source: Teachers' Questionnaire

Key: SA= Strongly agree, A= Agree, N= Neutral, D= Disagree, SD=Strongly Disagree

From table 4.11 majority of Biology, teachers constituting 41.7% strongly agreed and 32.4% agreed that teachers of Biology in this school like using ICT in teaching. However, 11.8% of the respondents were neutral, while 2.9% of them disagreed, 5.9% of teachers strongly disagreed to the statement. Majority of the teachers 61.8% strongly agreed, and 26.5% of them agreed that students

understand Biology very well, when ICTs are used, however, 8.8% of the respondents were neutral to the statement. All Biology teachers either strongly agreed 82.4% or agreed 17.6% that ICT makes teaching and learning interesting. The study also showed that majority (58.8%) of Biology teachers strongly agreed followed by 35.3 % who agreed to the statement "Integration of ICT in Biology lessons improves students' performance in Biology national examinations," whereas 5.9% of teachers were neutral. For the statement "Students in this school like the use of ICT in Biology lessons," it was indicated that 29.4%, of teaches strongly agreed and 38.2% of them agreed together constituting 67.6% while few teachers 11.8% disagreed and strongly disagreed. However, 20.6% of teachers were neutral to that.

Majority of teachers 55.9% strongly agreed, and 35.3% agreed that ICT makes the students to be active in the Biology lessons. The study found out that 35.3% of teachers strongly agreed, 44.1% of teachers agreed that much content is covered within a short time when ICT is used in Biology lessons. However, 11.8% of the teachers responded neutrally. The few teachers who strongly disagreed and disagreed comprise 8.8%.

In each of the statement, teachers either agreed or strongly agreed. This shows that majority of the teachers had a positive attitude towards the integration of ICT in teaching and learning. Findings from other researches revealed that teachers believe that ICT could be used as a pedagogical tool in improving their teaching when there are adequate resources and infrastructures (Ndibalema,

2014). And a Positive attitude of teachers towards the integration of ICT in education has been seen as an important factor to encourage teachers to use ICT in their classroom (Player-Koro, 2012).

In addition to the attitude of teachers, as the beneficiaries of the ICT integration, the study also looked at the attitude of students towards the use of ICT in Biology learning. Table 4.12 shows the attitude of students towards the integration of ICT in teaching and learning.

Table 4.12
Students' Attitude toward ICT Use in Learning Biology

	SA	**A**	**N**	**D**	**SD**
ICT can help to improve students' performance in Biology	109	53	6	6	1
	62.3%	30.3%	3.4%	3.4%	0.6%
Teachers of Biology like using ICT when teaching Biology	35	44	69	12	15
	20%	25.1%	39.4%	6.9%	8.6%
Students easily understand Biology when ICT resources are used	90	58	19	4	4
	51.4%	33.1%	10.9%	2.3%	2.3%
ICT makes learning interesting to students	98	53	12	7	5
	56.0%	30.3%	6.9%	4.0%	2.9%
Students like the use of ICT in Biology lessons	103	56	11	1	4
	58.9%	32.0%	6.3%	0.6%	2.3%

Source: Students' Questionnaire

Key: SA= Strongly agree, A= Agree, N= Neutral, D= Disagree, SD= Strongly Disagree

As presented in table4.12, over 90% of students strongly agreed and agreed that ICT can help to improve students' performance in Biology, few students (3.4%) disagreed, and another few students (3.4%) were neutral.

The study found that 25.1% of respondents agreed, 20 % strongly agreed that teachers of Biology like using ICT when teaching Biology. However, 39.4% of the respondents were neutral to that, whereas 8.6% the students strongly disagreed and 6.9% of the respondents disagreed with the statement.

For the statement, "Students easily understand Biology when ICT resources are used" 51.4% of students strongly agreed. They were seconded by 33.1% of students who agreed, however, 10.9% were neutral. Little percentage (4.6%) of students strongly disagreed and disagreed.

Majority, more than 80% of students strongly agreed and agreed that ICT makes learning interesting to students, 6.9% of the students were neutral, whereas 6.9% of them disagreed, only 2.9% of the students responded strongly disagree.

The study found that 58.9% of students strongly agreed, 32.0% of respondents agreed, only 2.3% of students strongly disagreed that students like the use of ICT in Biology lessons, whereas 6.3% of respondents were neutral in their responses. This shows that the majority of students had a positive attitude towards the use of ICT in biology learning.

Majority of the interviewed school directors said that teachers in their schools had a positive attitude towards ICT integration. Teachers like using ICT and believe ICT makes teaching and learning more interesting. Few school directors were not able to decide about teachers' attitude.

One school director was quoted in saying that:

> Without providing ICT resources necessary for teaching and learning their subject, giving them adequate training on how to integrate ICT in biology teaching and without observing them using ICT in their classrooms, it is not easy to judge about teachers' attitude towards ICT integration in teaching and learning. (School Director No.9, 2018).

Based on the quotation of the school director, it was difficult to measure teachers' attitude towards the integration of ICT in Biology lessons before providing the requirements.

The school directors were also asked to give their view on how they see the integration of ICT in teaching and learning. Majority of them believed ICT would improve the quality of teaching and learning. However, few responded that computer and internet could take the attention of students away from their Biology learning. When school directors have a positive attitude towards ICT integration in schools, they can give the necessary support for teachers in using ICT in their lessons. Teachers, students and school directors involved in the study showed a positive attitude towards the integration of ICT in teaching and learning process. The findings of this study were in agreement with several

research studies. A study conducted by Semerci and Aydın (2018) on examining high school teachers' attitudes towards ICT use in education, applying descriptive research design and questionnaire for 353 teachers working in different schools of Ankara, turkey. Teachers displayed a high level of positive attitude towards ICT use in education and low level of anxiety towards ICT use in education.

Hong (2016) carried out a study on teachers' views of ICT integration using open-ended, semi-structured interview for 23 teachers from different parts of Colorado, USA. The study revealed that teachers involved in the study had a positive attitude towards ICT as an instructional tool**.** A study conducted on pre-service Biology teachers attitude toward the use of ICT in Biology teaching, the result revealed that pre-service Biology teachers had a positive attitude with no difference in gender or class (Yapici and Hevedanli, 2012).

Although a positive attitude towards ICT is one of the factors for the integration of ICT in education, having a positive attitude alone is not enough for ICT integration in teaching and learning. Adegbenro, Gumbo and Olakanmi (2017) ascertained that teachers had positive attitudes towards using computers in their classrooms. Teachers were willing to learn more about how to integrate computers in the teaching and learning processes. However, teachers faced difficulties in the implementation of ICT in classroom practices due to their

inadequate knowledge and lacked skills to use ICT in their pedagogical practices.

4.7 Instructional Methods Used by Teachers of Biology

The fourth objective of this study was to establish the instructional methods used by the teachers of Biology. To achieve this objective data was collected from teachers and students questionnaire, interview with school directors and from classroom observation. The results are presented as follows:

The finding in figure 4.7 showed Biology teachers' feedback when they were asked whether they use teacher-centered or learner-centered approach in Biology lessons.

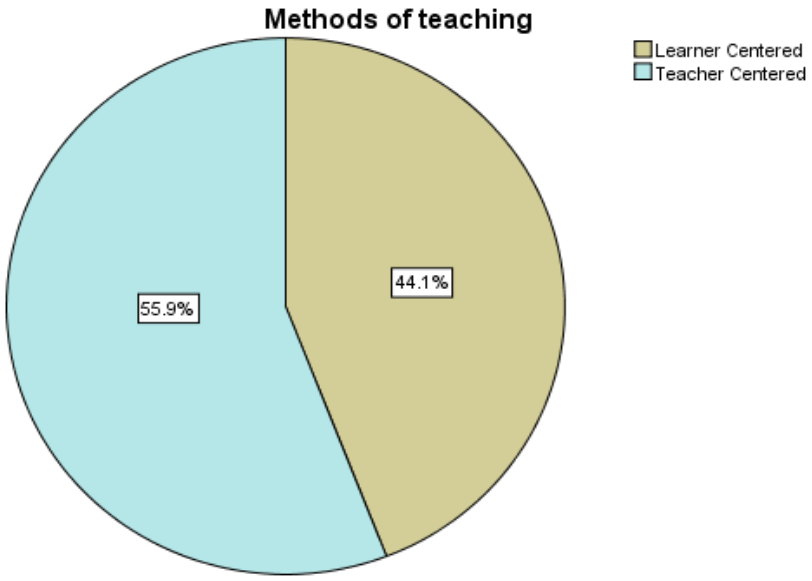

Figure 4.7. Methods of teaching used from teachers' responses

Source: Teachers' Questionnaire

As indicated in Figure 4.7, the majority (55.9 %) of teachers responded that they use teacher-centered approach of teaching, and the remaining 44.1% responded they use learner-centered in their lessons. This shows that the majority of teachers use teacher-centered approach in their Biology teaching. This finding aligns with the study that revealed lack of technology, lack of time, and way of assessment were identified as the major barriers to creating technology-enhanced, learner-centered classrooms (An and Reigeluth, 2011). These findings indicated that myriad factors could hinder the implementation of learner-centered learning.

Teachers of Biology were also asked to give their view on which of the two approaches enhances the integration of ICT in teaching and learning Biology. The findings were as presented in table4.13.

Table 4.13
Teaching Methods Enhancing ICT Integration as Teachers' View

Teaching approach	Frequency	Percent
Teacher-Centered	3	8.8
Learner-Centered	31	91.2
Total	34	100.0

Source: Teachers' Questionnaire

The finding in table 4.13 shows that majority (91.2%) of the teachers responded that learner- centered approach enhances the integration of ICT in Biology teaching and learning whereas the remaining 8.8% responded that teacher

centered approach improves ICT integration in Biology lessons. This finding indicates that teachers were conscious of the importance of integrating ICT in teaching and learning.

Students were also similarly asked to respond whether their teachers use teacher-centered or learner-centered approach in Biology classrooms. Students in secondary schools of Eritrea receive an orientation on teacher-centered and learner-centered learning from School directors as well as their teachers.

Figure 4.8 showed the students' response when they were asked whether their teachers use teacher-centered or learner-centered approach in Biology classrooms.

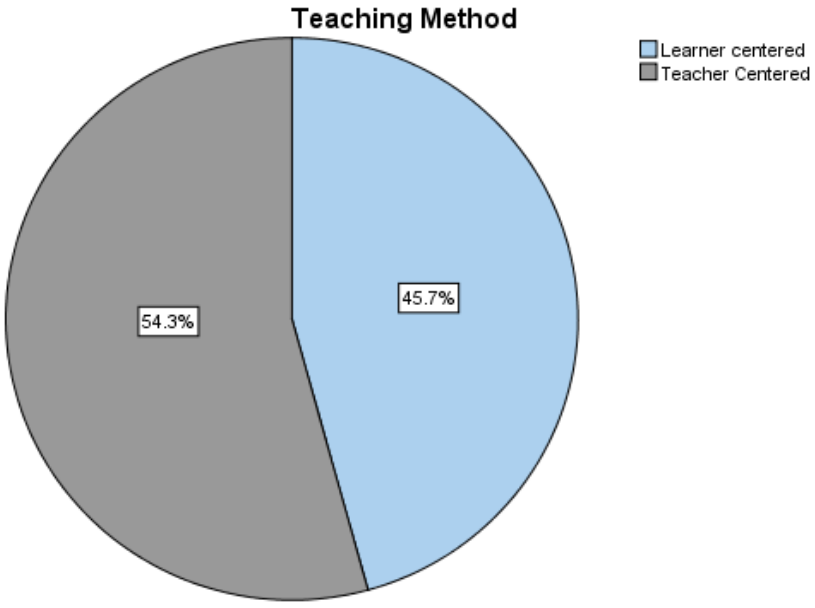

Figure 4.8. Methods of teaching used from students' responses

Source: Students' Questionnaire

As indicated in figure 4.8, the majority (54.3%) of students confirmed that their teachers use teacher-centered approach in the teaching of Biology whereas 45.7% of the students responded that Biology teachers exercise learner-centered in Biology lessons. This result supports the findings from the teachers' report. The views of students on which approach enhances more the integration of ICT in Biology teaching and learning are illustrated in table 4.14.

Table 4.14

Students' View to Teaching Methods Enhancing ICT Integration

Approach	Frequency	Percent
Teacher-Centered	45	25.7
Learner-Centered	130	74.3
Total	175	100.0

Source: Students' Questionnaire

According to the knowledge level of students regarding teacher-centered and learner-centered approaches of teaching most students mentioned that learner-centered enhances ICT integration. The findings in table 4.14 show that 74.3% of the students responded that learner-centered approach boosts the integration of ICT in Biology classes, while the remaining 25.7% replied that teacher-centered approach enhances the integration of ICT in Biology teaching and learning. This indicates that students are also aware of the role of ICT in learner-

centered learning. Researcher assured during the data collection students were aware of the difference between teacher-centered and learner-centered learning.

The response from the school directors also revealed that the methods of teaching used by teachers were dominated by teacher-centered approaches of teaching in both teaching and students' assessment methods. Teachers use mostly lecture method; even when they use discussion and demonstration methods, still the activities of the lesson were directed and dominated by teachers. Although teachers were informed to use continuous performance-based assessment, the assessment activities were dominated by written tests and exams. When teachers gave assignments and projects to be done in-group, only a few active students do the group work.

As a policy, schools should follow learner-centered approach. The Ministry of Education regional office gave a guideline to use discussion method in schools. However, it had challenges in practical. The school directors further explained that the implementation of learner-centered was hampered by several factors such as large class size, teachers' workload, lack of learning facilities, short instructional time, and above all inadequate teachers' in-service training.

The result from classroom observation confirmed the report from teachers and school directors. From the observed classrooms, the majority of the teachers were using the lecture method, question and answer where teachers ask, and students answer. Toward the end of the lessons, teachers would explain the

content, write short notes on the blackboard, and students listen, and write notes on their notebook. The researcher also observed in some schools teachers were using the discussion method. Desks were arranged in a circular manner for discussion, students were sitting in groups and discussing and presenting on the topic given by their teachers. The findings from teachers, school directors and observation confirmed that majority of Biology teachers were using teacher-centered approaches in their teaching.

4.8 Challenges Faced by Teachers and Students in the Integration of ICT in Education

The fifth objective of the study was to explore the challenges faced by teachers and students in the integration of ICT in teaching and learning. To accomplish this objective information was gathered from the school director's interview, teacher's questionnaire and student's questionnaire. The challenges faced by teachers and students are described in subtopics.

4.8.1 Challenges Faced by Teachers in the Integration of ICT in Teaching and Learning

Table 4.15 shows teachers' view on challenges encountered in integrating ICT in Biology lessons.

Table 4.15

Challenges of Teachers as Responded by Teachers

Challenges	**F (n=34)**	**Percent**
Inadequate ICT resources	32	94.1
Shortage of power supply	31	91.2
Lack of ICT integration skill	29	85.3
Large class size	21	61.8
An initiative by the school administration	18	52.9
Personal computer to prepare at home	15	44.1
Workload	16	47.1
Shortage of time of instruction	13	38.2
Lack of ICT technical support	11	32.4

Source: teachers' Questionnaire

Table 1.15 shows the challenges experienced by teachers of Biology in integrating ICT in Biology teaching and learning. Majority (94.1 %) of teachers reported that inadequate ICT resources were challenges of teachers. Lack of ICT integration skills was commented on by 85.3% of teachers. Shortage and irregularity of Power supply (electricity or solar energy) were reported as a challenge by 91.2% of teachers.

More than half of teachers said lack of initiative from school administration was a challenge; 44.1 % of teachers indicated a lack of personal computer was a barrier to prepare ICT integrated lesson at home. A large number of students in the classroom was mentioned by 61.8% of teachers as a challenge to the use of ICT in Biology lesson. The workload of teachers, the shortage of instructional

time and lack of ICT technical support were indicated by a number of Biology teachers as challenges.

On the other hand, majority of school directors reported that lack of adequate ICT resources related challenges like computers, projectors, internet services, and interruption of electricity were some of the difficulties in ICT integration by teachers. Challenges related to skills like insufficient ICT skills of teachers and lack of awareness on how to integrate ICT in teaching and learning were the main challenges of Biology teachers in the integration of ICT in their teaching. One of the school directors said:

> The major challenge that schools have in the use of ICT in teaching and learning are shortage of ICT resources. Schools have inadequate computers, no internet services and irregular electricity. In this kind of situation, let alone to use ICT for biology and other subjects, we do not have enough resources for running effective lessons in ICT subject. In the computer lab, two to three students share one computer during the ICT lessons. Sometimes students learn only in theory in computer class when electricity interrupts**.** (School director No 4, 2018).

From this description, it is noticeable that inadequate ICT resources and irregular supply of electricity were challenges of teachers in the integration of ICT in teaching-learning processes. This study indicated that from the responses of teachers, students and school directors the challenged encountered by teachers

were lack of adequate resources like desktop computers, laptops, computer labs, internet, projectors, power supply, lack of adequate knowledge and skills of ICT were cited by majority of respondents. Findings of this study are consistent with the study of Zakaria and Khalid (2016), that limited teaching time, insufficient training, lack of technical support, limited resources of students and lack of pedagogical knowledge on how to integrate ICT in teaching were the constrains. Bairagi, Rajon and Roy (2011) also revealed that the major constrains in the use and implementation of ICT in education in Bangladesh schools were the high cost of Internet, poor ICT infrastructure, lack of qualified teachers and shortage of ICT trained teachers.

4.8.2 Challenges Faced by Students in the Integration of ICT in Learning

When students were asked to answer the challenges they experienced in the use of ICT for learning Biology, they gave many challenges. The main challenges are illustrated Table4.16.

Table 4.16

Challenges of Students as Responded by Students

Challenges	**F (n=175)**	**Percent**
Lack of ICT resources (computer, internet)	161	93.1
Shortage of regular power supply	154	88. 0
Lack of awareness of ICT use in learning Biology	145	82.9
Poor computer skills	118	67.4
Motivation by school administration and teachers	64	36.6
Accessing personal tablet, Smartphone in school	52	29.7

Source: students' Questionnaire

As presented in Table 4.16, majority (93.1%) of the students indicated a lack of ICT resources as a challenge in using ICT for learning. Eighty-eight (88%) of the students pointed out the Shortage of electricity or solar energy made ICT use difficult in schools. Over half (67.4%) of students stated that they do not have the necessary computer skills; 82.9 % of students commented that they do not have awareness on how to use ICT for learning Biology. Lack of motivation by school administration and teachers to use ICT for learning was indicated as a challenge by 36.6% of students. The percentage of students who commented that they were not allowed accessing personal smart phone and tablets in the schools was 29.7%. This shows that students had many challenges in the use of ICT for Biology learning.

Similarly, majority of teachers and school, directors revealed that the main challenges of students in using ICT for learning were lack of computers in schools, inadequate computer laboratory, unavailability of internet services, absence of digital library in the schools and lack of awareness of students. In addition to this, it was stated that although ICT as a subject is taught in grade nine, it was not adequate to prepare students with the necessary knowledge and skills of ICT so that they will be able to learn other subjects using ICT as a tool.

The findings from the respondent teachers, students and school directors showed that the challenges of teachers and students in the integration of ICT in teaching and learning of Biology were almost similar and were related to insufficient

training on ICT skills and lack of ICT resources. These findings are in agreement with the study that showed the main challenges of teachers in using ICT in classrooms were scarcity of resources and low ability and confidence of teachers (Mathevula and Uwizeyimana, 2014). Integration of ICT into classroom instruction in east African countries remain far behind because of several inhibiting factors. The main factors are inadequate infrastructure, lack of realistic policy, vision and strategies on ICT use in education, lack of pre-service and in-service teachers' training, poor teachers' welfare and morale (Tedla 2012). Onwuagboke et al., (2014) also revealed that poor electric power supply, lack of knowledgeable ICT support staff, inadequacy of trained teachers were by as challenges in the effective integration of ICT in teaching and learning processes.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides an overview of the findings, conclusions based on the findings, recommendations and suggestions for further studies.

5.2. Summary

The purpose of the study was to investigate the integration of information and communication technology in teaching and learning of Biology in secondary schools across the Southern Region of Eritrea. The study was guided by the following five objectives: to determine availability of ICT resources for teaching and learning of Biology in secondary schools of Southern Region, Eritrea; to ascertain teachers' skills for ICT integration in teaching and learning of Biology; to establish teachers attitude towards integrating ICT in the instruction; to establish the instructional methods used by the teachers and To explore challenges faced by teachers and learners in the integration of ICT in teaching and learning.

A descriptive survey design was adopted for the study. Sample of the study included 12 school directors, 34 Biology teachers and 175 Biology students. A stratified random sampling technique was used to select 12 secondary schools from a population of 27 secondary schools of Southern Region. Questionnaires, interview and observation schedules were used as instruments for data

collection. Questionnaire for Biology teachers and students, interview schedule for school directors was applied. The Statistical Package for Social Sciences (SPSS) was used to analyze the data. Descriptive statistics, such as frequencies, percentages, were used to analyze the data. The analyzed data was presented in the form of frequency tables and figures.

Summary of the findings are presented based on the objectives of the study in the following subtopics.

5.2.1 Availability of ICT Resources in Schools for Teaching and Learning

The study found that most of the sampled schools had ICT resources in a diverse amount, where some schools are better equipped with ICT resources. The schools had computers, computer laboratories, projectors, Televisions, video players, storage hard discs, digital content, and printers. Internet services not yet introduced in the schools and power supply was not regular in most schools. The resources in the schools were inadequate to be used for teaching and learning Biology. The available resources were used mainly for teaching ICT as a subject. Biology teachers never used them in their classroom lessons.

5.2.2 Teachers' Skills for ICT Integration in Teaching and Learning

In the study, it was found that the majority of Biology teachers were computer literate, but the training was inadequate to have competency in computer**.** Moreover, due to the lack of computers, the training was more theoretical, and they did not use computers after taking the training. Having computer literacy

alone is not sufficient to integrate ICT in instruction. It was also established that majority of the teachers did not receive any formal training on how to integrate ICT in teaching and learning practices.

5.2.3 Attitude of Teachers towards Integrating ICT in Classroom Teaching

In this study, it was revealed that majority of Biology teachers who participated in the study had a positive attitude towards the use of ICT in teaching and learning. They liked to use ICT in their Biology lessons; they believed ICT makes learning Biology interesting, understandable and improves learners' performance. In addition, the study revealed that the attitude of the majority of school directors and students was also positive towards the use of ICT in education.Even though a positive attitude existed in the schools' community, ICT was not applied for teaching and learning of Biology. This could be due to other barriers that influenced ICT integration in instruction.

5.2.4 Instructional Methods Used by Teachers of Biology in the Classroom

The findings in the study showed that majority of the respondents reported that a large number of teachers were using teacher-centered approach in the methods of teaching in the classrooms, whereas some teachers were using learner-centered approaches. Teachers were predominantly using the lecture method and the traditional way of assessments in their classrooms. This could be due to several factors that hinder the implementation of learner-centered methods. Some of the hindering factors cited by the respondents were large class size,

short instructional time, a lot of content in the syllabus to be covered, heavy workload of teachers, inadequate learning facilities. The study also showed that most of the respondents believed that learner-centered teaching and learning methods enhance or favor the integration of ICT in Biology teaching and learning. Though teachers thought learner-centered approach improves the integration of ICT in teaching and learning, Biology lessons were found to be dominated by teacher-centered methods of teaching.

5.2.5 Challenges of Teachers and Students in the Integration of ICT in Instruction

The challenges of teachers found out in this study were mainly related to ICT resources and ICT knowledge and skills. The majority of respondents cited that lack of adequate resources such as desktop computers, laptops, computer labs, internet, and projectors were the main challenges. The few available ICT resources were not accessible by Biology teachers. Interruption and irregularity of power or electricity supply was also mentioned as one of the main challenges of teachers.

Most respondents cited lack of awareness and inadequate skills on how to incorporate ICT in teaching and learning as an obstacle to the use of ICT in biology lessons. It was reported that teachers had received computer literacy training that could not give them competency in ICT, and teachers did not receive any training on how to integrate ICT in the teaching-learning activities.

In the study, it was revealed that large class size, work load, shortage of time of instruction to cover content in the syllabus, lack of personal computer to prepare at home were cited by some respondents as challenges of teachers. Initiative and motivation by school administration and lack of ICT technical support were further mentioned that could contribute to the challenges of teachers in the integration of ICT in classroom instructions.

On the part of the students' challenge, the result of the study revealed that there were almost similar challenges cited by the respondents. The shortage of computers and internet services in the schools were reported among the major challenges. Students could not work the assignments and project work given by their teachers using ICT resources. Poor ICT skills and lack of awareness on how to use ICT in the learning of Biology were significant barriers of students to ICT use in learning Biology. Some respondents cited lack of motivation by school administration and teachers, and lack of accessing personal tablet, Smartphone in schools as students challenge in the use of ICT in learning activities.

5.3 Conclusions

The study concluded that most of the sampled schools had inadequate ICT resources like computers, computer laboratories, projectors, televisions, video players, digital content, and the internet. These resources were not enough or available for use by Biology teachers in teaching and learning.

The available resources were used mainly for teaching ICT as a subject. Biology teachers never used them in their classroom lessons. Therefore, there was no integration of ICT in Biology instruction.

In the study, it was also concluded that majority of Biology teachers had received inadequate training on computer literacy**.** Although they have attended computer training, they did not have sufficient computer skills. Majority of the teachers did not receive any formal training on how to integrate ICT in teaching and learning practices. Hence, there was low integration of ICT in teaching and learning Biology.

The study further concluded that majority of Biology teachers who participated in the study had positive attitudes towards the use of ICT in teaching and learning. The attitude of school directors and students was also positive towards the use of ICT in education. Though the attitude of teachers and school directors was positive, ICT was not integrated into instruction. From this, it is logical to conclude that having a positive attitude alone could not make ICT integration practical in the classrooms.

In the study, it was also concluded that majority of Biology teachers were using teacher-centered approach in the classrooms, whereas some teachers were using learner-centered approaches. Teachers predominantly used the lecture method and the traditional way of assessments in their classroom teaching.

The main challenges facing teachers and students were related to the availability and adequacy of ICT resources; Knowledge, and skills of ICT integration. Lack of desktop computers, laptops, projectors, and internet services in the schools for Biology instruction were revealed as major challenges alongside inadequate skill and awareness of ICT integration in education.

Overall, it can be concluded that due to many challenges such as lack of adequate resources for Biology instruction, inadequate ICT integration skills of teachers, and traditional methods of teaching. The integration of ICT in teaching and learning of Biology in secondary schools in the Southern Region of Eritrea was not yet implemented. Furthermore, it can be concluded that availability and adequacy of ICT resources in schools for teaching and learning, teachers' skills for ICT integration in teaching and learning, attitude of teachers towards integrating ICT in classroom instruction, and instructional methods used by teachers of Biology in teaching had influenced the integration of ICT in Biology teaching and learning

5.4 Recommendations of the Study

Based on the findings and conclusions obtained, the study proposes the following recommendations.

5.4.1 Study Recommendations

i. Adequate ICT resources, including the internet, need to be provided in schools for teaching and learning Biology and other subjects.

ii. Teacher training college should incorporate computer education and training on how to integrate ICT in education in the curriculum so that pre-service teachers leave the college being well prepared with ICT competency uniformly.

iii. Ministry of Education should provide adequate in-service training on ICT integration skills for teachers.

iv. Ministry of Education in the Southern Region of Eritrea should give more emphasis on the implementation of learner-centered approach in schools.

v. National ICT policy in education needs to reach schools and be implemented.

5. 4.2 Suggestions for Further Research

From the findings and conclusions, the following were suggested for further studies.

i. This study was limited in one region; therefore, a similar study should be conducted on the integration of ICT in teaching and learning in other regions of Eritrea, so that comparison can be made.

ii. A study should be conducted to explore ICT integration in classrooms in other science subjects since this study focused only on the integration of ICT in teaching and learning of Biology.

iii. A study should be done to examine ICT use in the college of education in Eritrea, to see how pre-service teachers are prepared with the skills of ICT integration in education.

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APPENDICES

APPENDIX I: QUESTIONNAIRE FOR TEACHERS OF BIOLOGY

Introduction

I am a post-graduate student at Kenyatta University, carrying out Research on integration of Information Communication and Technology (ICT) in teaching and learning of Biology. This questionnaire is designed to gather information on the same from the teachers of Biology. You are therefore humbly requested to give responses to all the questions. The information will be treated with a lot of confidentiality and will only be used for this study.

Thank you in advance.

Please tick (✓) where appropriate in relation to your school:

1. Gender: Male ☐ Female ☐

2. Your age in Years: 20-30 ☐ 31-40 ☐ 1-50 ☐ 1&above ☐

3. Professional Experience in Years:

1-2 ☐ 3-4 ☐ 5-6 ☐ 7-8 ☐ 9 & above ☐

4. Number of students in your biology class:_____

5. Number of lessons/periods you teach in a week:_____

6. Are you computer literate? YES ☐ NO ☐

7. Have you received training on how to integrate ICT in teaching and learning? YES ☐ NO ☐

8. There is an equipped ICT resource center in your school YES NO

9. There is internet connectivity & services in the School YES NO

10. There is electricity supply in the School YES NO

11. There are ICT resources for teaching and learning Biology YES NO

Please tick (✓) where appropriate in relation to ICT facilities in your school.

(**SA**-Strongly Agree, **A**-Agree, **N**-Neutral, D-Disagree, **SD**-Strongly Disagree)

No	**Statement**	**SA**	**A**	**N**	**D**	**SD**
12	Teachers of Biology in this School can easily access the various ICT resources					
13	Students in this School can easily access various ICT resources					
14	Teachers of Biology in this school always use the ICT resources in every Biology lesson					
15	All teachers of Biology allow students to perform tasks using the ICT					
16	Teachers easily access internet in teaching and learning Biology					
17	Teachers of Biology in this school use laptops and projectors in teaching					
18	The school administration is supportive on the					

	integration of ICT in Biology lessons					
19	ICT resources in this school are well maintained					
20	Teachers of Biology in this school like using ICT in teaching					
21	Students understand Biology very well when ICTs are used					
22	ICT makes teaching and learning interesting					
23	Integration of ICT in Biology lessons improves students' performance in Biology national examinations.					
24	Students in this school like the use of ICT in Biology lessons					
25	ICT makes the students to be active in the Biology lessons					
26	Much content is covered within a short time when ICT are used in Biology lessons					

27. What is the ratio of computers in the computer laboratory to the students of Biology in your class? (Tick (✓) appropriately).

1: 1 ☐ 1:2 ☐ 1:3 ☐ 1:4 ☐ 1:5 and above ☐

28. List down the ICT resources available in your school

_____

_____

_____

29. List down the most commonly used ICT resources in your school.

_____

_____

30. How many lessons per week do you use ICT in teaching and learning of Biology? (Tick (✓) appropriately).

4 ☐ 3 ☐ 2 ☐ 1 ☐ 0 ☐

31. How can you rate the integration of ICT in teaching and learning of Biology in your school? (Tick (✓) appropriately).

Excellent ☐ Very Good ☐ Good ☐

Average ☐ Poor ☐ Very Poor ☐

32. Which approach/method of teaching do you use in biology lessons?

Teacher-centered ☐ Learner-centered ☐

33. Which approach/method do you think enhance ICT integration in teaching and learning of biology? Teacher-centered ☐ Learner-centered ☐

34**.** List down the challenges experienced by teachers and students of Biology in the use of ICT in teaching and learning of Biology in your school.

Teachers:_____

_____

_____

_____

Students:_____

_____

_____

35. Suggest solutions on how to overcome these challenges.

_____

_____

_____

Thank you for filling this questionnaire!

APPENDIX II: QUESTIONNAIRE FOR STUDENTS OF BIOLOGY

I am a post-graduate student at Kenyatta University, carrying out Research on integration of Information Communication and Technology (ICT) in teaching and learning of Biology. This questionnaire is designed to gather information on the same from the Grade-11 Biology students. You are therefore kindly requested to give responses to all the questions. The information will be treated with a lot of confidentiality and will only be used for this study. Thank you in advance.

Please tick (✓) where you feel appropriate

1. Sex: Male ☐ Female ☐
2. Are you computer literate? YES ☐ NO ☐
3. Do you use ICT for learning and doing assignments? YES ☐ NO ☐
4. There is internet access for students in this school : YES ☐ NO ☐

Please tick (✓) where appropriate in relation to your school:

(**SA**-Strongly Agree, **A**-Agree, **N**-Neutral, **D**-Disagree, **SD**-Strongly Disagree)

		SA	**A**	**N**	**D**	**SD**
5	ICT can help to improve students' performance in Biology					
6	Students can easily access the various ICT resources					

	in this school					
7	Teachers of Biology always use ICT in each Biology lesson					
8	Teachers of Biology allow students to perform tasks using the ICT					
9	Biology teachers give reference to the internet as source of information					
10	Teachers of Biology like using ICT when teaching Biology					
11	Students easily understand Biology when ICT resources are used					
12	ICT makes learning interesting to students					
13	Students like the use of ICT in Biology lessons					

14. List down the main ICT resources used in teaching and learning of Biology in your school.

_____

_____

_____

_____

15. How many lessons per week do you use ICT in learning Biology? (Tick (✓) appropriately).

4 ☐ 3 ☐ 2 ☐ 1 ☐ 0 ☐

16. How can you rate the effectiveness of the use of ICT in teaching and learning of Biology? (Tick (✓) appropriately).

Excellent ☐ Very Good ☐ Good ☐

Average ☐ Poor ☐ Very Poor ☐

17. Which approach/method of teaching do teachers use in biology lessons?

Teacher-centered ☐ Learner-centered ☐

18. Which approach/method do you think enhance ICT integration in teaching and learning of biology? Teacher-centered ☐ Learner-centered ☐

19. List down the challenges experienced by teachers and students of Biology in the integration of ICT in teaching and learning of Biology in your school.

Teachers:_____

_____

_____

Students:_____

_____

_____

_____

20. Suggest solutions on how to overcome these challenges.

_____

_____

_____

_____

Thank you for filling this questionnaire!

APPENDIX III: SCHOOL DIRECTORS' INTERVIEW SCHEDULE ON INTEGRATION OF ICT IN TEACHING AND LEARNING

1. Gender: Male ☐ Female ☐
2. Professional Experience in your current post in Years:

   1-5 ☐ 6-10 ☐ 11-15 ☐ 6-20 ☐ above 20 ☐
3. Are you computer literate?
4. How do you describe the availability and accessibility of ICT resources in the school?
5. In your school, are teachers trained on how to integrate ICT in teaching?
6. How well do teachers of biology use ICT resources in their teaching and learning?
7. What do you say about the use of ICT in learning by your students?
8. From your observation what are the methods of teaching used by teachers?
9. In your opinion, how is the attitude of biology teachers toward ICT integration in instruction?
10. From your experience, what are the challenges faced by teachers and students in integrating ICT in teaching and learning?
11. What are your thought, what should be done to overcome the challenges and improve the integration of ICT in teaching and learning of biology?

Thank you for your co-operation!

APPENDIX IV: OBSERVATION SCHEDULE

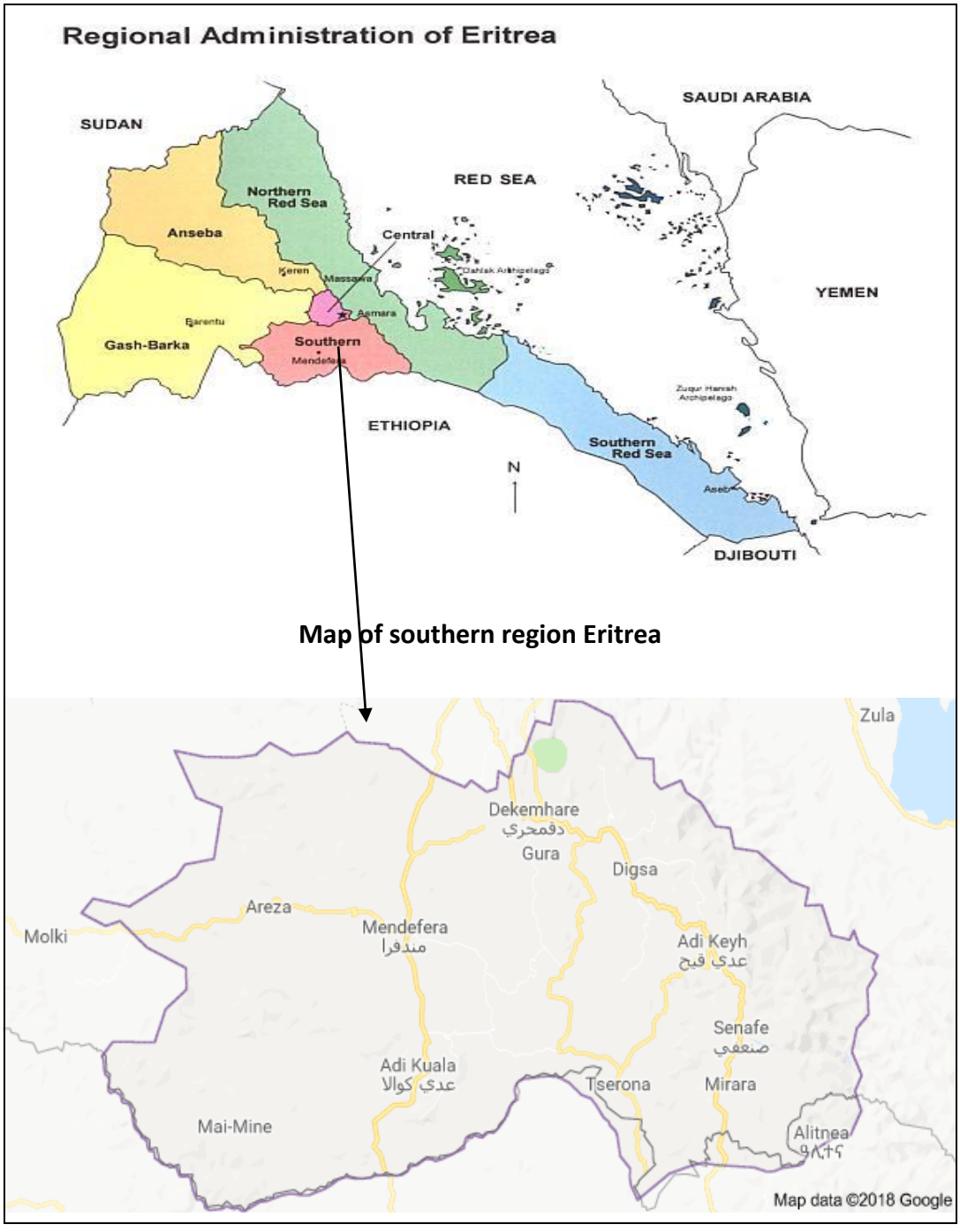
1. Name of School: _____ Date_____
2. ICT resources available in the school
3. Instructional methods used by teachers in their biology lessons

   _____
4. Teachers' integration of ICT in teaching biology lesson
   a. Hardware used
   b. Software used
5. Students' participation in the use of the ICT resources in classroom
6. How teachers engage students in the use of ICT during Biology lessons?
7. Ratio of computers to students per class in the computer lab?
8. General observations in relation to ICT resources and their use in teaching and learning Biology

NAME OF ITEMS	AVAILABLE	NOT AVAILABLE	ACCESSIBLE	NOT ACCESSIBLE
Computer laboratory				
Desktop Computers				
Laptops				
Projectors				
Printers and				

photocopier				
Radios				
Televisions				
Power supply				
Internet access in the school				
Video players				
DVDs/VCDs				
CDs				
Educational games				
Digital Cameras				
Instructional Animation				
Power point presentations				
Tablets				
Smart phones				
Storage of ICT resources				

APPENDEX V: MAP OF SOUTHERN REGION ERITREA



APPENDIX VI: RESEARCH AUTHORIZATION LETTER

KENYATTA UNIVERSITY
GRADUATE SCHOOL

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

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

Our Ref: E55F/32321/2015

DATE: 18th May, 2018

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

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR MR. MEHARI TESFAMARIAM BELAY – REG. NO. E55F/32321/15

I write to introduce Mr. Mehari Tesfamariam Belay who is a Postgraduate Student of this University. He is registered for M.Ed. degree programme in the **Department of Educational Communication & Technology.**

Mr. Belay intends to conduct research for a M.Ed. thesis Proposal entitled, **"Integration of Information and Communication Technology in Teaching and Learning of Biology in Secondary Schools in Southern Region, Eritrea."**

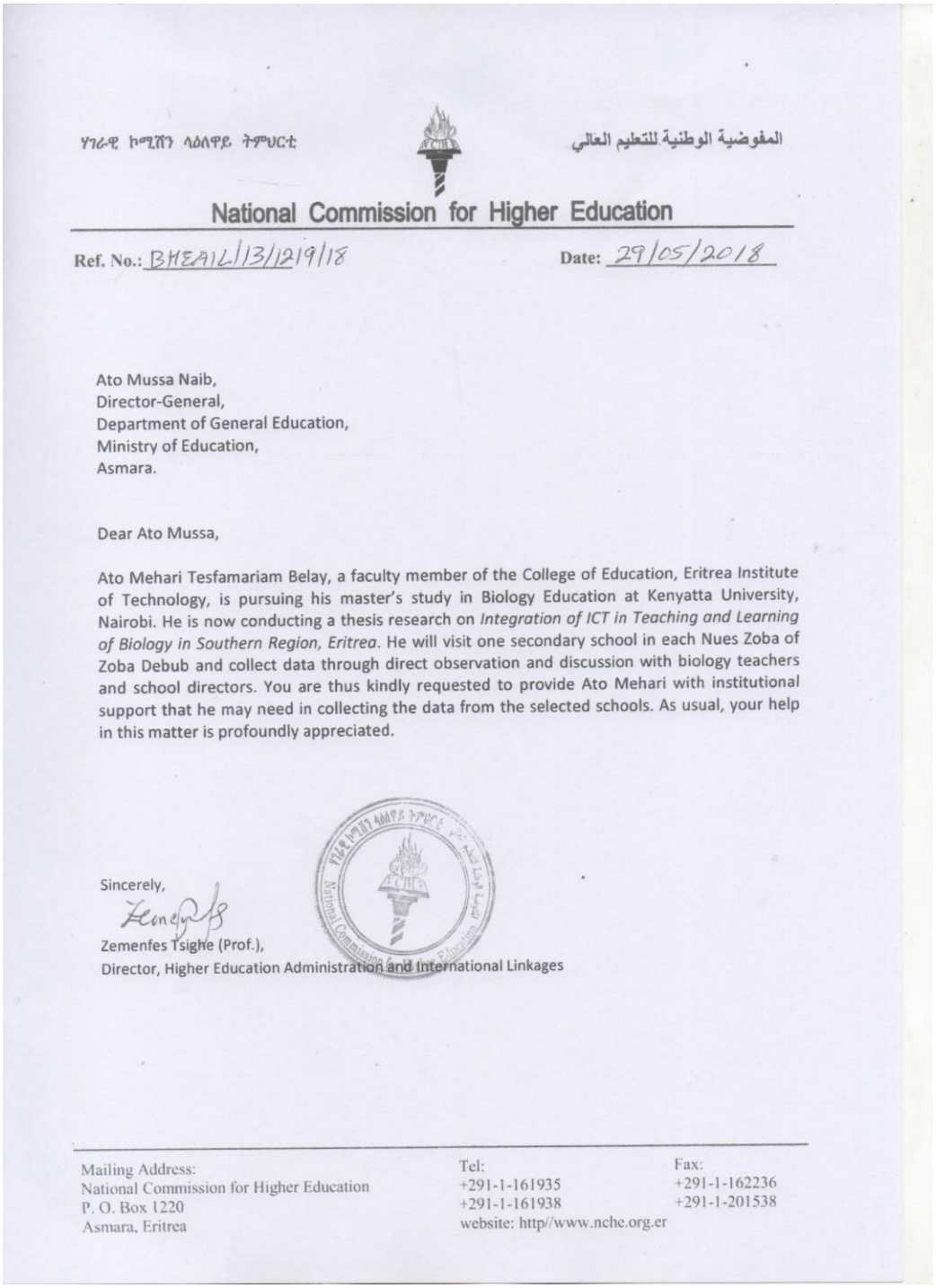
Any assistance given will be highly appreciated.

Yours faithfully,

MRS. LUCY N. MBAABU
FOR: DEAN, GRADUATE SCHOOL

JL/eww

APPENDIX VII: RESEARCH INTRODUCTORY LETTER



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المفوضية الوطنية للتعليم العالي

National Commission for Higher Education

Ref. No.: BHEAIL/13/1219/18 Date: 29/05/2018

Ato Mussa Naib,
Director-General,
Department of General Education,
Ministry of Education,
Asmara.

Dear Ato Mussa,

Ato Mehari Tesfamariam Belay, a faculty member of the College of Education, Eritrea Institute of Technology, is pursuing his master's study in Biology Education at Kenyatta University, Nairobi. He is now conducting a thesis research on *Integration of ICT in Teaching and Learning of Biology in Southern Region, Eritrea*. He will visit one secondary school in each Nues Zoba of Zoba Debub and collect data through direct observation and discussion with biology teachers and school directors. You are thus kindly requested to provide Ato Mehari with institutional support that he may need in collecting the data from the selected schools. As usual, your help in this matter is profoundly appreciated.

Sincerely,

Zemenfes Tsighe (Prof.),
Director, Higher Education Administration and International Linkages

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