AN INVESTIGATION OF THE USE OF TEACHING AIDS BY GRADE EIGHT BIOLOGY TEACHERS IN SECONDARY SCHOOLS IN ERITREA

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A minithesis submitted in partial fulfilment of the requirements for the degree of Master's in Philosophy in the Faculty of Education, the University of the Western Cape.

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DECLARATION

I declare that **An Investigation of the Use of Teaching Aids by Grade 8 Biology Teachers in Secondary Schools in Eritrea** is my own work, that it has not been submitted before for any degree or examination in any other University, and that all the sources I have used or quoted have been indicated and acknowledged as complete references.

Asmerom Kahsay Berhe September 2003

Signed: .....

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ABSTRACT

In Eritrea, to the extent to which secondary school Biology teachers have used teaching aids in their teachers use classrooms have not been addressed. Hence, this study focuses on the extent to which teachers use teaching aids in teaching and learning, with special references to grade 8 Biology in secondary schools in Eritrea. Further, to this study provides insights into the availability of teaching aids, constraints that prevent the use of teaching aids, and the importance of teaching aids on learners' understanding.

Located in the constructivist paradigm, the research focuses on gaining understanding of the research problems through questionnaire and interview. In this study the participants were teachers involved in the teaching of Biology. The desire of the researcher was to investigate the extent to which Biology teachers use teaching aids in teaching and learning situation from the point of view of teachers.

Data collected through a survey were weighed against those gathered from the interview of teachers in different secondary schools. This type of data collection helped to obtain validity through triangulation. During interview it was revealing to hear how teachers perceive the availability of teaching aids. The view of teachers to the availability of different types of teaching aids used in teaching are different because some of them use teaching aids which can be purchased, others saw them as anything they could prepare or collected from the local environment. These different perceptions of teaching aids had an influence on the way teachers use teaching aids in Biology lesson.

The research findings from the various data resources were recorded, analyzed and compared. They revealed comparable patterns among the surveyed secondary school Biology teachers and interviewed teachers. The methods of triangulation used were important in order to understand the situation from different angles and perspectives.

The result of the study indicates that teaching aids such as textbooks, diagrams, and living things collected from the community were the main once available in most schools. Audio-visual aids such as videos and other science related activities were not available due to the lack of funds. Also the result indicates that most Biology teachers use teaching aids along with the presentation of the lessons by means of the lecture method. Some of the constraints for not using teaching aids were large class size, lack of resources, and heavy teachers load.

The last part of the study suggests recommendations for the improvement of the situation in teaching and learning in secondary schools in Eritrea. Some of these recommendations include:

- Training teachers how to prepare teaching aids and integrate in their lessons
- Creating resource centers at school and at regional level to facilitate easy access to the necessary equipment; and
- Minimize teachers' load in order for teachers to have enough time for preparation

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CHAPTER ONE

BACKGROUND OF THE STUDY

1.1 Introduction

In this chapter, the problem and its background as to the use of teaching aids in the teaching and learning process in Eritrea secondary schools are introduced. The educational system of Eritrea before and after independence is discussed to have a clear understanding of why this study is needed.

The development of the Biology curriculum is also stated to clarify how it is dealt with in the classroom with specific reference to the use of teaching aids. The statement of the problem, the purpose of the study, and research questions are included in this chapter. At the end of this chapter the limitations and the structure of the thesis are discussed.

1.2 Background of the problem

Eritrea is a small country located on the horn of Africa. It has a coastline of about 1000 kilometers. The surface area of Eritrea is estimated to be 123,300 square kilometers. The population of Eritrea is estimated to be 3.5-4 million. Eritrea is a multi-ethnic and multilingual society. There are nine ethnic groups, each with its own spoken language.

The state of Eritrea obtained its de facto independence in 1991 after thirty years of war and its official independence in May 1993 after a UN supervised referendum in which over 99% of the people voted in favour of the independence (Ministry of Education (MOE), (1999).

The Eritrean educational system was shaped under Italian rule and then expanded under British rule. The long civil war against the Ethiopia regime has severely disrupted the educational system. Consequently, the majority of Eritrea children have

not received much formal education. After independence, however, education has been placed among the top priorities of the government.

The educational sector policy, which has been developed since 1991, has the following goals which is related to this study, that is, to steadily increase enrolment in secondary, technical and vocational schools to meet skilled manpower requirements, with emphasis on imparting multi-craft skills (MOE, 1999: 2)

The development of the current Biology curriculum started in 1976, during the struggle for liberation. Since then it has been revised three times and the last revision was in 1981. After independence in 1993, a preliminary survey was conducted on the syllabus and based on this syllabus the Biology textbook was prepared in 1995. The Biology curriculum syllabus requires the use of teaching aids, as essential tools in the teaching and learning process.

In Eritrea, the MOE, particularly the Curriculum Department Division (CDD), has been responsible for providing some of the teaching aids required for teaching and learning in schools. Schools would provide and teachers could prepare the teaching materials. The main types of teaching aids are textbooks, microscopes, simple-lenses, living things (smaller size animals and plants), and science related activities such as demonstration and laboratory work.

The Biology laboratory manual for grade 8 has been prepared and distributed to all secondary schools in 2001. The procedure in the manual served as a guide for using teaching aids.

1.3 Motivation for the study

There has been a great change over the last few years in an area such as applying instructional technology in the school environment. This change will continue in the next few years. The introduction of instructional technology will therefore affect the very roots of our teaching and learning environment.

The above condition will demand that most developing countries like Eritrea, which are unable to cope with the present technology because of political, economical and social problems, examine and transform their curriculum to the extent that changes to teaching and learning strategies will be made. The changes will enable Eritreans to educate their pupils to become better citizens. The challenge is to help their pupils to meet and overcome the new and rapidly changing demands in order to achieve their goals. To achieve these goals there is a need to prepare the appropriate teaching materials and use them effectively in order to develop critical thinking of learners, rather than the memorization of facts and theories.

The motivation for conducting this study was that the researcher has been teaching Biology for different grades in different secondary schools of Eritrea for the last 18 years. Since then, there had been discussions at workshops and seminars about the role of teaching aids and how teachers could use them in the teaching and learning process. However, no study has been done in Eritrea to indicate to what extent teachers use teaching aids in their lessons. After the researcher got the chance to do post-graduate study at the University of the Western Cape, he has been motivated to research this issue, which had been a concern to him for many years.

1.4 Significance of the study

According to Van Rooyen and Van der Merwe (2001: 241) "Use of teaching aids increases learner's motivation and participation and as a result arouse their curiosity and interest". Even though learners' cognitive development is different, when appropriate teaching aids are selected and used for teaching, it could provide a stimulating learning environment which promotes a desire to learn.

From my experience, I observed that when learners are taught using different teaching aids, they could develop skills, which can help them practicing in their environment. For example, once upon a time learners were taught about the transmission of malaria using diagrams and microscopes showing the structure of different phases of the mosquito life cycle. Learners were very interested and showed full participation during the discussions. Later, these learners were made to practice their skills to teach the community and involve them in the eradication of malaria from their environment.

Therefore, teaching Biology using teaching aids help learners to develop skills that are important in their real life. This in turn is important to enhance learners' participation in social and economical development of their society.

1.5 Statement of the problem

As mentioned earlier, Eritrea emerged as an independent nation in 1991. Since then, many salient efforts have been made to provide basic quality education for all. As stated by the MOE (1999), many schools have been built and renovated with special emphasis being given to the disadvantaged areas.

Before independence, there was an inadequate amount of instructional material. Due to lack of such materials, teachers were involved in the lecture method only. The lecture method, although considered by modern education as traditional or outdated, was one of the most widely used approaches to teaching. The lecture method has been used for many years. As a result, learners became passive recipients of ideas and developing an inquiring and creative mind had been discouraged. It has at its worse, produced learners to be mere listeners and not thinkers.

After independence, the MOE of Eritrea has designed a new curriculum for use in schools. It tries to equip teachers with enough resources for teaching and learning in actual and normal classrooms. New teachers' guidebooks have been prepared and teachers are required to follow the guide while teaching in classroom. The gap between the demand and supply of teaching aids among schools had been improved.

Based on the above situation, the researcher became interested in making a close and in-depth study of Biology. Therefore, the main problem for conducting this study was to investigate the extent to which grade 8 Biology teachers have used teaching aids along with other methods of teaching in the actual and normal classroom for the purpose of improving teaching and learning.

1.6 The purpose of the study

In order to improve the quality of teaching and learning, teachers need to use teaching aids to help stimulate and motivate learners to understand the lesson more easily. In preparing teaching aids, teachers and learners together make them. However, in some cases teaching aids are also provided by the school. For example, for the teaching of Biology, schools should provide teaching aids such as textbooks and microscopes. Teaching aids, which could possibly be prepared by teachers and learners include diagrams and living things.

In Eritrea, the school principals and regional supervisors are responsible for evaluating whether teachers use teaching aids or not. School principals and supervisors do visit classrooms regularly. However, such visits are used typically for purposes of evaluating teachers' performances rather than helping teachers to become more effective in using teaching aids in the teaching and learning process.

For a teacher to make choices about which teaching aids to use for teaching, he or she needs hard evidence about how learners perceive and respond to his or her actions. The teacher needs to be aware of how learners could easily be motivated and understand the lesson.

The purpose of this study was to investigate whether Biology teachers use teaching aids in the teaching and learning process. More specifically, the study attempted to:

- Identify the types of teaching aids which are available for teaching Biology in secondary schools of Eritrea;
- Identify the extent to which secondary school grade eight Biology teachers in Eritrea uses teaching aids meaningfully in the actual classroom;
- Compare the extent of the use of teaching aids between teachers in urban and rural secondary schools, teachers in different types of schools, and less experienced and more experienced teachers;

- Identify the constraints facing teachers for not using teaching aids and
- Identify whether the use of teaching aids helps to increase learners' understanding of Biology.

1.7 Theoretical framework

In order to study the activity of teachers in schools three paradigms, namely positivist, interpretive and constructivist paradigms of teaching and learning are important according to Kemmis, *et al* (1983: 128). These paradigms have a bearing on the teaching strategies and are currently used in education and the social sciences (Hwang, 1996:343). However, each of these paradigms has its own characteristics.

The positivist paradigm is one of the paradigms where teachers teach in a very technical way. This paradigm views education as a preparation for work. It prepares learners to participate effectively in society and the workplace as determined by their aptitude and ability. In this paradigm the teacher only implements the curriculum decisions designed by the expertise and his/her methodological skills and techniques enable him/her to carry out these predetermined tasks, according to Giroux (1988). " Based on a positivist ideology, learning can occur by giving certain kinds of facts and theory of knowledge to an individual" (Hwang, 1996: 243). The role of the teacher is essentially an implementer of policy and theory, and the learners are the receivers of the transmitted knowledge.

The second paradigm, the interpretive paradigm, involves a teaching and learning process to prepare learners for life rather than for work. It directs learners towards developing the whole person, rather than serving the economy. Its rationale is to improve the educational practice through improved understanding and liberate learners through the development of reasoning and intellect.

In the field of teaching, the interpretive paradigm aims to shed light on the meaning which actions have for teachers and learners, thereby affording teachers new means of

self comprehension and increasing the possibility of rational communication among teachers and learners.

The constructivist paradigm, which is based on the philosophy of critical theory, is another paradigm in teaching and learning, which regards the learners as the agents of their own learning. In such situations the learners should therefore be treated as individuals who must be assisted to construct their own knowledge. The learner is an active agent and not a mere passive recipient of knowledge. For this kind of learning to take place effectively, the teacher has to create and facilitate teaching activities in a variety of ways. There is a need to use a wide variety of teaching aids in order for teaching and learning to be effective. Therefore, in this study the constructivist paradigm is used as the guiding framework because this paradigm favors approaches that demand active participation, intensive interaction, and thoughtful reflections.

1.8 Research methodology

In doing a research the most commonly used research methods are quantitative and qualitative researching methods. A quantitative research method uses experimental and statistical techniques to collect numerical data on a representative sample of the population. While in qualitative research method, data are in the form of words and phrases, and samples tend to be small.

Both quantitative and qualitative research methods are used in this study. Under quantitative research, a survey method was applied to a sample of secondary schools in Eritrea. A total of 42 Biology teachers responded to the closed ended type of questionnaire.

The qualitative research was used to consolidate the information obtained through the survey. Therefore, the information obtained through the survey was deepened through the semi-structured interviews with 6 teachers, currently teaching Biology for grade 8. They were selected from different secondary schools.

1.8.1 Research techniques

A review of literature pertinent to this study was undertaken in order to investigate the use of teaching aids in the teaching and learning situation. The literature indicates strongly that the effective use of teaching aids in teaching and learning impacts strongly on the learners' understanding. Different materials used in this study came from the sources listed below:

A. Published materials:

Eritrea educational briefs, international books and relevant studies in journals and articles in periodicals were used to investigate the role of teaching aids in teaching and learning.

B. Unpublished materials:

Materials from previous studies in Biology education in general and studies in the use of teaching aids for teaching and learning science was of immense value in this study. Materials and findings from minor studies undertaken by M. Ed students were also incorporated into this study.

C. Information supplied by teachers in questionnaires:

The questionnaire to teachers was designed to investigate:

- The extent to which secondary school Biology teachers use teaching aids in the teaching and learning process;
- The types of teaching aids available in secondary schools of Eritrea;
- The constraints that prevent the use of teaching aids in the teaching and learning process and
- The importance of teaching aids on the development of learners' understanding.

D. Information collected from interview conducted with teachers:

- Semi-structured interviews were used to investigate teachers' perception concerning the extent to which teachers use teaching aids and to identify the constraints for not using teaching aids.
- The responses from the questionnaire together with the data from the interviews were used to interpret the extent to which secondary school Biology teachers use teaching aids.

1.8.2 Research questions

In order to solve the problem of this study the following main research question was formulated:

- **To what extent grade 8 Biology teachers in Eritrea secondary schools are using teaching aids in teaching and learning process?**

Sub-research questions

The main research question has further sub-divided into four sub-questions which could provide the necessary information to solve the problem:

- To what extent are teaching aids, that are helpful for teaching Biology, are available in secondary schools in Eritrea.

- What is the relation in using teaching aids when comparing urban and rural secondary school teachers, private and governmental secondary school teachers, and less experienced and more experienced teachers?

- What are the constraints for not using teaching aids in the teaching and learning process?

- What is the significance of teaching aids on learners' understanding of Biology?

1.8.3 Data analysis and data interpretation

A significant amount of data was collected through the survey. Once all the data was captured data analysis was done to investigate the responses of teachers to the different questions asked in the questionnaires. The frequency of responses was recorded and compared to significant grouping variables such as 'type of locality', and ' experience of teachers'. This was done to investigate whether these variables impacted on the pattern of responses. Also, the data collected using the interview was recorded and transcribed into main themes. Then, data analysis was based on the themes. Finally, the main findings of the research were synthesized and evaluated in terms of the study under investigation.

1.9 Limitations of the study

In this study the main limiting factors which influenced the research study were:

The length of time spent on data collection was limited. The researcher visited the schools between January and February. School holidays and examinations of the first semester fell within this period.

This was a small-scale study which involved only two regions of the country. Therefore wider aspects, which included the perception of other people involved in the schools like head of departments, principals, and supervisors were not investigated.

Only 21 secondary schools that the researcher could easily access were chosen for the study.

Since the study was conducted in only two regions, namely the central and northern Red Sea regions, the result could not necessarily be generalized for all regions in the country.

Although the findings may be true for the teaching and learning of Biology, they cannot be extended to other disciplines with any degree of confidence and conviction.

1.10 Structure of the study

The first chapter deals with the background and purpose of the study and addresses the statement of the problem, that is, to identify to what extent teaching aids are necessary in the teaching and learning process.

The second chapter deals with the literature review about the different types of teaching aids and their relevance in the teaching and learning process. In addition, the various methods for selecting teaching aids are mentioned in this chapter. The factors, which prevent the use of teaching aids, are discussed at the end of this chapter.

The third chapter provides details of the methods used to develop the instruments and to collect the data for the study. These data collection instruments (questionnaires and interviews) helped the researcher to collect relevant data, which were necessary to illuminate the research problem.

The fourth chapter includes the data presentation and analysis section of the study. In this chapter, the data collected using questionnaires and interviews, are presented and analyzed. The analyzed data are also evaluated to determine the possible recommendations to the research problem.

Finally, the last chapter deals with the conclusions and recommendations of the major findings. The focus of the recommendations is to create awareness, amongst teachers and Biology curriculum developers and to make suggestions for further research.

1.11 Conclusion

This chapter gave a general background to one of the existing problems that is a challenge in the teaching and learning of Biology in the secondary schools of Eritrea. This study attempts to address as to what extent Eritrean secondary school Biology teachers use teaching aids in their classrooms. The theoretical framework for the study, the purpose, the main research question, significance, and limitation of the study have been discussed.

In the next chapter the literature related to the study is discussed which helps to answer the main research question in the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The main content of this chapter is to provide relevant literature dealing specifically with the different types of teaching aids, their value, and to review results of research on different teaching activities practiced in classrooms. Hence, in this chapter the predominant role played by teaching aids in the learning process is explored. Secondly, issues dealing with different techniques for selecting and utilizing teaching aids are mentioned.

In this study the term teaching aids denotes the various materials, techniques, activities and audio-visual aids used for the purpose of assisting the teacher in attaining learners learning outcomes far more easily, quickly and effectively.

2.2 Development of Biology education

Biology is a branch of science, which deals with living organisms and the relationships within the environment. A learner in Biology is exposed to various aspects of plants and animal life such as Morphology, Anatomy, Classification and their relationship with the environment.

In addition to factual and conceptual learning, learners are always developing attitudes and skills and has experiences beyond those only envisioned by the teacher. Through the exposure to different teaching aids (visual aids, audio aids, and audio-visual aids) gaps are filled between the learner and desirable learning. Inculcation of scientific attitudes can take place and opportunities for behavior changes are created. In essence, all teaching aids pose the potential for establishing and making a unique contribution to the experiences that enable high school Biology learners to develop essential learning skills, knowledge and values in science.

In Eritrea, learners start to learn about the Biology course from grade 8 up to grade 11. The main contents of grade 8 Biology topics are : The nature of living things around us, their life functions, and the different chemical reactions in the body of living things, especially the process of photosynthesis in plants. In teaching and learning these topics, the teacher needs to use different teaching strategies in presenting the lesson. For example visual aids help to illustrate the structure of sample plants and animals and to show some chemical reactions. By using science-related activities such as demonstrations in classrooms, learners are able to observe and study live plants and animals in the environment.

2.3 Objectives of teaching Biology

Science instruction in the past has been concerned mainly with memorization of the scientific body of information. In Biology, the learners are asked to memorize the names and characteristics of the various plants and animals.

Today, however, with the tremendous mass of factual information in each of the scientific disciplines, it is totally unrealistic to assume that any one individual could begin to memorize even a comparatively small bit of significant information concerning the field of Biology.

In the process of science teaching and learning, the understanding of broad concepts, principles, and conceptual schemes or themes, becomes the primary task of the Biology teachers. This task is not an easy one for either the Biology teacher or the learner, since merely reading or listening to a presentation about a given topic cannot assure understanding. The teacher must rather have an understanding of the thought processes that a learner should have in order to teach accordingly. The learner must also become an active participant in the process of deriving these understandings of scientific concepts and conceptual schemes in Biology.

The objectives of teaching Biology in the secondary school can be divided into two main areas: teachers' objectives and learners' objectives. In this study the important one is teacher objectives because the study mainly deals with teachers. Voss and Brown (1968: 34) suggest some of the objectives of teaching Biology as follows:

> Stimulating a genuine curiosity in the mind of the leaner; the teachers must provide the opportunity for the learner to experience the thrill of discovery by himself/herself; the teacher must present Biology as a means of inquiry and investigation.

For the first objective, the skillful teacher can give just the optimum amount of information so that the learner cannot help but be driven to find out the real cause or effect on himself/herself. Concerning the second objective, the teacher must set the stage, must provide the background information and then provide the necessary materials to do his/her own and finds the answer that he/she is seeking. To achieve the third objective the teacher must make the learner aware that progress in Biology comes as a result of scientific investigation and that the methods of investigation are many and varied.

2.4 Meaning of teaching aid

Since the early 1900s terms such as visual aids, instructional materials, teaching aids, communication media, educational media, and many more have been used interchangeably to designate a group of materials and techniques which stimulate the sense of the learning, according to De Kieffer (1965). In literature various words and phrases such as educational aid, teaching aids, learning aid and audiovisual aid, are found to designate different materials used in teaching and learning (Freysen, *et al,* 1989).

Different educators have given different meaning to teaching aids. Van Rooyen and Van der Merwe (2001: 240), define teaching aid as "An object the teacher uses, or which is given to the learners to use, to achieve specific teaching and learning outcomes." Shortly, teaching aids are materials of different types of which each one has a specific value.

In this study, the term teaching aid refers to different teaching materials used for teaching Biology in the classroom and the laboratory. Therefore, a teaching aid is explained as those visual aids such as textbooks, microscopes and lenses, diagrams, living things and specimens, and teaching materials for demonstrations and laboratory

work utilized by biology teachers to be effective in achieving learning outcomes (MOE, 2001).

2.5. Historical background of teaching aids use

The use of instructional materials started in the prehistoric times. The cave man taught his son to hunt; he did not only use words but, also demonstrated and practiced how to use tools for hunting. Today, in some countries, a batch of sand is used for practicing drawing and counting.

The instructional media have been used to a large extent in the educational process in recent decades. The first teaching material in modern times was printing. The printed media shared the ideas of great thinkers and the strategies of teachers. The teaching materials we talk mostly about today are the electronic and photographic media that came into use in the 19th and 20th century, namely photographs, slides, films, recordings, radios, television sets and computers. Like printing, these teaching materials are not specially designed for instruction; they are simply information carrying technologies that can be used for instruction.

Nowadays, education is transformed into the application of scientific technology to instruct example computer-assisted instruction that is practiced in some countries of the world. Kulik & Bangert-Drowns (1983: 137) suggest that the benefits that technology offer to learners are:

> Better and comfortable and foster learning since learners will be able to use technology to learn at their own pace and at their own convenience; opportunities to work with vastly richer materials and more sophisticated problems; unlimited, individual tutoring; and automatic measurement of learners' progress.

However, the use of modern technology was not easily available in most secondary schools in Eritrea because it is expensive and schools could not afford it.

2.6 Variety of teaching aids used in teaching and learning

Since earliest times man has made use of non-human media to transmit messages or information and to instruct. "The first examples probably were sketches in the sand and rock paintings" according to Conradie (1979: 10). By the Middle Ages teachers had media such as books, models and blackboards available to support them in their teaching. The development of book printing naturally promoted the use of school textbooks tremendously, and this promoted other media.

The development of teaching aids is seen in different periods for different purpose in education. Schramm cited by Duminy and Sobnge (1980: 137), distinguishes between four generations of educational media as follows:

- First generation media are those which do not require mechanical or electrical device. Examples are charts, maps, graphs, and the like.

- Second-generation media includes for the first time, instruments introduced in the communication process to duplicate man's writing and drawing. This has made possible universal public education and world literacy. Examples are printed textbooks, workbooks, and so on.

- Third generation media were seen in the 19th and early 20th centuries when man introduced machines into the communication process, first to see, then to listen and finally to both see and listen. This resulted in photographs, slides, stripfilms, silent motion pictures, sound recording, and later also sound motion pictures and television.

- Fourth generation media are just beginning to come into use and they are distinguished by the fact that they depend on communication between man and machine. Typical devices are programmed instruction machines, language laboratories and electronic digital computers.

Different educators have mentioned different types of teaching aids. According to Gerlach and Ely (1980: 247), teaching aids are classified into six groups, namely, still

pictures, audio materials, motion pictures and television real object, models and specimens and programmed and computer assisted instructions. While according to Van Rooyen and Van der Merwe (2001: 240), teaching aids are classified into three depending on their values:

- Those encouraging concrete experience like laboratory work, demonstration and field trips;
- Teaching aids encouraging iconic experience like pictures, posters, slide... etc; and
- Teaching aids encouraging abstract experience like diagrams, radios and so on.

These teaching aids are selected depending on the objective of the lesson. They are also depending on the cognitive stage of the learners. For example, for teaching children in elementary level it is not advisable to use teaching aids that encourage abstract ideas because their cognitive development is at a lower level.

Also Nacimo-Brown, *et al* (1982: 167), suggest a list of available teaching aids, which help in terms of effective teaching. They are visual aids, audio aids and audio-visual aids. From these, the most commonly used teaching aids in teaching and learning of Biology are the visual aids.

In Eritrea the types of teaching aids for teaching Biology are mostly traditional in nature. They are either prepared or purchased by the MOE and then distributed to schools or could be prepared by the subject teachers for use. Some of the main teaching aids distributed are textbooks, and visual aids such as microscopes and models. The rest are prepared or collected from the community. For example, most living things could be collected and preserved for use in the lesson.

2.7 The value of visual aids in teaching and learning

There are teaching aids that consist of three dimensional materials (e.g. specimens, models and objects), printed materials (e.g. textbooks), still picture (e.g. non-projected and projected) and graphs (e.g. diagrams, posters). Slides, overhead transparencies and on-screen presentations are not intended to replace the verbal presentation, but they can enhance it. Visuals can serve as brief outlines to assist learners in following

the lecture. In addition, films and visuals aids can be used to illustrate and to imagine difficult concepts and issues.

Visual aids are used to accomplish four ends according to Miller and Blaydes (1962: 87). They are as follows:

- To stimulate interest and thus expedite learning;
- To augment the learning process by providing visual experience beyond the concepts of words;
- To increase understanding by relating these experiences to life; and
- To test for the application of learning.

Concerning the first, any learner could find a great interest in those things that they could see or handle. This is true in Biology where live plants and animals could be used as visual aids, they could stimulate interest of learners in their study.

In regard to the second aim, it is generally accepted that learning proceeds from concrete to abstract. For example, if a Biology teacher mentions the word 'chameleon' to a class, the learners will most probably be unable to call up any image or concept that corresponds to the word. If a teacher explains that the chameleon is a reptile, it is possible that some learners would have some experience with reptiles. If a teacher explains further that it is a reptile or lizard type, the meaning is still further clarified. However, all this depends on the explanation, clarification and classification of information, which have meaning only in terms of past experience. Visual experiences can greatly enhance the learning ability of learners.

The third reason for using visual aids has to do with relating new experiences to life. In teaching it is always a safe practice to utilize the experiences of the learner. A wise teachers makes special effort to discover the kinds of experiences his/her learners may have. The fourth use of visual aids lies in the testing of the application of learning. A visual aid may be used rightly as an illustration or as an additional explanation.

There are certain standards of essential qualities that may be used to determine the extent to which visual aids are of value in a learning situation. "Their value depends on the extent to which they assist in achieving the objectives of instruction and may be indicated briefly under the following: accuracy; relevancy; realism;

comprehensibility; and interest" according to Miller and Blaydes (1962: 89). These values make teachers use teaching aids in the teaching and learning process besides the lecture method.

As stated in the Curriculum Guide for teaching Biology in secondary schools in Eritrea, the main types of visual aids used for teaching grade 8 Biology are the textbooks, microscopes and hand-lenses, and living things and specimens. Therefore, the literature review which is related to these teaching aids and research studies on the role of teaching aids are discussed in the following section.

2.7.1 The textbook as a teaching aid

The textbook, during the last century, has come into use more widely and has proved itself more broadly useful than any other medium. Of all the teaching aids available to the teacher today, it is likely to be considered most indispensable and most nearly perfected. For example in Eritrea, textbooks are the most commonly used teaching aids in the teaching and learning process. This is because the MOE of Eritrea prints and distributes all types of textbook to all schools. The modern textbook is an effective combination of word description and clear, meaningful illustrations according to Shipley, *et al.* (1972: 237). Similarly, in Eritrea, the grade 8 Biology textbook used for teaching and learning is composed of word descriptions and diagrams.

Many educators explain the use of textbook as a teaching aid. For example according to Armbruster, (1992) cited by Digisi and Willet (1995: 124) "When textbooks are used effectively with a broad repertoire of instructional activities, difficulties of factual inaccuracy, inadequate explanation, and lack of depth can be minimized and the teaching of critical reading and thinking skills enhanced." Also according to Brown, *et al* (1973) and Nacimo-Brown, *et al* (1982) textbooks offer several advantages when used for classroom instruction. Some of them are summarized as follows:

- Individualization of instruction- textbooks help to individualize instruction by enabling learners to proceed at their own rates, and to a limited extent, according to what they are interested in studying;

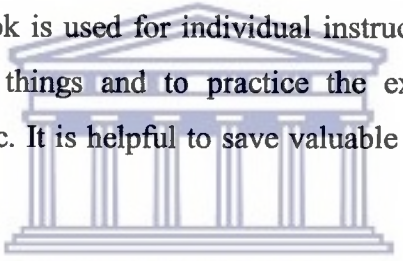
- Economy- textbooks are used and reused; their cost per pupil is therefore quite low;

- Organization of instruction- textbook help to organize and unify instruction by providing some reading experiences suggested activities, recommended readings, and question;

- Tutorial contributions- teachers often maintain that textbooks help learners to learn how to read better, to study, to weigh evidence, and to solve problems; and

- Improvement of teaching- textbooks are also regarded as helpful in improving teacher skills (especially through teachers' manuals and notes) and in suggesting ways to handle instructional problems.

In Eritrea, the Biology textbook is used for individual instruction such as drawing the structure of some living things and to practice the experiments using the procedures given for each topic. It is helpful to save valuable time for teachers and cover a stated syllabus.



Different research studies were done indicating the role of textbooks on learners. For example, Shymansky and Kyle (1986) summarize the study conducted on the effect of textbooks on learners' performance. Textbooks can help learners develop effective science reading strategies. The textbook has long been a key in the instructional plan of science teachers. In Eritrea, the grade 8 Biology textbook consists of diagrams of plants and animals. Learners could study easily the structure of living things by observing the diagrams and this also helps them to have good understanding of the concept and to perform in their examinations.

Also, Gallager (1987) summarized the study conducted by Horak, who analyzes the effects of different types of aids on learning science concepts from textual materials. The result of his study indicates that most learners benefit from forms of textual structuring that aid them in selecting the important concepts and assist them in making internal connections within the presented materials.

2.7.2 The microscope as a teaching aid

According to Miller and Blaydes (1962: 282) "The microscope is one of the visual aids, which is used to stimulate, interest and thus assist learning." It makes greater the learning process by providing visual experience beyond the concept of words. " Of the tools for extending the Biologists senses, the microscope is one of the most useful in many areas of laboratory work according to Harding, *et al* (1969: 26). It is mainly useful in helping to observe the smaller living things which cannot be seen by the naked eyes.

Also Risk (1958: 356) suggests the role of the microscope to be "in establishing vivid and accurate images, and as a means of arousing interest in and fixing attention on the desired relationships being studied". When learners observe the different parts of a living thing, they would be more motivated and interested.

Many research studies have been conducted to determine the effectiveness of visual aids in teaching and learning. The results of these studies reveal that a series of values are derived from the use of visual aids in teaching. As to the value of the microscope, it is used to observe living things accurately. In the Eritrean secondary schools learners study the structure of animal and plant cells, using the simple light microscope when learning grade 8 Biology.

2.7.3 Living things as teaching aids

It is known that the more effective learning takes place when one observes concrete objects or organisms in their natural environment. As Biology teaching is all about unlocking reality for the learner and orienting him or her towards reality, learners must be given as many opportunities as possible to experience reality for themselves.

Real things and models include people, actual objects, and specimens. "Real things are those stimuli presented to learners by means of field trips or by bringing people or things to the school for direct observation", according to Gerlach and Ely (1980: 375). No teaching aid, picture, or film can produce the clear-cut concept, which the real object can evoke according to Shipley, *et al* (1972: 242). Objects are quite easy to

obtain with a little foresight and some help from the learners. Many of the small animals, trees, and fruits can be collected for use in lessons in science. Many real objects are not practically brought to the classroom. Therefore, use of carefully constructed models will assist the teacher to create good learning situations.

According to Miller and Blaydes (1962: 79), " The most valuable form of visual aid in Biology is undoubtedly the specimen and, wherever possible, it should be the living specimen." A specimen represents a living thing and used as a teaching aids in the classroom. According to Harding, *et al* (1969: 119), " Specimens are powerful media for Biology students as they represent nature in its most direct approach". This helps learners to learn in an informed way because they have opportunities for true experience with the materials under study. Animals have also been used since early time for educational purposes. Aristotle dissected animals for study and teaching purposes (Stainsstreet, *et al,*1993: 411).

According to Wittich & Schuller (1979) and Gerlach & Ely (1980) using real objects such as organisms in teaching and learning Biology have significant advantages. Some of them are summarized as follows:

- Real organisms give authenticity to an experience and in so doing narrow the gap between teaching and reality;
- Using real organisms in the classroom make it possible to compare certain concrete kinds of plant and animals with one another;
- Working with and studying organisms make use of senses such as the sense of touch and the sense of smell that often are not employed in the teaching-learning situation;
- A good collection of organisms naturally saves time, because an overview can be given without having to look for examples on excursions; and
- Learners can help teachers in collection of organisms from the community. Learners' participation is encouraged in this way.

Research results show that living materials in the Biology classroom stimulated curiosity and interest, in turn, influenced attitudes and achievement according to Gallager (1987). "The real animal provides an educational experiences which is deeper, and therefore of more value, than that given by surrogates such as textbooks, charts, computer simulation or plastic models" according to Stainsstreet, *et al* (1993:

411). Research studies have found that the presence of living things in the classroom like plants, insects, birds, fish, animals, not only helps the student learn facts about their growth, but also builds attitudes of responsibility, consideration, and gentleness.

Gallager (1987) summarizes the research conducted by Saunders and Young that dealt with the effects of the presence and absence of living things in the high school biology classrooms. The result shows that living materials in the biology classroom stimulated curiosity and interest, which, in turn influenced attitudes and achievement.

Also, Killermann (1996) reported that the use of living animals in the lesson could have a positive influence on student attitudes. It is found that working with living animals is more motivating and this motivation led to a greater amount of learning. An overall conclusion from the study is that living animals should be used in the lessons as often as possible, whether in the classroom, or out-of doors.

In Eritrea secondary schools, living specimens like spirogyra and other plants are used for teaching and learning in grade 8 Biology. Learners themselves collect them from their surrounding pond. This help learners to acquire knowledge by direct observation in addition to the teacher's presentation.

Even though using real organisms help learners in many ways, there are limitations in using organisms as teaching aids. Some of the limitations suggested by Gerlach and Ely (1980: 375) are:

- Real things are not always readily available;
- Real things cannot always be viewed in their natural settings; and
- Real things are not always useful in their natural state.

2.8 The value of audio aids in teaching and learning

A large portion of classroom learning experience involves listening: listening to lectures, discussions, explanations and comments. It has therefore become necessary to include audio aids such as the radio, and the tape recorder. Unlike television and overhead projectors, audio aids can be carried and used everywhere and anytime even in villages where there is no electricity supply.

2.8.1 The radio

It was one of the first technological aids and has been used on a large scale since the 19th century. In developing countries, for example India, where teachers are scarce and often badly trained, profitable use is made of school radio broadcasts, according to Conradie (1979: 44). In Eritrea, the national radio is used to broadcast the Biology lessons to which learners listen to and afterwards discuss with their classmates.

The radio as a teaching aid has great value, especially auditory distinctions play a role and in areas where television is not available or too expensive. For example, Biology lessons for secondary schools broadcast is possible because of the following advantages according to Wittich and Schuller (1979: 271):

- The radio can overcome boundaries of time and space. For example recordings of lecture of Biology lesson can be brought right into the classroom or learners can listen at home;
- Radio is a relatively cheap medium of communication; and
- It also gives an opportunity for active participation. Learners who listen are prepared to draw, write, look at diagrams, and do exercise.

The use of the radio as a teaching aid could help learners to have equal understanding of the concepts because it is prepared by well-trained teachers.

2.9 The value of audio-visual aids in teaching and learning

Audio-visual aids are composed of two instructional devices of sound motion pictures and television. Research studies have shown that a person learns 1% by taste, 1 and

1.5% by touch, 3.5% by smell, 11% by hearing, and 83% by visual experience Conradie (1979). This indicates that teaching aids, which have both seeing and hearing devices, are more effective for teaching and learning.

Film and video can also be effective teaching tools. They demonstrate things we cannot see and offer views of dangerous processes, complex events (such as the workings of the heart) by combining images and sounds, and can invoke an emotional response often more powerful than mere words. One of the most effective uses of television teaching is in audio-visual mediums for presenting specialized demonstrations. Especially laboratory demonstrations can be used in these subjects where skills need to be developed.

2.10 Research findings on the importance of teaching aids

During the last few decades a number of researchers were asking questions about the role of teaching aids. Can teaching aids help to make teaching and learning more meaningful? This question has been asked over and over, and the answer has been that pupils can learn effectively if teachers use teaching aids.

There are numerous research findings that show that individuals can learn effectively if appropriate teaching aids are designed, produced, made available and accessible to their users. According to Ibe-Bassey (1996: 288) point of view "... instructors and learners can use teaching aids to transfer their systematically planned lessons to others with the ultimate aim of promoting learning among learners." Hence, using such aids properly, create interest in the learners, motivate the learners to learn, make instruction productive, and provide developmental teaching and learning.

Research on the use of the integration of teaching aids in various phases of the lesson shows that the meaningful use of more than one teaching aid can definitely contribute to the support of the teaching and learning process. However, according to Kinder (1973) cited by Freysen, *et al* (1989: 65), "... the number of teaching aids used do not itself determine the success of a presentation". The success of using different teaching aids is largely determined by the suitability of the various teaching aids, the

way in which they complement one another and the planned use of teaching aids to realize the stated objectives.

The teaching of biological principles as a result of many worthwhile learning activities can establish a good relationship between the need of facts and generalizations. According to Dicker (1987: 45), " Resource materials are intended to assist the learning process rather than a means of allowing a teacher to have easier life at school or to be used as a substitute for an absent teacher". This implies that teachers use teaching aids in addition to other teaching methods (e.g. lecture method) that can help learners understand the lesson easily.

The general objective for the use of teaching aids is to make learning more meaningful. Some of the specific objectives suggested, according to Shipley, *et al* (1972: 222) are:

> Focusing pupil interest and attention; showing basic structure of a concept; relating abstractions to concreteness; integrating scattered understanding into a generalized idea; encouraging verbal and written expressions; turning conceptual patterns into languages; and explaining relationships.

Concerning the first idea, teachers who rely solely on the oral presentation find that their learners frequently are unable to relate effectively a new learning to any well founded basic experience. The use of a picture, drawing, sketch and so on will assist immeasurably, to focus the attention on the subject.

For the second idea, the use of visual materials by the teacher lead the learner to mastery of the skill by using charts and sketches to understand whole concepts where explanations, by using words, are often inadequate.

Thirdly, the learners' imagination cannot be expected to reach a completely accurate mental picture of the concepts about which, the learner has been learning. Thus, it is imperative that the teacher employ some kind of visual material to relate the general concept to a three dimensional reality.

In attaining the fourth object, teachers can use the motion picture. A real object, a still picture, or a motion picture will serve to relate a general concept to particular circumstances. In teaching about internal structure of organisms it would be difficult to communicate word descriptions without the use of diagrams. Finally, concepts that are developed in one subject area are thought of as separate and apart from concepts developed in some other subject area. Teachers must make every effort to relate learning to life and to show learners that all learning is related to the whole experience of living.

Also research studies show that learners' performance can be improved by the use of appropriate learning materials and teaching methods. One of the findings by Cohen and Ben-Zvi (1992: 147) suggest that " Variety of teaching activities, which optimize students involvement in the learning process, together with well-prepared materials, which are appropriate for such activities, help learners to improve their performance." This implies that using different teaching aids, besides the lecture method would make learners to involve different sense organs rather than only hearing.

Using teaching aids in classrooms is essential to create two-way communication between teacher and learners. Sometimes some psychological barriers occur that can be solved using teaching aids. Wittich & Schuller (1979: 9), suggest five barriers to effective classroom communication such as"... too much verbalization, confusion over referents, daydreaming, perceptual difficulties, and physical discomfort". The means for solving these barriers are described in the next paragraph.

To overcome the first problem, teachers may draw on a wide variety of instructional materials by using modern communication techniques to transmit information. The second kind of communication problem is overcomed by using a message that is highly graphic, visual and unmistakable. The more graphic and visual a message is, the more understandable the stimuli .

The problem of day dreaming can be lessened or eliminated by making lessons more interesting or easier to understand. Learning materials that appeal to the senses and require some kind of activity by the student are very useful in this regard. A learner's capacity of information about the world is gained through the senses, largely through

the eyes and ears but also through the mechanism of smell, touch and taste. Our physical environment can have a favorable or an unfavorable effect on our emotions. To solve the unfavorable effect classrooms should have controlled lighting systems that permit the use of projected materials and temperature control that encourage mental alertness.

2.11 Science-related activities in Biology lessons

2.11.1 Demonstration

Nacino-Brown, *et al* (1982: 54) defined demonstration as "An activity which combines telling, showing and doing for the benefit of an audience, be it a person or a group of persons. It is an activity in which learners reassert or validate information previously stated by the textbook on the teacher" according to Candela (1997: 500). Here a teacher could show learners the different principles of Biology by using the procedures given in the textbook. For example, according to the Eritrean textbook of Biology for grade 8, the principles of Biology such as osmosis and diffusion should be demonstrated for learners. This helps learners to prove the theory or facts stated in the textbooks. According to Fraser, *et al* (1983: 159), all four fundamental didactics forms are applicable to the demonstration method:

1. The demonstration can involve learners through play;
2. Demonstration is related to discussion, because the demonstrator must communicate constantly with the audience in order to explain the demonstration;
3. The demonstrator uses examples freely in his teaching, for example in the form of specimens or models; and
4. If the demonstrator involves the learners in the demonstration or gives them specific tasks to do, he is using the assignment as a fundamental didactic form.

There are instances when demonstration is appropriate such as "... when teaching skills; when teaching materials and equipments are insufficient; and when experimenting with dangerous chemical solutions", according to Nacimo-brown, *et al* (1982: 54).

Like most other effective techniques or procedures in science teaching, demonstrations may be used for a variety of purposes. Among thes purposes for which demonstration have proved functions are: motivation; explanation of principles or application; preview of a unit work; provision for various phases of teaching for thinking; provision for particular learners needs or interests; exemplification of a skill or technique; review; and evaluation, according to Richardson and Cahoon (1951). According to Voss and Brown (1968: 71), demonstrations have certain advantages, namely

- It is easier to theorize about a phenomenon after one has observed it directly;
- It is easier to conceptualize something when the person actually observes it;
- It is easier for students to think about what they have seen for themselves than something they have read about;
- It provides students with opportunities to observe and think with a biologist in a problem solving situation; and
- It saves on materials, class time and teaching time.

In teaching Biology, demonstrations are possible in classrooms. From my experience, I used to teach about the reproduction of flowering plants by showing a live flower and its different parts to learners. However, using demonstration activities have some disadvantages as stated by Fraser, *et al* (1983: 159):

- It provides less opportunity for learners to discover things or solve problems by themselves;
- Active participation is reduced as the learners mainly act as observers; and
- It is difficult to follow demonstrations in a large group.

2.11.2 Laboratory work

The laboratory is the place where one learns most readily. Race (1992: 15) defines practical work as "an important type of teaching activity in teaching science." It helps to develop knowledge and understanding of scientific facts and theories by the provision of concrete experience, developing psychomotor skills and promoting motivation. From this type of learning activity learners' retention of what is learned is

very high; that is, they can remember 90% of what is said, while doing something according to Rick cited by Conradie (1979).

Science instruction that includes a regular laboratory experience is a viable and effective instructional method for science teachers. Experimental work in Biology provides an opportunity and examines the various structures, processes and relationships that are characteristics of the living organisms, according to the MOE, (2001).

The science laboratory in secondary schools has been promoted as serving a wide variety of educational functions such as "Developing and restructuring knowledge schemes; promoting inquiry and problem solving reflecting science as it is practiced by scientists; and developing skills in the processes of science", according to Germann, *et al* (1996: 415). It is important in teaching Biology that animals can be dissected for observing their internal organs and learners to develop the skill by observing and doing the dissection themselves.

Research studies on the effect of teaching materials on learners show that the value of science practical work to pupils lies in their involvement in personal discovery, a sense of curiosity, and an acquiring confidence in devising strategies for problem-solving or learning social co-operation through group work, according to Denny (1986).

Shymansky and Kyle (1986), summarize the role of the laboratory carried out by Hounsbell. Of the 196 teachers who replied to the questionnaires, 80% felt that laboratories were effective in increasing learners processing skills, enhancing knowledge, and positively influencing attitudes. However, about half of the teachers reported that discipline problems increased during laboratory time and most mentioned problems with obtaining adequate funding for the laboratory.

The study carried out by Killermann (1996), concerning the learners' attitude towards Biology lesson, shows that experiments carried out by learners themselves led to a significantly better attitude towards Biology lessons while the group in which the experiment was demonstrated by the teacher showed a slight negative change in

attitude. When learners do practical work, like dissecting animals themselves, they will develop the skills easily rather than observing the work done by others. In the teaching and learning process the learner develops more skills by doing practical work than by observation only.

2.12 Methods of selecting teaching aids

When well-designed teaching aids are implemented successfully, it will enable teachers to lead and direct in a well-designed environment for large and more heterogeneous groups, according to Waghid, (1999). Using a variety of instruction materials is important for effective teaching, but their selection, utilization and evaluation requires professional skills, which can only be acquired through training and practice as stated by Nacino-Brown, *et al* (1982). For example, for using the laboratory, teachers should be trained so as to apply it correctly and effectively.

According to Van Rooyen and Van der Merwe (2001: 240), "Teaching aids are most effective when they are employed to supplement the personality and the teaching skills of the teacher." They assist in the meaningful learning of the subject matter by learners. However, Aho, *et al* (1993: 505), point out that "The choice of suitable materials and equipment to support learning is an important matter. If this is lacking it may result in the teacher continuing to use traditional teacher-centered methods." The teacher needs to have a skill or should train how to select and use the appropriate teaching aids before he/she tries to use them.

As teaching aids in the classroom become an extension of the teacher, the following aspects "Simplicity and clarity, symbolic coding element of the medium, pupil participation, availability, cost, suitability, and technical quality " must be taken into consideration when teaching aids are to be selected, according to Stuart, *et al* (1985: 78). These can be explained as follows

A. Simplicity and clarity

In a simple presentation the information will be arranged to make the important fact immediately obvious. Too much information and too complex a composition of

images is confusing; clarity also means that it will become possible for pupils to gain insight through the manner in which the content is presented.

B. Symbolic coding elements of the medium

The way in which information is coded and shaped by a medium will influence the cognitive (intellectual) activities of the learner when he/she is integrating new information into his/her existing knowledge. Examples of coding elements are sound, colour and so on.

C. Pupil participation

Teaching aids can only be effectively incorporated if they promote pupil involvement. Meaningful interaction must be possible between the pupil and the content.

D. Availability:

The first matter, which should receive attention, is the infrastructure as well as the availability of apparatus and programs.

E. Cost

There should be a sensible relationship between cost and expected learning results. Smaller teaching aids (textbooks, overhead projector etc) are most cost effective than many of the more sophisticated teaching aids.

F. Suitability

The most important aspect when selecting a teaching aid is determining its suitability in assisting the pupil towards realization of the learning objectives.

G.Technical quality

Programs should be of a high quality in order to eliminate disturbances. Such aspects as clarity, vividness, visibility, legibility and audibility are of important once.

During selecting teaching aids there are different factors to be considered. For example Romiszowski (1988) mentions the factors that affect the choice of an appropriate teaching aids in teaching and learning aids as follows: "Instructional method; interest of students; special characteristic of students; and practical constraints." The influences of these factors are explained below.

A. Instructional method

The choice of a particular instructional method will dictate or limit the choice of a teaching aid. No one type of teaching aid is appropriate for all kinds of learning. The teacher therefore, should select materials that would best aid the method. For example, if a teacher uses a method involving group discussion and sharing of experience, teaching aids such as visual aids (e.g. microscope) would not be suitable, as it limits the opportunity for feedback and exchange of ideas.

B. Interest of students

The type of learning task facing the student will also influence the choice in teaching aids, because it limits the choice of suitable methods of instruction. Teaching aids are effective only when they are understood and appreciated by the learners using them. According to Freedman & Berg (1961) learners' preparation depends on readiness and participation. The readiness for learning refers to 'view', to 'listen', and to 'absorb'. This readiness is presented when their interest has been aroused and when they know why they are seeing or hearing the material and what they are to look for and why. The teacher removes barriers to understanding in the form of difficult words or concepts by listing them on the board and teaching them. Then the teacher can introduce which is to be seen, thus setting the stage for learning. Learners participate during an audio-visual experience by concentrating, thinking, and reacting. After it is over, they can participate more actively by answering the questions posed earlier, by

joining in discussion, drawing, writing, practicing the skills learned and applying the knowledge gained to other situation.

C. Special characteristic of learners

The special characteristics of some learners will directly influence the teaching aids to be chosen. For example, to instruct learners with sight problems using visual aids will not be suitable.

D. Practical constraints

The practical constraints such as money, time, and administrative factors also limit the choice of teaching aids. The cost depends on school budget and the time allocated for the subject.

2.12.1 Problems in selection and utilization of teaching aids

Baird, *et al* (1994: 576) provide evidence of many similarities and differences between rural and urban science teachers on selecting and using teaching aids in teaching and learning. They reported some of the factors, which influence science teachers in rural and urban schools. The most common problems in selecting and using the appropriate teaching aids, according to Baird, *et al* (1994: 576), are as follows:

- Insufficient/ lack of teaching aids
- Out-of date teaching materials
- Insufficient fund for purchasing equipment and supplies
- Inadequate laboratory facilities
- Too many class preparation per day
- Class size large

The result of the study shows that both rural and urban science teachers identify sources such as inexpensive materials, and use hand-on teaching strategies. Both groups reported that they made use of lectures and demonstrations for science instruction. Also, both groups of teachers faced many of the same everyday concerns

including poor student problem-solving skills, insufficient funding for their science program and inadequate laboratory facilities.

As to the difference between rural and urban science teaching the data revealed that rural teachers saw their environment as lacking a sufficient number of science role models for their students. Having too many daily preparations was a much greater problem for rural teachers. However, more urban teachers than rural teachers felt that class size was frequently a problem.

Also Dicker (1987: 45) mentions a number of barriers, which can prevent teachers from making adequate, use of suitable resource materials namely:

- Lack of resource centers which provide the materials;
- Teachers' may not have sufficient time to carry out or prepare teaching materials themselves;
- Lack of capital expenditure available for purchasing resource materials; and
- Limited experience of teachers' may encounter some difficulties in showing pupils the relevance and applications, of classroom science teaching.

2.13 Conclusions

In this chapter the objectives of teaching Biology and what Biology is about were discussed. The different types of teaching aids and the values of visual aids, audio aids, and audio-visual aids are briefly explained with some research related findings. Finally, the methods used for selection of teaching aids and the problems facing teachers in using teaching aids were discussed.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

In the previous chapter, the literature review concerning the use of teaching aids by Biology teachers in secondary schools were discussed. In addition, different factors that influence the selection of teaching aids for use were stated.

In this chapter, I will discuss the research methodology adopted in the present study. It describes the research design, the scope, the area of the study, the samples, and the procedures of the research process. It also points out the background of the research and the choice of the research approach.

The study was conducted in two regions of Eritrea, that is, the Central and the Northern Red Sea regions. Both governmental and private schools, urban and rural schools, and teachers with different experiences are teaching in these schools.

3.2 Paradigms in research methods

Research methods refer to the ways in which research studies are designed and the procedures by which data are analyzed. According to Goodman and Adler (1985) cited by Fraenckel and Wallen (1993: 408) " The rationale for choosing one methodology over the other is connected to the nature of the subject studied and the underlying goals of the research."

The researcher is concerned about the availability of teaching aids and the frequency of teaching aids use in the classroom. The study is carried out by collecting statistical data using questionnaires. Hence, a quantitative research method is used to answer the first three research questions. Also, semi-structured interviews were conducted to identify the availability of teaching aids, the constraints that prevent teachers from using teaching aids and the importance of teaching aids on learners' understanding. Teachers' beliefs and attitudes were collected using semi-structured interviews. A

qualitative research method was used to answer the last three research questions. Hence, the study falls within both quantitative and qualitative research paradigm. The use of two or more methods of collecting data enables the researcher to cross check the results in the process, subjectivity is controlled, and the validity of the results is increased. Exclusive reliance on one method may bias a researcher's picture of the phenomenon under investigation and therefore, methodological triangulation having different methods was used on the same subject of study according to Cohen and Manion (1980).

In this study both quantitative and qualitative research methods were used to investigate the research problems and to analyze the data collected using questionnaires and interviews. In the quantitative research method, questionnaires were prepared to collect numerical data from the representatives. In the qualitative research methods data were collected using interviews..

Babbie and Mouton (2001: 273) suggest that the main difference between quantitative and qualitative methods could be summarized as follows:

Characteristics	Quantitative method	Qualitative methods
Form of data	Uses numerical data	Data in the form of words & phrases
Sample size	Large population	Small
Focus of the research	On quantity	On quality
Role of the researcher	The primary instrument for data collection & analysis	To observe & to ask open ended questions
Study design character	Predetermined & structured	Flexible
Generalizability of findings	Provide factual, reliable data at the end of the research study. They are usually generalizable to a large group	Results are not generalized to a reference population

Table 3.1 Summary of differences between quantitative and qualitative research methods

3.3 Choice of research approach

After a definite research problem was identified and a thorough search of the literature was accomplished, the researcher had to decide which will be the approach to take in systematically collecting the data, or information needed to solve the research problem. One of the research approaches used was descriptive research. Descriptive research is a broad classification of research under which many of research are conducted.

Descriptive research was conducted to describe the present situation, what people currently believe, what people are doing at the moment, and so forth according to Baumgartner and Strong (1998: 130). Descriptive research is conducted by collecting information, and based on this information the situation is described. In this study, descriptive research is used to investigate the extent to which Biology teachers in the actual and normal classroom in Eritrean secondary schools use various teaching aids. This study is a primary research investigation of teachers currently teaching grade 8 Biology learners in secondary schools in Eritrea.

3.4 Research design

A research design is a plan or blueprint of how a researcher intends conducting a research process in order to solve the research problem. There are different types of research designs such as experimental, survey, participatory action research, and so on. In a survey approach, information concerning opinions or practices is obtained from a sample of people, representing a population, through the use of interviews or questionnaires techniques (Bell, 1987: 13).

In this study the survey approach, which is one of the descriptive research approache was used to investigate the extent to which Biology teachers in the actual and normal classroom in Eritrean secondary schools use various teaching aids. Questionnaire and interview techniques of data collection were used in this survey.

According to Descombe (1998), conducting research using surveys have advantages. Some of the advantages are stated as follows:

- Surveys focus on data more than theory-producing data based on real world observation;
- Wide and inclusive coverage. This gives credibility to generalized statement on the basis of the research.
- Lend themselves to quantitative data; and
- Can produce a mountain of data in a short time for a fairly low cost (Descombe, 1998: 27).

According to my point of view the information collected using survey method helped me to make comparisons and to know the current situation. However, a survey method has some limitations like the information obtained may be inaccurate or misinterpreted. These shows that using only a survey method is not complete by itself in collecting data. Hence, a qualitative research method is needed to overcome the shortcomings of using a survey.

3.5 Methods of data collection

3.5.1. Sampling

Sampling is the process of selecting a number of individuals for a study in such a way that the individuals' represent a larger group from which they were selected according to Gay (1981: 85).

Among the various types of sampling, the researcher has used a purposive sampling method. In purposive sampling, the researcher already knows something about the specific people or events and deliberately selects because they are seen as participants that are likely to produce the most valuable data according to Descombe (1998: 15). For example, in this study the Biology teachers currently teaching grade 8 learners are purposely selected because they were the right sample that could give the exact information.

As indicated in chapter one, the study is located in the central and northern Red Sea

regions of the state of Eritrea. The researcher has focused on the Central region because it has a high density of schools consisting of governmental and private schools. The northern Red Sea region has been selected because it consists of rural and urban types of schools.

In Eritrea there are 49 schools (45 governmental and 4 private secondary schools). Most of them are situated in the central region and a variety of schools for different ethnic groups are situated in the northern Red Sea region. The researcher selected all secondary schools in the central and the northern Red Sea regions.

The second reason for selecting these secondary schools is that the researcher was working as a secondary school Biology teacher in the northern Red Sea region for about 9 years, and have close contact with Biology teachers in the central region due to having conducted workshops and seminars related to curriculum development.

By doing this research the researcher intends to get an idea from the teachers' perceptions on the use of teaching aids in the rural and urban, governmental and private secondary schools of Eritrea.

3.5.2 Instruments

Questionnaires and interviews were the instruments used to collect information, which were important in conducting research. In this study the clarity and validity of the questionnaires and interviews were first discussed with experts working in the MOE of Eritrea and those colleagues studying at the University of the Western Cape. In the process it was determined whether the questions were correctly formulated or not. On the bases of their comments the necessary revision done to ensure that the research instruments were capable of measuring what they were supposed to measure. However, due to time constraints the questions were not discussed with the researcher's advisor.

3.5.2.1 Questionnaires

Questionnaires are one of the most widely used social research techniques, which can be administered in different ways according to Blaxter, *et al* (1996: 159).

- They can be posted to the intended respondents, who are then expected to complete and return them themselves; and
- They can be administered over the telephone or face to face.

Using questionnaires has a number of advantages and disadvantages. Nachmias and Nachmias (1981: 108) suggest the following advantages and disadvantage of using a questionnaire in survey research.

- Using questionnaires is cheaper than an interview. A questionnaire does not require a trained staff interviewer. The processing and analysis of data are also simpler and cheaper than those of the personal interview;
- It reduces biasing errors that might result from personal characteristics of interviewers and from variability in their skills;
- It assures anonymity especially when surveys deal with sensitive issues;
- It gives chance for subjects to consult documents; and
- It permits wider geographic contact with minimal cost, whereas interviewing would require expensive travel cost and time for the interviewers (Nachmias & Nachmias, 1981: 107).

However, using a questionnaire has also some disadvantages according to Nachmias and Nachmias (1981: 108). They are:

- A questionnaire can be used as an instrument for data collection only when the questions are straightforward enough to be comprehended solely with the help of printed instructions and definitions;
- There is no opportunity to probe beyond the given answer to clarify ambiguous answers, or appraise the non-verbal behavior of respondents;
- Researchers have no control over the respondents' environment; thus they can not be sure that the right person

completes the questionnaire; and

- The final disadvantage is that the return rate is usually poor (Nachmias & Nachmias, 1981: 108).

In this study an interview was conducted to fulfil the shortcomings that occurred in collecting data using a questionnaire.

A. Closed ended questionnaire

This technique includes questions that can be answered with yes-no or true-false responses, or by selecting an answer from a list of suggested responses. The short, quick response format takes less time

This type of questionnaire was used in this study and helped the subjects to give their response easily and the analysis of the data from this type of instrument is relatively simple.

B. Open ended questionnaires

This technique provides an either-or or multiple-response opportunity. Subjects answer freely in their own words. While this type of questionnaire tends to produce answers of great depth, it takes considerable time to answer on the part of the subject.

3.5.2.2 Interview

According to Macintyre (2000: 84), " The interview is a face-to-face interaction which allows the interviewer to ask carefully prepared questions and, in addition, to probe the respondents so that further information is obtained."

The interview method involves questioning or discussing issues with people, according to Blaxter *et al* (1996: 6). An interview can be structured, semi-structured and unstructured based on the degree of structure or formality of the interview.

A. Structured interviews

In essence, the structured interview is like a questionnaire, which is administered face to face with a respondent. The researcher has a predetermined list of questions, to which the respondent is invited to offer limited responses. The tight control over the wording of the questions, the orders in which the questions occur and the range of answers that are on offer have the advantage of standardization. Each respondent is faced with identical questions.

B. Semi-structured interview

The interviewer has a clear list of issues to be addressed and questions to be answered. However, with semi-structured interviews the interviewer is prepared to be flexible in terms of the order in which the topics are considered, and perhaps more significantly, to let the interviewee develop ideas and speak more widely on the issues raised by the researcher.

C. Unstructured interview

The researcher's role is to introduce a theme or topic and then letting the interviewee develop his or her ideas. Both semi-structured and unstructured interviews allow interviewees to use their own words and develop their own thoughts.

3.6 Selection of research methods

In this study, closed ended questionnaires and semi-structured interviews were used to collect the relevant data. In conducting a research it is usually advisable to discuss reported practices with teachers or to evaluate teachers' reported practices via observation. For this reason, follow-up interview with 6 Biology teachers was conducted

3.7 Designing and administering of teachers' questionnaires

3.7.1 Designing teachers' questionnaires

A questionnaire is a list of questions or statements to which individuals are asked to respond in writing (Ogunniyi, 1992). In social science, particularly in education, a questionnaire is probably the most commonly used method of gathering information. In this research study, the researcher used self-administered questionnaires. The items on teachers' questionnaires used in this study were partly derived from a questionnaires used by Baird, et al (1994). The teachers' questionnaire contains closed ended type of questions. They are easy to answer and to analyze (Cohen & Manion, 1980). The teachers' questionnaires used in this study were divided into five sections which is based on the research sub questions of the research under investigation

Section one is the introductory part of the questionnaire, which is concerned, with biographical data of the respondents. This section is important as to compare teachers' responses based on their backgrounds.

Section two deals with the availability of teaching aids in schools. It contains items which teachers were expected to rate in terms of two choices. The response choices are "yes" and "no". This section is important as to answer the first research question of this study.

Section three deals with the multiple-choice type of questions. The teachers were expected to rate in terms of five choices. The response choices are "frequently used", "used", "fairly used", "occasionally used" and "never used". This section is important as to get an answer to the second research question in this study.

Section four deals with the constraints that prevent teaching aids used in the teaching and learning. This section will help to identify the main constraints and answer the third research question in this study.

Section five deals with the importance of teaching aids on learners' understanding. In

this section teachers were asked to evaluate the importance of teaching aids on learners' understanding.

3.7.2 Administering teachers' questionnaires

The questionnaires were delivered to all grade 8 Biology teachers in the secondary schools of both selected regions. The researcher personally handed the questionnaires to them at their respected schools. A total of 50 questionnaires were distributed in both regions. After two weeks the completed teachers' questionnaires were collected . Of the 50 questionnaires, 42 were collected giving a return rate of 86%. The data obtained from teachers' questionnaires were analyzed in terms of certain categories or themes.

3.8 Designing and conducting teachers' interviews

The interviews used in this study were of the semi-structured type allowing the respondents to express their ideas freely. The questions were open-ended in that they put a minimum of restraints on answers given by the respondents. Each respondent was asked the same question in the same way and this ensured uniformity.

Six Biology teachers were selected from different secondary schools. The schools included governmental and private schools, urban and rural schools. The teachers were selected from selected schools using the purposive-sampling method. The teachers include male and female teachers, and both experienced and less experienced teachers were included. Having been assured of anonymity the teachers were quite willing to participate in the interview. The time for the interview was scheduled in accordance to the convenience of the interviewees.

The researcher chose one of the local languages in Eritrea, Tigrigna for conducting the interview. The interview was conducted with six biology teachers in their respective schools. Before interviewing started, the researcher welcomed and thanked them for their willingness to be interviewed. Later, permission from the subjects was asked as to whether the interviews could be recorded. The duration of each interview ranged from 30-45 minutes. The interviewing was interrupted for two weeks because

of the first semester vacation. Hence, the process of conducting interviews continued for one month. After the interviews had been conducted, the researcher transcribed and translated the interview to English for analysis.

3.9 The research site

In Eritrea there are six administrative regions (zobas). The study was confined to all secondary schools in the central and northern Red Sea regions of Eritrea. There was not enough time to reach other regions within the given short period of my stay in Eritrea. The central region consists of the largest number of secondary schools in Eritrea. There are 21 secondary schools in the Central region, which includes governmental and private schools, urban and rural schools and the largest number of teachers. The capital city of Eritrea, Asmara, is situated in the central region. The northern Red Sea region covers the largest area in the country and includes a variety of ethnic groups compared with other regions.

At the beginning of this study the researcher handed a letter to the officials at the central and the northern Red Sea regional offices of the University of Asmara, requesting permission and cooperation for conducting the study in their respected secondary schools. After getting permission the researcher introduced himself and then briefed them about the aim of the study. The headmasters allowed the researcher to have contact with the grade 8 Biology teachers in both regions. The teachers who gave their responses wanted to remain anonymous. Hence, in accordance to research ethics, the respondents' request were respected.

3.10 Methods of data presentation and data analysis

After the questionnaires had been administered and the interviews conducted, the data from the questionnaires were coded and the data from the interview were transcribed and translated into English.

The data obtained from the teachers' questionnaires were analyzed in terms of categories and themes. To analyze the data collected through interviews, certain themes were first developed from the reported data. The themes were the key points

to be discussed, which the researcher considered as key factors about teachers' perceptions on the use of teaching aids by Biology teachers.

3.11 Conclusion

This chapter dealt with the quantitative and qualitative research paradigms. The research design used in this study was a survey, which is one of the descriptive research approaches. Finally the methods used to collect the data, namely questionnaire and interviews, were discussed.

The following chapter focuses on the data presentation.

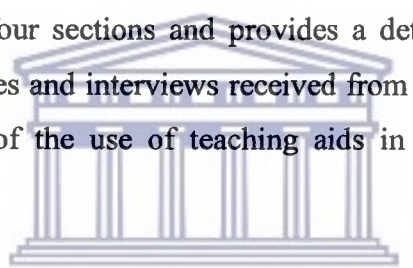
CHAPTER FOUR

DATA PRESENTATION

4.1 Introduction

In chapter two, the nature, types, relevance of teaching aids, and methods of selecting teaching aids in Biology lesson were discussed in detail. In this chapter, the result of the study which describes the types of teaching aids available, the extent to which teachers use teaching aids, the constraints that affect the use of teaching aids in Biology lessons, and the effectiveness of teaching aids on developing learners' understanding will be discussed.

This chapter is divided into four sections and provides a detailed overview of the findings from the questionnaires and interviews received from teachers. Each section deals with a specific aspect of the use of teaching aids in Biology lessons. The sections are:



- Types of teaching aids available in Biology lessons;
- The extent to which teachers use teaching aids in the Biology lessons;
- The constraints that affect teaching aids use in Biology lessons and
- The role of teaching aids help in developing learners' understanding.

As was mentioned in chapter three, specific variables were selected to compare the findings and establish relationships between variables. The data was then analysed according to these variables, namely:

- Experience of teachers (less experienced and more experienced); and
- Locality of teachers (urban and rural teachers); .

The findings of the questionnaires and interviews are summarized and presented in tables that show the responses of teachers according to the four variables listed above.

4.2 Details of teachers participated in the questionnaire

4.2.1 The number of teachers

About 50 questionnaires were prepared and dispatched to 23 secondary schools in Eritrea. Only 42 teachers completed and returned. This represents a return rate of 86 percent. The summary of the details is indicated in Table 4.1 below.

Number of dispatched questionnaires	Number of completed & returned questionnaires	Percentage of returned questionnaires
50	42	86%

Table 4.1 Summary of teachers who completed and returned the questionnaire

4.2.2 The experiences of teachers

Teachers with different experience were involved in the study. This helps to compare their responses from the questionnaires. The summary of their experience is analyzed and indicated in Table 4.2 below. The experience in teaching Biology was categorized in 3 groups namely, 1- 5 years; 6- 10 years; and 11 years & above. The majority of the respondents fell into the 11 years and above (27 teachers). This represents 11.9 % for 1- 5 years; 23.8% for 6- 10 years; and 64.3% for 11 years and above.

Experience in years	Teachers	
	Number	Percentage
1- 5 years	5	11.9
6- 10 years	10	23.8
11 & above years	27	64.3

Table 4.2 Summary of teachers' experiences.

4.2.3 The localities of teachers

The responses of teachers from different localities were also analysed from the questionnaire. Table 4.3 illustrates the analysis of the teachers' responses in relation to

their type of localities. As can be seen from Table 4.3, 33 or 78.5% of the teachers teach in urban secondary schools; 9 or 21.4% of the teachers taught in rural secondary schools. The majority of the respondents fell into the urban schools, because most of the secondary schools in Eritrea are situated in urban areas.

Type of Locality	Teachers	
	Number	Percentage
Urban	33	78.5%
Rural	9	21.5%

Table 4.3 Summary of teachers from different localities.

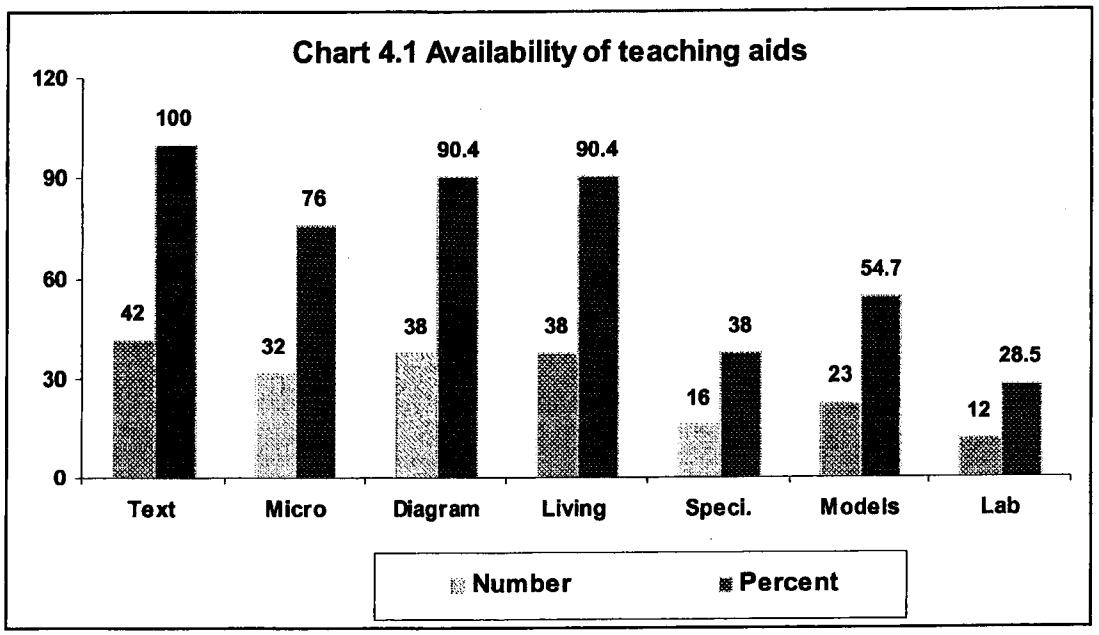
4.3 Analysis of teachers responses to the questionnaires

4.3.1 Teachers' responses to the availability of teaching aids in Biology lessons

This section addresses the findings of results pertaining to the availability of different types of teaching aids used in Biology lessons. All teachers in the sample were asked to tick "yes" to indicate the presence and tick " no" to indicate the absence from variety of teaching aids listed in the questionnaire.

Items	Number of Teachers N= 42	Percentage Of teachers %
Textbooks	42	100
Microscopes	32	76
Diagramss	38	90.4
Real living things	38	90.4
Specimens	16	38
Models	23	54.7
Overhead projectors	-	-
Videos	-	-
Laboratory facilities	12	28.5

Table 4.4 Summary of teacher's response on the availability of teaching aids



The responses of teachers' in Table 4.4 indicates that, textbooks, microscopes, diagrams, models, and real living things were the main types of teaching aids available in Biology lessons; while other teaching aids such as specimens, audio-visual aids, and laboratory facilities were few or not available in the Biology lessons.

The comparison of teaching aids available in urban and rural secondary schools was done and indicated in Table 4.5 below. Table 4.5 indicates that all teachers in urban and rural areas responded that there were adequate numbers of textbooks in their schools. There was no a difference in the availability of textbooks between the urban and rural secondary schools. As to the presence of microscopes, table 4.5 shows the responses of 29 urban teachers while only 4 rural teachers responded to the availability of microscopes in Biology lessons. As to the availability of living things, table 4.5 shows that 30 or 90.9% of urban teachers and 8 or 89.9% of rural teachers indicated the possibility of collecting and using of real living things.

The data shows that there was no difference between urban and rural secondary schools on the availability of living things. Table 4.5 shows that 23 or 69.6% of urban teachers and 7 or 77.7% of rural teachers indicated lack of laboratory facilities for conducting science related activities. Also, it indicated that no audio-visual aids (e.g. sets television or videos) were available.

Therefore, the data analysis of the responses of teachers indicates that textbooks, visual aids and real living things collected from the community were the main teaching aids available in most secondary schools. There is shortage of facilities for conducting science-related activities (demonstration & laboratory work) and no audio-visual aids were reported from teachers

Type of teaching aids	Teachers					
	Urban secondary schools			Rural secondary schools		
	Yes	No	Total	Yes	No	Total
Textbooks	33	-	33	9	-	9
Microscope	29	4	33	3	6	9
Living specimens	30	3	33	8	1	9
Laboratory	10	23	33	2	7	9
Audio-visual aids	-	-	-	-	-	-
Other	-	-	-	-	-	-

Table 4.5 Comparison between urban and rural teachers' responses on the availability of teaching aids

4.3.2 Teachers' responses to the extent to which teachers use teaching aids

Teachers were asked to indicate the frequency of the use of teaching aids in the classrooms. To indicate the frequency of the use of teaching aid, a five point scale had to be used by the teachers according to the following: as frequently used; used; fairly used; occasionally used; and never used.

The responses of teachers such as frequently used, used, and fairly used were combined for analysis and the data on Table 4.6 shows that the majority of teachers used teaching aids in Biology lessons. Further analysis is done to compare the difference between urban and rural school teachers, and less experienced and more experienced teachers.

Rate of teaching aid use	Gender of teachers			
	Male teacher		Female teacher	
	Number	Percentage	Number	Percentage
Frequently used	1	2.9	-	-
Used	5	14.7	2	25
Fairly used	13	38.2	4	50
Occasionally	13	38.2	2	25
Never	2	5.9	-	-

Table 4.6 Summary of teacher's responses on the frequency of teaching aid use.

The comparison between urban and rural teachers on the frequency of the teaching aids used is indicated in Table 4.7 below. The result indicates that teachers in rural schools use teaching aids more frequently than those in urban school. That is, 6 or 66.7 percent of teachers in rural schools use teaching aid more frequently, while only 19 or 57.6 percent of teachers in urban schools.

Locality	Teachers use teaching aid		Teachers do not use	
	Number	Percentage	Number	Percentage
Urban	19	57.6	14	42.4
Rural	6	66.7	3	33.2

Table 4.7 Comparison between urban and rural teachers' responses on the frequency of teaching aids use

The frequency of the use of teaching aids is compared between teachers with different experiences and is indicated in the Table 4.8 below. Analysis of the data indicates that there is no difference between less experienced and more experienced teachers in the frequency of teaching aid use. That is, 60 percent of less experience teachers and 55.6 percent of more experienced teachers frequently used teaching aids.

Experience of teachers	Teachers using teaching aid		Teachers not using teaching aid	
	Number	Percent	Number	Percent
1-5 years (less)	3	60%	2	40%
6-10 years (Medium)	7	70%	3	30%
11 & above (more)	15	55.6%	12	44.4%

Table 4.8 Comparison between less experience and more experienced teachers' responses on the frequency of the use of teaching aids

4.3.3 Teachers' responses to the constraints that prevented teachers to use teaching aids

A number of constraints that could possibly affect the use of teaching aids were numbered and listed in the teachers' questionnaires. Five such constraints were listed. Teachers were requested to add to this if they felt that any others were omitted. However, no additions were made to the list. The constraints listed, included the following:

- Large class size;
- Lack of resources;
- Time allotted for the subject (Biology) per week was less;
- Number of preparations per day was great; and
- Lack of competence on how to integrate teaching aids into specific learning areas.

Teachers were asked to select the constraints that affected the use of teaching aids in Biology lessons. Analysis of teachers' responses with regard to the number and percentage of teachers who selected the constraints, done and the result illustrated in the Table 4.9 below.

	Urban teachers		Rural teachers	
	Number n=33	Percentage	Number n=9	Percentage
Large class size	23	69.6	9	100
Lack of resources	27	81.8	8	88.8
Less time allotted time for the subject is less	17	51.5	4	44.4
Number of preparation per day high	30	90.9	6	66.7
Lack of competence	15	45.5	3	33.3

Table 4.9 Summary of teachers' responses on the constraints that prevented teachers from using teaching aids.

The constraints that drew the highest percentage of teachers' response were large class size, lack of resources, and number of preparation per day. The lowest percentage was reported for the time allotted for the subject and lack of competence to prepare and organize the lesson which included teaching aids.

When compared between urban and rural teachers' response, the highest percentage of teachers in urban responded that the number of preparation per day and lack of resources as constraints, while in rural there was large class size and lack of resources. Both urban and rural teachers' responses have similarity in lack of resources.

4.3.4 Teachers' responses to the importance of teaching aids

Teachers were asked to evaluate the importance of teaching aids on developing learners' understanding.

	Textbooks	Visual aids Microscope, diagrams	Real living things, models, specimens
Very Important	55%	62%	79%
Fairly Important.	25%	29%	15%
Half-half	12%	5%	8%
Fairly Unimportant.	8%	4%	-
Not important	-	-	-

Table 4.10 Summary of teachers' response in the importance of teaching aids

The result in Table 4.10 above indicates that most teachers evaluated the teaching aids as very important for learners. As the data indicates, the majority of teachers, namely 79% of teachers indicated that real things such as living things were the most effective teaching aids in teaching. Most teachers suggested teaching aids as important to help develop learners' understanding of Biology lessons. Except few teachers, namely, 8 % for textbooks and 4 % for visual aids considered them as fairly important.

4.4 Analysis of teachers' interviews

The purpose of the interview was to consolidate the data collected using the questionnaire. In the interview, teachers' opinions about the types of teaching aids available, the constraints that affect the use of teaching aids in Biology lessons and the importance of teaching aids on the development of learners' understanding were asked. Semi-structured interviews were conducted with 6 Biology teachers from different secondary schools in Eritrea. The details of teachers in the interview are indicated in the Table 4.11 below.

Teacher	Gender	Locality & school Manag.	Level of Experience	Qualification
T-1	Male	Rural (Gov.)	More	Degree
T-2	Female	Rural (Gov.)	More	Degree
T-3	Male	Urban (Gov.)	Less	Degree
T-4	Male	Rural (Gov.)	More	Degree
T-5	Female	Urban (Gov.)	More	Diploma
T-6	Male	Urban (Private)	More	Degree

Table 4.11 Details of the teachers interviewed

The full responses of teacher was recorded and then transcribed. The questions of teachers' interview are found in the Appendix 1.2.

4.4.1 Teachers' views on the availability of teaching aids

Teachers were asked to describe their views on the types of teaching aids available and used in Biology lessons. Teachers' view on the types of teaching aids available is summarized in table 4.12 below.

Types of t/aid		Number of teachers (n-6)
Textbooks		6
Microscopes		5
Living things		6
Specimens		1
Laboratory facilities		2
Videos		-
Others		-

Table 4.12 Summary of teachers' views on the availability of teaching aids.

Table 4.12 above summarizes the teachers' views on the types of teaching aids available in schools. The majority of the teachers responded that the presence of textbooks, microscopes, and real living things in Biology lessons. 2 teachers responded to the lack of prepared slides and specimens. No one from the respondents suggested the presence of audio-visual aids (e.g. videos).

During the discussion teachers described that the Biology textbook was the most available teaching aid in school. According the opinion of one teacher **T-1,**

> *The textbook is one of the teaching materials that the school supplies teachers and learners. I used Biology textbook as a guide to the course work and help to give examples and exercise in teaching in classroom.*

Most teachers, **(5 teachers)** responded to the availability of visual aids such as the microscope and different diagrams prepared by teachers and learners. However, one of the teachers **(T-1)** responded that:

> *The school does not have visual aids. The microscope, which was available before, is out of use because it broke during demonstration. The school did not purchase a new microscope. In order to show learners the structure example of organism I used diagrams in reference books. However, this is not an effective way compared to observing and studying minute organisms under a microscope.*

All teachers responded to the availability of real living things, which were collected and prepared for a lesson. In the discussion, one of the teachers **(T-2)** responded that it was easy to get real living things because the school has an agriculture field with Agriculture as a subject. Prepared specimens mounted on slides were not available in schools. Only one teacher **(T-6)** responded that the presence of slides of specimens that helped learners to observe and study the internal structure of animal and plant cells were available.

Two teachers from two different secondary schools in the sample, **T-3 and T-5** said that their schools have laboratory facilities, but because of time constraints and lack of laboratory assistants, they did not use laboratories. **T-3** added that he used to show demonstration such as the process of osmosis and photosynthesis in the classroom while presenting the lesson.

Generally, most teachers' opinions indicated that there are teaching aids which could be easily handled and used in teaching and learning. However, laboratory with

equipments and audio-visual aids such as videos and overhead projectors were not available because schools did not have enough funds to purchase them.

4.4.2 Teachers' views on the constraints that prevented teachers from using teaching aids

Teachers were asked in the interview about the constraints that prevented the use of teaching aids. Most of them indicated similar factors that prevented them from using teaching aids. The responses to their views are listed in Table 4.13 below.

The responses of teachers in the interviews showed that the majority suggested that large class size and number of preparations per day were the main factors that prevented the use of teaching aids in Biology lessons.

Constraints	Teacher's response
Large class size	6
Lack of resources	4
Teacher's competence to prepare & use teaching aid	2
Number of periods allotted for Biology	3
Number of preparation/day	5

Table 4.13 Summary of teachers' views on constraints that prevented teachers to use teaching aids

The majority of teachers' views commented the size of a class as being one of the main constraints that prevented the use of teaching aids in Biology lessons. One teacher, **T-4** said:

> *The average number of learners in my class in rural secondary school is between 65-70. This is because the school is the only one in the surrounding area. So, most learners who finish junior school will continue their study here. This problem does not allow using teaching aids. Mostly, I have depended on textbooks and have rarely used simple aids such as diagrams and living things from the school compound.*

Other constraint affecting the use of teaching aids in Biology lessons were the number of preparations per day. Most teachers said that they teach 6-7 periods daily. For example, one of the teachers, **T-1,** said :

> *I teach six periods per day; that is 4 periods in the morning and 2 periods in the afternoon shift. I also teach 2 different grades (grade 8 & grade 11). There is no extra time to prepare teaching aids. I use the Biology textbook and ask learners to prepare diagrams and collect living things from their surroundings in group work.*

4.4.3 Teachers' views on the importance of teaching aids

Teachers were asked to evaluate their views on the importance of the use of the teaching aids in the teaching and learning process. Teachers' views on the importance of teaching aids are summarized in Table 4.14 below.

Importance of teaching aids	Response of teachers (N=6)
Better visualization	6
Easier to motivate learners	4
Science understanding is stimulated	5
Time saved in teaching	3
Make instruction up to date	3

Table 4.14 Summary of teachers' views on the importance of teaching aids

All teachers stated that teaching aids were effective for better visualization. According to one of the teacher's, **T-1,** teaching aids helps learners to look at the structure of organisms and study their life activity. This makes learners to develop their knowledge using their visual senses.

The majority of teachers stated that the importance of teaching aids was to help stimulate the understanding of science. One teacher **T- 6** said :

> *When I use teaching aids such as showing learners a live chicks cell under a microscope, they easily observe what the structure of*

animal cell and the parts of the cell look like. This made my students to become very interested and assisted their understanding of Biology.

Some of the teachers, **T-1, T-3, & T-4** have responded that teaching aids were effective for saving time in teaching. One of them suggested that instead of lecturing the whole period, it was better to show a demonstration. I used to teach the photosynthesis process using charts on the wall, which was very simple and easily understood. If this is taught using only the lecture method, one period would not be enough and learners would not be able to understand the concept easily.

Other responses of teachers indicated that using teaching aids in Biology lessons helped to make the instruction up-to-date. If there is a possibility to use a video machine to show the growth of plants, learners will develop their creativity by looking at the growth of a plant, which was impossible before. Therefore, the use of microscopes and video machines make instruction relevant and meaningful to learners.

4.5 Conclusions

In this chapter data collected from questionnaires and interviews were analysed and presented. The responses of teachers with different experiences and in different localities are analysed and compared in order to give their similarities and differences.

The next chapter, the results of this study will be discussed along with other previous research findings and related literature topics.

CHAPTER FIVE

DATA ANALYSIS AND DATA INTERPRETATION

5.1 Introduction

The purpose of the study was to investigate the extent to which secondary school Biology teachers use teaching aids in the teaching and learning process. The more specific aims of this study were:

:

- To identify the types of teaching aids available in school;
- To study the extent to which teachers use teaching aids and compare the relation with regard to the difference between urban and rural teachers, and less experienced and more experienced teachers;
- To identify the constraints for not using teaching aids; and
- To identify the importance of using teaching aids in developing learners' understanding.

In this chapter, the data presented and analysed will be discussed along with other research findings and related literature topics.

5.2. The availability of teaching aids in secondary schools

One of the factors, which should be considered in selecting the appropriate teaching aids and the use of it in the teaching and learning process, is the availability of teaching aids in a school. According to Stuart, *et al* (1985: 78), "The first matter, which should receive attention when selecting teaching aids is the infrastructure as well as the availability of apparatus and programs". Therefore, availability of appropriate teaching aids is a crucial aspect in the teaching and learning process.

Different research studies have suggested the types of teaching aids to be utilized in the teaching and learning situation. According to Harding, *et al* (1969: 119), "... some of the teaching aids, which are commonly used for teaching Biology are living

things (e.g. plants, insects, ... etc), visual aids (e.g. diagrams, films, ... etc), and prepared specimens on slides."

Some of the types of teaching aids stated in the Curriculum Guide for teaching grade 8 Biology are:

- Textbooks, which were prepared by the Curriculum Department and distributed to all secondary schools in Eritrea;

- Some visual aids like simple microscopes, and hand lenses are important for observing small organisms and to study their structures;

- Real living things in that teacher could collect from the surrounding community and preserved them for use. This is one of the most important in teaching Biology when compared with other types of teaching aids. Learners will observe and learn from reality;

- Possibility of using preserved specimens, when a school has enough funds to purchase commercially prepared slides; and

- Some science related activities are suggested such as demonstrations and laboratory work. These activities are mainly for studying the process of osmosis and diffusion, photosynthesis and transpiration in plants.

Baird, *et al* (1994:563) reported the study conducted on teachers. Teachers were asked to indicate the number of outside resources (e.g. museums, field trips) available to the school. While responses to this item were subjective, they indicate that science-related activities such as observing living things in their natural form could only be available outside the school. Among rural teachers, 56.7% indicated they could only think of three or fewer outside resources, while only 31.9% of urban teachers had three or fewer resources nearby.

Analysis of teachers' questionnaires and transcripts of interviews in this study shows that textbooks, some visual aids, and real living things are the main teaching aids

available in urban and rural secondary schools in Eritrea. The most commonly stated teachers' view indicates that there was a lack of resources and facilities for conducting demonstration and laboratory work.

My suggestion on the above result is that the success of instructional depends on a creative teacher and the materials used in the instruction. Even the dedicated teacher alone, cannot cope with the various teaching methods and large number of learners in the classroom. Likewise, no teaching aid, regardless of the care in designing and organization of the lesson, can foresee all the learning difficulties that exist in the classroom. Consequently, the availability of variety of teaching aids and the appropriate use of it are crucial to the successful operation of an instruction. It is the responsibility of the teacher to be aware of the teaching aids and of the ways that they may be used most effectively.

5.3 The extent to which teachers use teaching aids

There are several ways in which the quality of an education system can be improved. Whatever is done in terms of distributing new material and developing new curriculum, the quality of education that learners receive will always be highly dependent on the quality of instruction that teachers provide.

Many research studies were conducted to study the frequency with which teachers use different instructional strategies. The research findings by Weiss (1987) cited in Baird et al (1994: 563) shows that the lecture method was the dominant mode of instruction among science teachers, consuming 43% of mean instructional time compared with 21% for hands-on/laboratory work.

Furthermore, a study by Baird, *et al* (1994: 563) showed that both rural and urban teachers felt approximately the same need to motivate their learners and use hands-on teaching strategies.

Nayar, *et al* (2002) conducted a survey to study Biology teachers on their use of teaching aids. The result of the study showed that most secondary school Biology teachers did not use teaching aids to make their teaching interesting and were satisfied

with the traditional chalk-&-talk method. In the study, the comparison between more experienced and less experience teachers was done and the result showed that the less experienced teachers displayed a significant high percentage than the more experienced teachers.

The findings of this study show that most secondary school Biology teachers used teaching aids in teaching Biology. The data indicates that 60% of Biology teachers use teaching aids, while the rest, namely 40% use resources occasionally or never.

- The percentage of using teaching aid was greater in less experienced Biology teachers than in more experienced teachers. The result showed that 60% of less experienced teachers used teaching aids, while only 55.5% of the more experienced teachers used them. There was no significant difference between the less experienced and more experienced teachers in using teaching aids in the Biology lessons; and

- The percentage of teaching aids used was greater in Biology teachers in urban secondary schools than in rural secondary schools. The result showed that 66.7% of Biology teachers in urban secondary schools use teaching aids, while only 57.6% in the rural Biology teachers. But the difference is not statistically significant.

5.4 The constraints that prevented teachers from using teaching aids.

Many research studies were conducted to identify the factors that affect the use of different instructional strategies in the teaching and learning process. According to Forbes (1985) cited by Baird, *et al* (1994: 557) teachers in rural schools are often placed in multi-grade, multi-subject and one-roomed situations.

Baird, *et al* (1994: 562) reported that rural teachers have more daily preparations than their urban colleagues. The report indicates that 49.5% of rural teachers had four different preparations per day, while only 10.3% of their urban peers had this kind of workload. Such preparations have an adverse effect on teaching effectiveness. In addition, Weiss (1987) cited by Baird *et al* (1994: 563) found that science teachers

frequently reported resources-related problems in their schools. In his study, rural teachers reported inadequate resources for teaching science more compared with urban teachers. About half (50.2% urban; 53.0% rural) of all secondary teachers reported that equipment and supplies for laboratory teaching were either missing or inadequate.

Baird, *et al* (1994: 563) also conducted a study and asked teachers to identify problems that might interfere with teaching science in schools. The result indicates that both rural and urban teachers faced many of the same everyday concerns including poor learners' problem-solving skills, insufficient funds for their science programs, and inadequate laboratory facilities. The data also revealed some interesting contrasts between the two groups (rural & urban) of teachers. Rural teachers saw their environment as lacking a sufficient number of science role models for their students. The problem of professional isolation was much greater among rural teachers, who indicated a lack of science teaching colleagues with whom to discuss their own problems. Having too many daily preparations was a much greater problem for rural teachers.

The research study conducted by Nayar, *et al* (2002) showed that the majority of teachers did not have sufficient time to use teaching aids. Others were of the opinion that they did not have sufficient expertise to use audio-visual aids like slides and film projectors. Similarly, it was cited by 44% of teachers that teaching aids like television sets, radio etc. were not available in schools.

The findings of this study indicate that there are some constraints that affect the use of teaching aids in Biology lessons in secondary schools in Eritrea. The most prominent constraints reported by urban and rural secondary school Biology teachers were large class sizes and the lack of resources to incorporate science related activities into the classroom. The majority of urban teachers stated that they taught single grade classes but the number of preparations per day was high (an average 6-7 periods) in addition to large class sizes. Rural teachers stated that they teach multi-grade and a class size of averaging 65-70 learners in a classroom. In addition, the lack of resources was significant in rural schools because there were no funds and fees contributed by the

community. The result of this study which deals with the constraints have similarities with the previous results obtained by Baird, *et al* (1994).

5.5 The importance of teaching aids in the development of learners' understanding.

Modern Biology learners acquire facts, understandings, insights, concepts, and conceptual schemes through the inquiry approach. One cannot learn in a vacuum, educationally speaking. The real and rich world of instructional media enables learners to become more directly involved in the learning process. Through the wide variety of such media, learners are helped to be more than mere observers they can become active innovators in the dynamics of learning, according to Voss & Brown (1968).

Many research studies have been conducted to determine the importance of teaching aids on the development of learners' understanding. The results of these studies reveal that a series of values are derived from the use of teaching aids.

De Kieffer (1965: 2) argues that teaching aids are essential tools in the teaching and learning process. They stimulate interest, provide concrete basis for the development of understanding, provide experience, and motivate learners to investigate.

A research study conducted by Ibe-Bassey (1996: 288) indicates that when teachers use teaching aids effectively, they will create interest on learners, motivate the learner to learn, make instruction immediate and productive and provide a scientific basis for instruction and learning.

According to Nacimo-Brown, *et al* (1982: 45) teaching aids are important because they promote meaningful communication between teacher and learner, hence effective learning.

Research studies show that learners' performance can be improved by using appropriate teaching aids. The study performed by Cohen and Ben-Zvi (1992: 147) shows that a variety of teaching activities which optimize learners involvement in the

learning process, together with well prepared teaching aids, which are appropriate for such activities, help learners to improve their performance.

Van Rooyen & Van der Merwe (2002: 240) argue that, " The correct use of teaching aids can be important for teaching because of the following benefits: Motivation of learners; learners' participation; provision of learning needs; and contributing to stimulating learning experience."

My opinion for the first benefit is that the use of teaching aids can increase learners' motivation by introducing visually attractive, interesting and challenging material. Concerning the second point, the effective teaching aid present stimuli to which learners will react, stimulate active learner participation (physically and /or mentally), which brings about a meaningful learning experience.

The third opinion is that variations in teaching aids used during a lesson enriches the learners' experience. Since learners differ intellectually and in learning style, they do not benefit equally when only one teaching aid is used. Finally, a good teaching aid helps to overcome the limitations of word-only communication, as it helps to present a meaningful interpretation of an abstract situation or phenomenon. Thus, in supplementing the spoken word, the correct use of teaching aids provide a stimulating learning environment and promotes a desire to learn.

The result of this study shows that teaching aids are important if properly selected and used in an appropriate way. This study indicates the importance of teaching aids as: to create better visualization by learners with regard to the subject matter, make instruction up-to-date and stimulate learners to active participation.

5.6 Conclusions

In this section the result of this study was discussed in relation to other related literature topics and research studies conducted previously. Compared to other literature topics, the types of teaching aids currently used in teaching Biology are the traditional types. At present, more development is happening with regard to the types of teaching aids for teaching Biology. These include teaching using videotaped

instruction, computer-assisted instruction, and instructional programmes. As to the nature of constraints for using teaching aids, different factors were discussed that are similar to other research studies. The extent of the use of teaching aids is better in Eritrean secondary schools compared to other research results conducted elsewhere.

In the next chapter the conclusions and the recommendations related to this study are discussed.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

6.1.1 Introduction

Education has to be planned in such a way as to develop the available resources in the best possible way and in the process enhance the social and economical development of the country.

In Eritrea, education falls under the state government. The government plans all educational policies where all citizens have equal right to obtain an education. It works towards creating a good academic environment, which is essential for the multidimensional growth in education. Many research studies have already shown that learners can learn more effectively in a creative environment.

In the classroom the relationship that exists between the teacher, the learner, and the curriculum is important. The teacher occupies a strategic role in coordinating the interaction of the learner with the curriculum and in bringing the learner and instruction into meaningful harmony. The challenge facing all teachers today, is the organization of instruction in such way as to facilitate learning for the majority of learners. In Eritrea, the Biology teachers are required to utilize more of the essential teaching aids that help learners to increase interest and easily understand the lessons.

6.1.2 Results emerged from the study

One of the main aims of the study was to establish whether, and to what extent teachers are using teaching aids in the teaching and learning process. The findings of this study revealed that the majority of teachers used teaching aids in the teaching and learning process. One could therefore predict that if teachers use teaching aids, learners who are taught with the help of teaching aids, would be able to participate actively in the classroom, and would then be able to develop creativity and think

critically. The study shows the following specific results which can help to answer the different sub research questions.

6.1.2.1 The availability of teaching aids in secondary schools

Since the teaching and learning process requires the use of a variety of teaching aids, the availability of teaching aids has a direct impact on this situation. Therefore, the aim of this section has been to provide a descriptive account of the various teaching aids which are available and important for effective use in the teaching and learning process. Most of the teachers described the presence of teaching aids such as textbooks, visual aids (e.g. diagrams, microscopes), and living things in schools. However, only a few teachers were able to identify the lack of audio-visual aids. This finding shows that most schools have teaching aids that could be easily available and use in classrooms.

Few teachers' identified the availability of laboratory facilities. Due to some constraints like time (only 40 minutes for a period which is not enough for practical work), the lack of laboratory assistant teachers, and the lack of competence to prepare and organize the programme, teachers were restricted to using traditional teaching aids.

In Eritrea education is under the state. All citizens have the right to go to school. Hence, the total expenditure on education is the highest compared to other sectors of the government. This large budget was meant to increase the literacy rate, and to development of new teaching facilities within the country and hence to improve the general standard of living. However, the result show that secondary school teachers were equipped with traditional teaching aids. Those modern audio-visual aids such as video and overhead projectors were not available due to the lack of funds. In addition, facilities and equipment for science-related activities were not available in most surveyed secondary schools, especially in rural school.

6.1.2.2 The extent to which teachers use teaching aids in Biology lessons

According to Fenstermacher (1986: 39) cited in Shymansky and Kyle (1986) a central task of teaching is to enable the learner to perform the tasks of learning. The teacher's task is then, to help learners acquire skills, select materials to be studied, adapt material to the level of the learner, create conditions conducive to learning, monitor learner progress and serve as a source of knowledge and skills.

How teachers view their role in the classroom, the place of science in the curriculum, and the use of various instructional materials and strategies are critical. The teacher is key to what happens in the science classroom and the teacher's attitudes and perceptions and / or abilities and skills greatly influence decision-making. The study review in this section focuses on teachers' views of selected issues and practices like the extent of the use of teaching aids in classrooms.

Most teachers indicated that they have used teaching aids fairly in the teaching and learning process. However, few teachers indicated that they have not used teaching aids as expected because of some constraints. When urban and rural teachers were compared, there was no significant difference in the frequency of using teaching aids. In this study the comparison between female and male teachers was not indicated because the number of females was very few compared to males..

6.1.2.3 The constraints that prevented teachers from using teaching aids

There are several prerequisites for the successful use of teaching aids in teaching and learning, namely the flexibility of time, allowing teachers to organize, and the use of teaching aids in classrooms. In addition to the allocation of time schedules, use of teaching aids in teaching, requires a teacher who is willing to use a variety of teaching aids, within a school with enough resources to accommodate the teacher.

The constraints listed in the questionnaire seemed to affect the use of teaching aids. Some of the constraints that have the greatest adverse effect were the large class sizes, number of preparations per day, and lack of resources. Although the lack of teaching aids can be a very real constraints on how much Biology can be taught, teachers in

relatively well resourced schools also gave these reasons. Teacher motivation, skill in planning flexible and creative lessons, and lack of understanding of curriculum objectives are likely to be contributory factors in determining why so much of the Biology that is taught appear to diverge from the expectations of curriculum developers.

6.1.2.4 The importance of teaching aids in the development of learners' understanding

In this study teachers mentioned the importance of teaching aids on the development of learners' understanding. The majority of the teachers responded that the use of teaching aids is very important. Some of the advantages of teaching aids that were suggested were to develop better visualization of concepts, developing learners' class participation and the enhancement of the understanding of science.

6.2 Recommendations

6.2.1 Introduction

In the course of this study many notable examples of the use of teaching aids were seen in teaching and learning. It is known from different sources that many interesting developments that are contemplated in the teaching and learning process were as a result of the teacher's role and the types of teaching aids used. I have become convinced that these aids can help to improve the quality of teaching, and to enrich the teaching and learning process.

As indicated earlier, many constraints prevented the availability and use of teaching aids in teaching and learning in secondary schools in Eritrea. Though it is not possible to eliminate all the prevailing problems completely, it is possible to minimize some of the constraints that prevented the effective use of teaching aids.

In this section recommendations are suggested and are restricted to the findings of this study.

6.2.2 The recommendations for Biology teachers

- The local environment is always available and is usually rich in teaching resources. Therefore, teachers can prepare or collect different types of teaching aids for Biology lessons and use them for the benefit of learners. Teachers can prepare models using different materials from the environment and this can be done by involving learners in the collection of materials.

- The biggest problem mentioned by both urban and rural teachers was the shortage of resources. It is possible to share or borrow some resources from other local institutions. For example, in our case teachers can borrow resources such as microscopes from health institutions and videos from youth association clubs.

- Workshops need to be conducted where teachers could discuss and exchange their experiences on how teachers could use teaching aids properly. This can be possible in schools by group discussions within the department of Biology.

6.2.3 The recommendations for principals and regional education officers

- For practicing local field trips, which can be effective and successful in collection of different specimen, the school principals should arrange a time whereby fieldwork activities can be carried out during other times e.g. holidays. This activity was difficult or impossible for teachers to carry out during school time because they teach in two shifts.

- Training, refresher courses and workshops should be arranged to equip teachers with the necessary knowledge and skills to develop and use teaching aids effectively. Training of teachers may also be necessary because the improvement of skills is possible if one has some training in developing creativity.

- As a nation we should try to give the best to our learners. We cannot rely on traditional teaching aids (textbooks, diagrams) and materials collected from the local environment. Full provision of teaching aids to all the schools should be the goal. We should not be defensive when shortages and needs are pointed out. We

need to fulfill our responsibility and provide our schools with high quality of education and high quality resources.

- The creation of resource centers in schools can make a big difference to the quality of teaching and learning. This could be the responsibility of both the school and MOE to get the center started. If the MOE or the school does not have enough funds to provide all the necessary facilities, parents can get involved through the school governing bodies that have been given the power to raise funds by the state. Parents can be asked to contribute. Some people think that the government must provide everything because they promised free and compulsory education.

- There are teachers who, due to the lack of competence, are unable to use teaching aids available in schools. During summer and other vacations, permanent training for subject teachers should be arranged to introduce them to different instructional technology.

- Time restriction was one of the reasons that teachers were using the lecture method in presenting the lesson. A revision needs to be done on the number of preparation teachers have in a day. In addition, a program needs to be scheduled for practical activity because 40 minutes are not enough.

- Teachers need incentives in order to devote adequate time during weekends, holidays, and summer in selecting and collecting living materials for the course. Teachers can become acquainted with the local sources of living materials through this experience.

6.2.4 The recommendations for parents and private business sectors

- The private sector in the form of big and small businesses should also contribute. They can make donations for example in kind and cash. Some businesses were doing this, but there are many who are not getting involved, especially those operating in the rural areas. Thus, schools in rural areas of the central and northern Red Sea regions remain extremely poor compared to those in large urban areas. It

is understandable that schools in the urban areas are found near the businesses and factories.

- Members of the community could donate their skills by building for free or at a lower rate.

6.2.5 The recommendation for further research

A research study such as this cannot investigate every aspect that plays a role in studying as to what extent teachers use teaching aids. Among the areas that seem to deserve further research, are the following:

- The perception of principals and regional education officers on the supply and use of resources. Most of the time they criticize teachers by stating that they are not preparing well during teaching; and

- The involvement of parents and the whole community in providing the necessary resources is another area that requires investigation. Parents in some secondary schools of the country, especially in urban areas are involved in the life of the schools their children attend. However, in most rural areas many parents are illiterate and poor. The attitudes and perceptions of these communities should be investigated.

Bibliography

Aho, L., Huopio, J. & Huttunen, S. (1993). Learning science by practical work in Finnish Primary Schools using materials familiar from the envronment: a pilot study. *International Journal of Science Education,* 15(5): 497-507.

Babbie, E. & Mouton, J. (2001). *The practice of social research*. Belmont California: Oxford University Press.

Baird, E.W., Prather, P. J., Finson, D. K. & Oliver, S. J. (1994). Comparison of perception among rural versus nonrural secondary science teachers: a multistate survey. *Science Education,* 78(6): 555-576.

Baumgartner, A. T. & Strong, H. C. (1998*). Conducting & reading research in health & human performance*. Boston: McGraw-Hill.

Behr, L. A. (1988*). Empirical research methods for human sciences*: *an introductory text for students of education, psychology & the* social *sciences.* Durban: Butterworths.

Bell, J. (1987). *Doing your research project: a guide for first-time researchers in education and social science.* Philadelphia: Open University Press.

Bentley, D. & Wattas, M. (1989). *Learning & teaching in school science: practical alternatives*. Milton Keynes: Open University Press.

Blaxter, L., Hughes, C. & Tight, M. (1996*). How to research: collecting data*. Buckingham Philadelphia: Open University Press.

Brown, W. J., Lewis, B. R. & Harcleroad, F. F. (1973). *Av instruction*: *technology media & methods*. 4th edition. New York: McGraw-Hill.

Caillods, F., Gottelmann-Duret, G. & Lewin, K. (1996). Science education and development: planning and policy issues at secondary level. Paris: Pergamon.

Candela, A. (1997). Demonstration & problem-solving exercises in school science: their transformation within the Mexical elementary school classroom. *Science Education,* 81: 498-511.

Carr, W. & Kemmis, S (1986). *Becoming critical*: *education, knowledge & action research.* London: The Falmer Press.

Cohen, I. & Ben-Zvi, R. (1992). Improving student achievement in the topic of chemical energy by implementing new learning materials and strategies. *International Journal of science education,* 14(2): 147-156.

Cohen, L. & Manion, L. (1980). *Research methods in education.* London: Croom Helm Ltd.

Conradie, J. P. (1979*). From teaching aids to systems teaching: an introduction to educational technology*. Durban: Butterworths.

De Kieffer, E. R. (1965). *Audiovisual Instruction*: New York: Center for Applied Research in Education.

Denny, M. (1986). Science practical: what do pupils think? *European Journal of science education,* 8(3): 325.

Descombe, M. (1998). *The good research guide for small-scale social research projects*. Philadelphia: Open University Press.

Dicker, R. (1987). The use of industrially produced resources materials in secondary school science. *School science review,* Vol. 68 & 69: 42-49

Digisi, L. L. & Willet, B. J. (1995). What high school Biology teachers say about their textbook use. A descriptive study. *Journal of Research in Science Teaching,* 32(2): 123-142.

Duminy, A. P. & Sobnge, A. W. (1980). *Didactics*: *Theory & Practice*. Cape Town: Longman.

Ellington, H. and Race, P. (1983*). Producing teaching materials: a handbook for teachers and trainers*. Second edition. London: Kogan Page.

Fraenckel, J. R. & Wallen, E. N. (1993). *How to design and evaluate research in education*. New York: McGraw Inc.

Fraser, J. W., Loubser, P.C. & van Rody, M. P. (1983). *Didactics: for the undergraduate students. Second edition.* Johannesburg: Heinemann Publishers.

Freedman, B. F. & Berg, L. E. (1961). *Classroom teachers guide to audio-visual materials*: *effective use of teaching tools from chalkboard to television*. New York: Chilto Co. Book Division

Freedman, P. M. (1997). Relationship among laboratory instruction, attitudes toward science, and achievement in science knowledge. *Journal of research in science teaching*, 34(4): 343-357.

Freysen, J. B., Briel, M. R., Potgieter, C., van Graan, J. E. S & van Niekerk, J. N. (1989). *Media Science*. Kempton Park: Audio visual aids.

Gallager, J. J. (1987). A summary of research in science education. *Science Education,* 71(3): 351-355.

Gay, R. J. (1981). *Educational research*: *competencies for analysis & application.* Colmbus, Ohio: Merrill.

George, M. June (1992). Science teachers as innovators using indigenous resources. *International Journal of Science Education,* 14(1): 95-109.

Gerlach, S. & Ely, P. D. (1980). *Teaching and Media: a systematic approach.* Second edition. New Jersey: Prentice Hall.

Germann, J. P, Haskin, S. & Auls, S. (1996). Analysis of nine high school laboratory manuals: promoting scientific inquiry. *Journal of Research in Science Teaching,* 33(5): 475-499.

Giroux, H. (1988). *Teachers as intellectuals: towards a critical pedagogy of learning.* New York: Bergin &Garvey.

Grundy (1987). *Curriculum: Product or praxis*? London: The Falmer Press.

Harding, E. D., Volker, P. R., & Eagle, L. D. (1969). *Creative Biology teaching.* Ames, Iowa: Iowa state University Press.

Harris, N. D. C. (1979). *Preparing educational materials.* London. Croom Helm.

Hwang, A. (1996). Positivist & constructivist persuasions in instructional development. *Journal of Instructional Science,* 24: 343

Ibe-Bassey, S. G. (1996). Designing instructional materials for qualitative primary instruction in Akwa Ibom state. *Journal of educational technology systems,* 24 (3): 287-295.

Kemmis, S., Cole, P. & Sugget, D. (1983). *Orientations to curriculum and transition: toward the socially-critical school.* Victoria, Aus.: Voctorian Institute of Secondary Education.

Killermann, W. (1996). Biology education in Germany: research into the effectiveness of different teaching methods. *International Journal of Science Education,* 18 (3): 333-346.

Kulik, J. A. & Bangert-Drowns, R. L. (1983). Effectiveness of technology in pre-college mathematics & science teaching. *Journal of Educational Technology System'.* 12(2): 137-153.

Macintyre, C. (2000). *The art of action research in the classroom.* London: David Fulton.

Miller, F. D & Blaydes, W. G. (1962). *Methods and materials for teaching the biological science: a text source book for teachers in training and in service.* New York: McGraw-Hall.

MOE. (1995*). Biology For Grade Eight.* Asmara: Eritrea: Sabur Printing Press

MOE. (1999*). Education Brief 1999.* Asmara, Eritrea.

MOE. (2001). *Biology Laboratory Manual For Grade Eight.* Eritrea: Biology Panel, Curriculum Division.

Nachmias, C. & Nachmias, D. (1981). *Research methods in the social sciences. alternate second edition without statistics.* London: Edward Armld.

Nacimo-Brown, R., Oke, E. F. & Brown, P. D. (1982). *Curriculum and Instruction: an introduction to methods of teaching.* London: The Macmillan Press.

Nayar K., A. & Pushpam K. (2000). Willingness of secondary school teachers of Biology to use teaching aids. *School science quarterly journal of science education,* 38(4): 1-8. University of India: (online) available http:// www.ncert.nic.in/journal/journalnew/sschap11.htm

Ogunniyi, M. B. (1992). *Understanding research in the social sciences.* Logos: University Press.

Race, P. (1992*). Fifty-three Interesting Ways to write Open Learning Materials.* Bristol: Technical and Educational services.

Reiser, A. R. & Gagne, M. R. (1983*). Selecting media for instruction.* New Jersey: Educational Technology Publications.

Richardson, S. J. & Cahoon, P. G. (1951). *Methods and materials for teaching general and physical science.* New York: McGraw-Hill.

Risk, T. M. (1958). *Principles and practice of teaching in secondary schools.* 3rd edition. New York: American Book.

Romiszowski, A. J. (1988). *The selection and use of instructional media: for improved classroom teaching and for interactive, individualized instruction.* 2nd edition. London: Kogan Page.

Shipley, M. C., Cann, M. M., Hildebrand, F.T., John, & Mitchel, T. G. (1972). *A synthesis of teaching methods.* Third edition. Toronto, Canada: Mcgraw-Hill Ryerson: Ltd.

Shymansky, A. J. & Kyle, C. W. (1986). A summary of research in science education. *Science Education,* 72(3): 249-268.

Stainsstreet, M., Spofforth, N. & Williams, T. (1993). Attitudes of children to the uses of animals. *International Journal of Science Education,* 15 (4): 411-425.

Stuart, F. J, Van Niekerk, J. L., W.Mcdonald, E. M & De Klerk, O. (1985). *Didactics: an orientation for first year students.* Braamfontein, Johannesburg: Macmillan South Africa.

Van Rooyen, G.H & van der Merwe, R. C. (2001). Teaching media. M. Jacobs, N. Gawe & N. Vakalisa (Eds.) *Teaching–learning media: teaching-learning dynamics.* 239-279. 2nd edition. Johannesburg: Heinemann: 239-279.

Voss, E. B & Brown, B. S. (1968*). Biology as inquiry: a book of teaching methods.* Saint Louis: C. V. Mosby.

Waghid, Y. (1999). Instructional systems design "tools" and engineering materials development. *South Africa Journal of Education,* 19(2): 115-121.

Watts, M. (1998). Towards critical constructivist teaching. *International Journal of science*, 20(2): 173-185.

Wittich, A. W. & Schuller, F. C. (1979). *Instructional Technology its nature and use.* 6th Edition. New York: Harper and Row Publishers.

Appendix 1.1

Teachers' questionnaires on the use of teaching aids in teaching and learning in secondary schools in Eritrea

Note

1. This questionnaire is to be completed by grade 8 Biology teachers.
2. The information supplied is for research purposes. The objective of the research is to investigate secondary school Biology teachers on the use of teaching aids.
3. Please complete all the sections
4. Try and answer all questions. Please feel free to answer in English.
5. You are assured of confidentiality.
6. Please try to complete the questionnaire within two weeks.
7. Thank you for participating in this research.

Section A: General information

Please answer the questions in section A by placing cross (X) in the relevant block

1.1 Please tick as appropriate

Male	Female

1.2 Please tick the extent of your teaching experience

1-5 years	
6-10 years	
Above 10 years	

1.3 Please tick your school locality

Urban	
Rural	

1.4 Please tick the type of your school

Private	
Governmental	

Section B: Availability of teaching aids

Please put an (X) on the choices " Yes" or " No" to indicate the available of teaching aids listed below

Type of teaching aids	Yes	No
Textbooks		
Microscopes		
Diagrams		
Living things		
Specimens		
Models		
Overhead projector		
Videos		
Others		

Section C: The extent of teaching aids use in classrooms

1.6 How often do you use teaching aids in your Biology lessons?

Frequency of teaching aids use	Textbooks	Visual aids	Audio aids	Audio-visual aids
Used frequently				
Used often				
Used fairly				
Used rarely				
Never used				

Section D: The constraints that prevent the use of teaching aids

Tick the factors the prevent the teacher from using teaching aids as a teaching and learning tool

Factors	Yes	No
Large class sizes		
Shortage of resources		
Heavy load of teachers		
Lack of competence		
Less time allotted for the subject		

Section E: The importance of teaching aids on learners' understanding

Tick the degree of importance of teaching aids

	Textbooks	Visual aids (diagrams, Microscopes)	Living things models, specimens
Very important			
Fairly important			
Half-half			
Fairly not important			
Not important			

Appendix 1.2

A sample of questions asked Biology teachers

During the interviews

Note: interview guide for teachers

I would very much appreciate if you could give me your perspective as a Biology teacher in the secondary school by offering brief notes according to the following guide. All your responses will be confidential. Only summary comments will be given in the final research.

Sample questions for teachers:

1. What are the types of teaching aids, which are not available in your school but listed in the curriculum guide?

2. Are the types of teaching aids listed in the curriculum guide available in your school?

3. Is it easy or difficult for you to obtain teaching aids?

4. What do you feel about the quality of teaching aids in the school?

5. Do you have a place (enough space) to demonstrate or to do laboratory work?

6. Are there any constraints that prevent use of teaching aids in Biology lessons?

7. What is your opinion about the relevance of teaching aids in teaching and learning situations?