

Addis Ababa University  
School of Graduate Studies  
Institute of Educational Research (IER)

The Status of Practical Work in Science Teaching in selected  
Preparatory schools in Addis Ababa

By

Tsegaye Engida Minale

September, 2012

Addis Ababa

Addis Ababa University  
School of Graduate Studies  
Institute of Educational Research (IER)

The Status of Practical Work in Science Teaching in selected  
Preparatory schools in Addis Ababa

*By*

*Tsegaye Engida Minale*

A thesis submitted to the School of Graduate Studies of Addis Ababa  
University in Partial Fulfillment of the Requirement for the Degree of  
Master of Arts in Educational Research and Evaluation.

*September, 2012*

*Addis Ababa*

Addis Ababa University  
School of Graduate Studies  
Institute of Educational Research (IER)

The Status of Practical Work in Science Teaching in selected  
Preparatory schools in Addis Ababa

By

Tsegaye Engida Minale

Approval of Board of Examiners

_____	_____
Chairperson, Department	Signature
Graduate committee	
_____	_____
Advisor	Signature
_____	_____
Internal Examiner	Signature
_____	_____
External Examiner	Signature

## Table of Contents

	<b>Page</b>
Acknowledgement -----	i
List of Tables -----	ii
Acronyms and Abbreviations -----	iii
Abstract -----	iv
 <b>CHAPTER ONE INTRODUCTION</b>	
1.1 Background of the study -----	1
1.2 Statement of the Problem -----	6
1.3 <i>Basic Research Questions</i> -----	7
1.4 Objectives of the study -----	8
1.5 Significance of the study -----	8
1.6 Delimitation of the study-----	9
1.7 Limitation of the study -----	9
1.8 Operational definition of key terms -----	9
1.9 Organization of the Study-----	10
 <b>CHAPTER TWO</b>	
<b>REVIEW OF RELATED LITERATURE</b>	
2. The Nature and purpose of practical work in science -----	11
2.1 The Meaning and Nature of practical work -----	11
2.2 The purposes of practical work in teaching Science -----	11
2.3 Practical work in science teaching -----	16
2.3.1 Science laboratories and Equipments-----	18
2.3.2 Experimental procedures in science teaching -----	18
2.3.3 Demonstration in science Teaching. -----	19

2.4 Practical works and the science Curriculum -----	20
2.5 Major constraints for implementation of practical activities in preparatory	
/Secondary Schools -----	22
2.5.1 Poor Organization and Management of the Laboratory -----	22
2.5.2 Lack of well-trained lab-technicians and teachers-----	23
2.5.3 Lack of Equipments and other facilities of laboratory-----	23
2.5.4 Large Class Size and Inadequate Time Allotment-----	23
2.5.5 Students Assessment strategies -----	24
2.6 Status of Practical Work in Science Education in Ethiopia-----	24

## **CHAPTER THREE**

### METHODOLOGY OF THE STUDY

3.1 Research Design-----	27
3.2 Sampling techniques -----	27
3.3 Data collection instrument-----	29
3.4 Research procedure -----	30
3.5 Methods of data Analysis -----	31

## **CHAPTER FOUR**

### ANALYSIS, INTERPRETATION AND DISCUSSION

4.1 Characteristics of respondents -----	32
4.2 students' response on the current status of practical work in	
Preparatory schools -----	35
4.3 Teachers' response on current status of practical activities in	

Preparatory schools. -----	52
4.4 Responses of Department heads on current status of Practical works -----	71
4.5 Science Laboratory Observation Check List -----	78
4.6 Discussion -----	81

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

5.1 Summary -----	90
5.2 Conclusion -----	93
5.3 Recommendations-----	94

### **REFERENCE**

### **Appendices**

Appendix-A: Questionnaire filled by students

Appendix-B: Questionnaire filled by teachers

Appendix-C: Check list filled by Department head

Appendix-D: Interview Questions for school principals

Appendix-E: Interview Questions for Educational Officials

Appendix-F: Observation Check List

Appendix-G: Document Analysis Check List

Appendix-H: Preparatory Schools in Addis Ababa City Administration

## Acknowledgement

I would like to express my appreciation to my advisor Ato Tesfaye Getnet (Assistant Professor) who has given his valuable advice, warm welcoming during contact hours and giving his time to comment and correct my proposal as well as the drafts of this research paper.

Secondly my heartedly and deepest gratitude goes to the officials, instructors and staff members of the Institution of Educational Research (IER) for their dedication, and polite co-operation to complete the postgraduate program on the intended time.

Thirdly my great thanks go to the participants of this research including teachers, students, school principals, lab technicians and department heads of the sample government, private, Church and public schools. My especial thanks delivered to teacher Dechassa Gemechu ( Yekatit 12 prep school), Ato Hailu Tameme and Alem Beyene (Addis ketema prep school), Ato Tadesse Tirfessa (Dej. Wondiriad prep school), Ato Zewdu Dereje (Limat Minch prep school), Ato Molalgn Moges (Abiyot Kirs secondary and Prep school), Ato Worku Kelkile (Radical Academy Amanuel Branch), W/ro Almaz Delebo (Elshaday Holy Savior) , Ato Kinfe W/Silassie (Aygoda), Ato Tesfahun Ayele (Yenegew Sew) and Ato Belete Gebreyes (Lideta Catholic Cathedral School) and others who fostered collegial support and cooperation during collecting data.

I also sincerely thank those educational experts who participated in the interview of this research. Moreover, I thank all my family for their strong motivation and kindly help for the completion of this research work.

Finally, on top of all others, I would like to remember and thank for ever, the savior of the world “GOD” to give me strength and Patience for the successful completion of my research work on this time he allowed.

# List of Tables

	<b>Page</b>
Table 1: - Lists of Sample preparatory schools, number of teachers and students -----	28
Table 2:- Types and Description of instrument -----	30
Table 3: - Characteristics of respondents-----	33
Table 4: - Analysis of Students' Response on Organization, Facilities and Functions of Science Laboratories. -----	35
Table 5:- Analysis of Students Response on Teachers commitment, skill, experience, contribution of science practical works and status of science lab clubs. -----	43
Table 6: -Analysis of Teachers Response on Function, Facilities, Organization, Annual plan and contribution of practical works. -----	52
Table 7: -Analysis of Teachers Response on Mark Allotment, Plasma TV, need of Training and workshops, Major constraints and Formation of Science Lab clubs. -----	60
Table 8: - Analysis of Teachers Response on Monitoring and Evaluation of practical works and presence or absence of Trained lab Technicians/Assistants.-----	68
Table 9: - Check list filled by department heads -----	71
Table 10: - Summary of Science Laboratory Observation-----	78

## Acronyms and Abbreviations

A.A.C.A----- Addis Ababa City Administration

EMA ----- Educational Media Agency

EMPDA----- Educational Material Production and Distribution Agency

FDRE-----Federal Democratic Republic of Ethiopia

ICT----- Information Communication Technology

IER----- Institution of Educational Research

Lab----- Laboratory

MOE ----- Ministry Of Education

NRC----- National Research Center

STS----- Science, Technology and Society

TGE----- Transitional Government of Ethiopia

UK----- United Kingdom

USA----- United States of America

UNCSTD----- United Nations Conference on Science and Technology for Development

UNESCO----- United Nations Educational, Scientific & Cultural Organization

## ABSTRACT

*This study investigates the current status of science practical works and laboratory activities in government, private, church and public schools in Addis Ababa City Administration (AACCA). By employing a descriptive survey method the study comprehensively assesses the practices and problems of science practical work in 12 preparatory schools that comprises five governments, four private, one church and two public schools have been selected purposively. Data was collected from grade 11 and 12 students, preparatory school science teachers, department heads, principals from five selected schools, lab technicians/assistants and educational officers. 320 students were selected by random stratified sampling techniques. On the basis of availability, all science teachers, five lab assistants/technicians, students of grade 11 and 12 are taken as samples for this study. Five School principals and five educational officers are selected purposively from schools and sub-cities respectively. From purposively selected five sub-cities five educational officers, one from each took part in the study. In addition available department heads have participated as subjects of the study. The main data collection methods for this research were questionnaires, interview, document analysis, check list and laboratory observation. Quantitative data were tabulated and organized in tables and analyzed using percentage and chi-square. The qualitative data was categorized and analyzed thematically to substantiate the quantitative analysis and interpretations. The findings of this current study indicated that: - (i) The current status of practical works in preparatory schools of Addis Ababa is in a very low level where science teaching learning process is not supported adequately by practical works; class room instruction of science education is more of lecture method and dominated by teachers with least participation of students. (ii) The most determinant constraints of practical activities in preparatory science education in government, private, Church and public schools include lack of laboratory rooms, inadequate supply of lab equipments, reagents and facilities, absence of trained laboratory technicians/teachers, lack of commitment and interest of teachers, shortage of time for practical activities, no plan and regular schedule for lab sessions, poor management, monitoring and evaluations of practical activities, no system for grading and assessment of practical examinations.(iii) Practical activities did not get the necessary concern in all schools investigated by this study. Therefore, to bring the progress of practical activities in schools and to play a great role in initiating and supporting science teaching in the class, there should be done awareness creating campaigns by all stakeholders of the education system. Current and regular workshops and short term trainings about practical activities should be given to science teachers in order to enhance and update their practical skills and capacities to carry out experiments and demonstrations more effectively and efficiently. As all participants agreed, the inclusion of practical works in the scoring and grading system of science results assumed to be one of the remedies of the poor activities of practical works in preparatory schools. In addition, the government should give special consideration and effective implementation strategies for the improvement and efficient ways of science teaching in schools in order to achieve the mission and goals of the new education policy.*

# CHAPTER ONE INTRODUCTION

## 1.1 Background of the study

As Kerr (1963) explained “practical work has been defined as an experiment performed by the teacher for demonstrations, or series of experiments and observational exercises carried out by the students to relate theoretical knowledge with practical activities done in the laboratory, classroom, field or elsewhere.”

Practical activities are essential in all level of science education and in particular it is highly significant in preparatory schools to help students in internalizing and understanding the theoretical knowledge of science fields such as Chemistry, Biology and Physics. The natural science core subject at the secondary level (grades 9-10 and grades11-12) becomes distinctly differentiated as Biology, Chemistry and Physics. At this level, slight shift of emphasis is given on the pure science aspects. Nevertheless, aspects of applied sciences of agriculture, and productive technology have to some extent been incorporated. It should be noted that in all of these science subjects- be it integrated or linear- have aspects of applied science and related technology elements as their major contents to ensure the achievement of problem solving capacity through the understanding of one’s environment (Ethiopian National Agency for UNESCO: 2001).

The government of Ethiopia has espoused a practical problem-solving approach to teaching and learning science. The challenge facing the Ministry of Education is how to implement its objectives in a country which is the least developed nation in the world. Because of this fact, there is deficit in budget to fulfill adequate laboratory facilities in secondary, preparatory schools and Teacher Training Institutes. Hence, the main turning point focuses on teacher education and capacity building strategy of science teachers in order to support science teaching with practical works and to produce well qualified science graduates. This turning point gives a description of science student-teachers’ experience of pre-service education and the factors affecting their professional development with regard to practical work. It examines the structure of teacher education programs, the content of the teacher-training curriculum and student-teachers’ classroom practice in order to provide a complete account of science- teacher education (Bekalo and Welford: 1999).

Tekeste (1990), his introductory part described science education in Ethiopia as being in crisis due to irrelevant and inappropriate methods which had failed to incorporate relevant practical experience. The present and post-1992 Ethiopian government has begun to develop science teaching as a process of enquiry and to look a fresh at its methods of instruction. The new Education Policy and Sector Strategy (EMPDA 1994a,b) addresses issues, for example, the purposes of science education, the context for the science curriculum, teacher education, and conditions that foster the development of practical work in school science. Accordingly, the primary science curriculum has been replaced, and a new secondary curriculum is to be phased in from the beginning of the millennium. The Ministry of Education (MOE 1997, 1998), recognizing that reform of school education requires concomitant reform in teacher-training, has redrafted the teacher education program. For instance, several studies suggest that teachers' views, understanding and practice evolve from their own education and training. These experiences strongly influence not only what science is taught, but also how it is taught.

The report of Bekalo and Welford elaborated that Science education imparts a method of inquiry and a systematic way of processing knowledge about the physical world. For this reason, science education provides part of the foundation for any knowledge-based effort to improve health, nutrition, family planning, environment, agriculture, and industry.

According to the World Bank report (1993), "Science education has two broad purposes. The first purpose is to promote scientific literacy among citizens on matters directly affecting their own lives and the society so that they can make decisions based on information and understanding. This is essential for the sustainable development of a modern and technological society. The second purpose is to build up the technological capability by equipping the future work-force with essential science-based knowledge and skills, and by preparing students for scientific disciplines in higher education and science-related careers. Given the potential benefits, the provision of quality science education to all children will have far reaching consequence on a country's development prospect."

Therefore, based on the above description practical activities in science education at all levels in general and at preparatory level in particular are regarded as one of the necessary elements to promote understanding of scientific principles.

To accomplish the goal of practical activities in science, the equipment and experiments have to be carefully selected to give students a relevant experience (World Bank report: 1993).

The World Bank report (1993) further elaborated that the understanding is enhanced if the activities are coming from the daily life of the students. Provision of relevant equipment is a necessary, but not sufficient condition for successful science teaching. Other factors such as pre-service and in-service teacher training, technical and educational suitability of equipment, distribution, maintenance, supply of consumables etc., influence the quality of practical activities.

Practical activities have a long distinctive and central role in the science curriculum and science educators have suggested that many benefits accrue /increase from engaging students in science practical activities (Hofstein and Lunetta, 1982; 2004; Tobin 1990; Hodson, 1993; Lazarowitz and Tamir, 1994).

At the beginning of the twenty-first century we are entering a new era of reform in science education. Both the content and pedagogy of science learning and teaching are being scrutinized, and new standards intended to shape and rejuvenate science education are emerging (National Research Council, 1996; 2000). The *National Science Education Standards in USA* (NRC, 1996) reaffirm the conviction that inquiry in general and inquiry in the context of practical work in science education in particular is central to the achievement of scientific literacy. Inquiry-type laboratories have the potential to develop students' abilities and skills such as: posing scientifically oriented questions (Krajcik et al., 2001; Hofstein et al., 2005), forming hypotheses, designing and conducting scientific investigations, formulating and revising scientific explanations, and communicating and defending scientific arguments.

Over the years, many scholars have argued and several studies revealed that science cannot be meaningful to students without worthwhile practical experiences in the school laboratory. Usually, the terms *school laboratory* or *lab* and *practical work* have been used interchangeably, too often without precise definition, to embrace a wide array of activities. Typically, the terms have meant experiences in school settings where students interact with materials to observe and understand the natural world. Some practical activities have been designed and conducted to engage students individually, while others have sought to engage students in small groups and in large-group

demonstration settings. Teacher guidance and instructions have ranged from highly structured and teacher- Centered to open inquiry.

Sime (2004) explained that “laboratories are important educational facilities in schools in general and in preparatory schools in particular for various reasons.” So it is possible to say that practical activities in science fields are paramount relevant to make science learning more practical and observable to internalize the theoretical knowledge about natural processes and phenomena. The most important condition to conduct practical class is to hold experiments in the lab, which is pertinent to materialize theory into practice. Hence in order to administer laboratory activities of science disciplines in preparatory schools efficiently there should be adequate laboratory rooms, which encompasses separate demonstration, store and preparatory rooms and they should be equipped with different instruments, activity manual, reagents and laboratory technician as well to produce competent and skillful citizens.

Several studies reaffirmed that “Practical activities in science have sometimes been used to include investigations or projects that are pursued for several weeks, sometimes outside the school, while on other occasions they have referred to experiences lasting 20 minutes or less. Sometimes practical activities have incorporated a high level of instrumentation, and at other times the use of any instrumentation has been meticulously avoided” (Hofstein and Lunetta 1982).

Many research studies have been conducted to investigate the educational effectiveness of laboratory work in science education in facilitating the attainment of the cognitive, affective, and practical goals. These studies have been critically and extensively reviewed in the literature (Hofstein and Lunetta 1982; 2004; Blosser, 1983; Bryce and Robertson 1985; Hodson, 1993; Lazarowitz and Tamir 1994). From these reviews it is clear that in general, although the science laboratory has been given a distinctive role in science education, research has failed to show simple relationships between experiences in the laboratory and student learning. Hodson (1990) has criticized practical work and claimed that it is unproductive, and confusing, since it is very often used without any clearly thought-out purpose, and he called for more emphasis on what students are actually doing in the laboratory. Tobin (1990) wrote that: “*Practical activities appeal as a way to learn with understanding and, at the same time, engage in a process of constructing knowledge by doing*

*science*". He also suggested that meaningful learning is possible in the laboratory if students are given opportunities to manipulate equipment and materials in order to be able to construct their knowledge of phenomena and related scientific concepts.

As Aklilu (2010) quoted that "the best way to learn science is by doing practical activities in the laboratory." This makes science learning and teaching more tangible, interesting, live and unforgettable and it contributes to widen the skill and knowledge of students.

Tesfaye (2009) also elaborated that practical work means experiments performed by the teacher as demonstrations, co-operated demonstrations by groups as well as experiments and observational exercises carried out by pupils either in the laboratory or elsewhere.

So, several researchers argued that practical activities have been used in many natural science disciplines to teach students of many age spans in very different cultural and classroom contexts. In many studies and varied research settings, important issues and variables intersect. However, there have been many substantive differences in the laboratory settings and in other variables reported.

To develop research in the field, the science education community and especially the research community must be careful to provide detailed descriptions of the participating students, teachers, classrooms, and curriculum contexts in research reports. Among the many variables to be reported carefully are (based on: Lunetta et al., 2007): learning objectives; the nature of the instructions provided by the teacher and the laboratory guide (printed and / or electronic and / or oral); materials and equipment available for use in the laboratory investigation; the nature of the activities and the student–student and teacher–student interactions during the practical work; the students' and teachers' perceptions of how the students' performance is to be assessed; students' laboratory reports; the preparation, attitudes, knowledge, and behaviors of the teachers .

What do the students perceive they are supposed to accomplish in the practical activity?

How do they perceive their laboratory performance will be assessed? How important do the students and the teachers perceive the laboratory activities to be?

Studies should clearly report the amounts of time students spend in practical activities, and how those are integrated or separated from other work in the science course. They should distinguish clearly between long-term and short-term student investigations, and indicate clearly the numbers

and roles of students in each laboratory team. Thus, there should be a regular and effective implementation of practical work in preparatory schools to bring science teaching at a standard level with better understanding and greater achievement of students (Lunetta et al., 2007).

## **1.2 Statement of the Problem**

Kerr (1963) stated that in all science subjects, there was plenty of practical work being done but, it was not well integrated with the theory and it was unlikely to achieve the unique educational value often claimed for it. Theory and practice must support each other to form an integrated experience.

In Ethiopia, two aspects i.e. academic and pedagogical content are not given comparable credit or attention, with pedagogical content knowledge not being seriously considered. Although academic courses in teacher training programs for physical science incorporate routine laboratory practical activities, the planning and performing of practical work and the assessment of abilities in practical work are completely neglected. (S.A. Bekalo: 1997)

The Ministry of Education of the Federal Democratic Republic of Ethiopia (FDRE), states in its policy as it gives much concern to the importance of science laboratory activities to produce well-qualified, scientifically literates and competent educated manpower. Not only this, to full fill the demand of the country's 70:30 ratio, to Science, Technology and Social Science & Humanities respectively. More emphasis has been given to science fields and students are expected to gain adequate practical knowledge parallel to the theoretical knowledge of science disciplines. The current concern of the Ethiopian Education Policy is to produce quality and large number of graduates year after year in different fields of science. The policy states that 70% of students who pass the higher education institute entrance examination will join various fields of science (Amdissa, 2008:53). But the implementation of practical works in Secondary as well as preparatory schools and producing quality educated man power is under serious problems and questionable. It needs a current investigation how the policy is carried out and how much it achieves its objectives and strategies.

To produce competent and well-qualified graduates, the students should have a good knowledge of practical activities in addition to the theoretical knowledge. Students should get the basic skills of practical activities in different areas of science fields to be creative, innovative and problem solving

citizens. However the actual practices and associated problems of practical activities in schools particularly in preparatory schools is not known. Furthermore, from my experience and observation there is little concern and attention about practical works in schools. I want to understand the actual practices of schools in carrying out science practical activities and the constraints that impede these activities. Moreover, the research tries to investigate the consistent monitoring and follow up of school principals, department heads and educational experts on practical works as they are implementing according to the curriculum or syllabus.

Hence, from my teaching experience I have been observing an academic gap between the theoretical aspects and practical activities. Students are not well equipped by practical activities and that is why the quality of graduate students decline from time to time and to assure this assumption conducting research is necessary. I believe that it is very important to assess and investigate laboratory facilities in schools, how do students participate in practical activities, what are the roles and readiness of science teachers towards practical activities in science fields, the major problems or constraints that preparatory schools are encountering in implementation of practical activities and how schools tackle out the imbalance between theoretical and practical aspects in science fields such as Biology, chemistry and Physics. I want to explore these in the context of some schools in Addis Ababa.

### **1.3 Basic Research Questions**

This study has been guided by the following research questions.

1. Are there sufficient facilities for carrying out science practical works in preparatory schools?
2. How often science teachers plan and conduct Practical activities in their respective schools?
3. What are the roles of science department heads, school principals and educational experts in monitoring and evaluating the implementation of practical activities?
4. How often do students participate in science practical activities?
5. Are there significance differences in laboratory facilities, organization and conducive laboratory setting between government, public, church and private preparatory schools?

6. Are there disparities between teacher's beliefs, interests, attitudes and abilities towards practical work in teaching science?
7. What are the factors that constrain the implementation of practical activities in preparatory schools?

#### **1.4 Objectives of the study**

The objectives of this study are:

- To evaluate how practical activities are being conducted parallel to the theoretical lessons in science fields (biology, chemistry and physics) in preparatory schools.
- To identify the main factors that influence practical activities in fields of science in preparatory schools.
- To assess the preparation and experience of schools in implementing practical activities as planned by the curriculum and syllabus.
- To identify and disseminate good practices to all schools in Addis Ababa and in other regional states.
- To propose possible solutions and recommendations for upgrading and excelling practical activities as planned in the curriculum consistently.

#### **1.5 Significance of the study**

This study is significant in:

- Providing insight for policy makers and developers how to monitor the regular implementation of practical activities in schools as planned by the curriculum.
- Inspiring teachers and schools to carry out practical activities as designed by the curriculum or syllabus in a sufficient way to produce well qualified science graduates.
- Provision of feedbacks for Schools to develop their capacities by fulfilling basic facilities of laboratory and by solving the problems associated with them.

- Identifying the need for implementation of periodical workshops, seminars and training for science teachers of government, public, Church and private schools about science practical activities and updating their skill and experience.
- Encouraging other science educators to conduct further research on the same topic.

## **1.6 Delimitation of the study**

This study is delimited to selected Government, public Private and Church preparatory schools in Addis Ababa city Administration (AACAA). Thus, the researcher wants to assess and address the current status of the general practices, traditions and constraints of practical activities in those selected preparatory schools in Addis Ababa.

## **1.7 Limitation of the study**

During the entire research, the researcher has been challenged by the following limitations.

- Shortage of time, resource materials, transport problem.
- Permission and co-operation of school principals and educational experts.
- Voluntariness of the participants and careful responses to the questionnaires and interview
- Delay in returning Questionnaires and not returning some dispatched questionnaires.

## **1.8 Operational definition of key terms**

The key terms used in this study defined as below:

**Demonstration:** - The presentation of pre-arranged and organized series of events or equipment to a group of students for their observation (Aggarwal, 1996).

**Experiment:** - A scientific activity carried out under planned, determined conditions/A scientific test which is carried out in order to discover whether a theory is correct or what the results of a particular course of action would be. (Encarta Dictionary, 1990).

**Implementation:** - In this study it refers to the actual use of practical work/performing what has been planned to do.

**Laboratory:** - A place where scientific work is done, a room or building fitted with apparatus for conducting scientific investigation, experiments or tests (World Book dictionary, 1985).

**Practical work:** - All kinds of experimental and observational activities in science teaching. It is also referred to a lab work, if those activities take place in the laboratory (Kerr, 1963).

**Preparatory school:** - It refers to second cycle (grades 11 and 12) of senior secondary education level.

**Skills:** - Those activities which are necessary but not sufficient in themselves to the carrying out of most practical works.

## **1.9 Organization of the study**

The study of this research work was organized in five chapters. The first chapter contains background, statement of the problem, research questions, objective, significance, delimitation, limitation, organization of the study and operational definition of terms. The second chapter presents the review of related literature and chapter three deals with research methodology and design. Chapter four concerns with presentation, analysis, interpretation of data and discussion. Finally, Chapter five deals with summary, conclusion and recommendations of the main research findings.

## **CHAPTER TWO**

### ***REVIEW OF RELATED LITERATURE***

#### **2. The Nature and purpose of practical work in science**

##### **2.1 The Meaning and Nature of practical work**

Kerr (1963) described practical work as experiments performed by the teacher as demonstrations, co-operation demonstration by groups of students or teachers as well as experiments and observational exercises carried out by the students.

In science teaching and learning process, the term “practical work” may be attempted to include any activity involving students in real situations using the required materials and properly working equipment. In many of biological and physical sciences practical work takes place in a laboratory and this often known as laboratory work (Husen and Postlethwaite, 1994).

According to Bekalo and Welford (2001) a practical work sometimes means “**hand –on**”, however, it also encompasses a range of ways of working, including teacher demonstration, group discussion of problems and their solutions, interaction between student-student, student- teacher or student, teacher and trainer. Practical work can include individual activity, such as measurement, observation and investigation. This practical work can take place in science laboratory, classroom, field or elsewhere.

Generally, regarding the meaning of practical work in science, Kerr (1993) elaborated that practical works could be conducted in either methods of demonstrations that verify facts and principles of qualitative or quantitative experiments, basic classical experiments to show important stages in the logical development of a principle or topic, problem- solving or discovery experiments, investigative projects and the activity prepared to develop skills and techniques.

##### **2.2 The purposes of practical work in teaching Science**

Tobin (1990) wrote that: “*Practical activities appeal as a way to learn with understanding and, at the same time, engage in a process of constructing knowledge by doing science*” (p. 405). He also suggested that meaningful learning is possible in the laboratory if students are given opportunities to

manipulate equipment and materials in order to be able to construct their knowledge of phenomena and related scientific concepts.

Scientific literacy of the population is a necessary condition for fast technological, environmentally sustainable development in a country. To achieve it, science education must be available to all. The main role of science education in primary, secondary and preparatory schools should be targeted to produce informed citizens, rather than new scientists.

The prevalent opinion among science educators and scientists is that practical work in Science education increases comprehension of scientific principles and their application in the real world. Modern teaching methods in particular emphasize 'learning by doing' and hands on approaches. For practical work in science teaching, some specialized equipment and facilities are needed, which in many developing countries are rarely available. Large investments have been made to improve the situation, but their effect has been in many cases far less than expected (World Bank Report: 1993).

Social and technological changes require constant updating of the general populations' knowledge and skills. Developments in science and technology are tangible realities affecting any member of the society. Science education has become so important that many consider it necessary to strengthen considerably science teaching in all educational systems and to allow scientific literacy to develop. It is particularly important for developing countries to develop their own capacity to evaluate, import, absorb and improve the scientific and technological knowledge that would be suitable and would contribute to their autonomous development (UNCSTD, 1979).

According to world bank report (1993) the main purposes of implementing practical or laboratory activities in science include: - formulating questions, planning experiments, making systematic observations, interpreting and analyzing data, drawing conclusions, communicating, and understanding of inquiry. Chaudhry et.al. (1975) explained the importance of laboratory experiment as it fosters an opportunity to the learners to familiarize themselves with various instruments, techniques and principles which they read and understood theory.

Moreover, it provides them with a glorious chance to learn the habit of systematic observation and methodological procedures and this in turn in how to do things genuinely, efficiently and regularly.

Educational Media Agency/ EMA (2002) claimed that most enjoyable part of science is experimentation in the laboratory. EMA (2002) further stated that practical work serves as a backbone for teaching all types of topics in the subjects of science.

As Tesfaye (2009) described for an effective science teaching, theory and practical work must support to each other to form an integrated experience. So, this makes teaching science more interesting, live and participatory for better understanding and long lasting knowledge. There are several functions for science teaching which can best be fulfilled through practical activities.

Kerr (1993) has listed the major purposes of practical works in science teaching.

- To encourage accurate observation and careful recording.
- To promote simple, common-sense, scientific methods of thought.
- To develop manipulative skills and experience.
- To give training in identification and solving of problems.
- To fit the requirements of practical examination regulations.
- To elucidate the theoretical background so as to make comprehensive
- To verify facts and principles already taught.
- To be an integral part of the process of finding facts by investigating and arriving at principles.
- To arouse interest and maintain in the subject
- To make biological, chemical and physical phenomena/events more real and tangible through actual experience.

Kerr (1993) further remarked that out of the above ten purposes of practical work the first four are possible effects of practical work, the next four purposes are referred to as the actual teaching process and the last two are possible effects on one's general attitude to science.

According to EMA (2002) advantages of practical work in natural science have been listed out. Some of the advantages are:-

Students can be taught scientific facts and theories but without experiments they cannot experience the reality of Biology, Chemistry and Physics as a natural science as follows.

- Students by doing experiments motivate to know more wonders of science.
- Practical work helps the students in reporting about events, project assignments and problems Without hiding which promote intellectual honesty among students.

- Laboratory work is an obligation in developing scientific attitude and scientific temper. Validity of concepts learned by the students can be tested by experimentation and hence satisfy human desire of knowledge, how and why of natural phenomena.
- As a result of practical work the students learn many good habits like hard working, initiative mutual-co-operation, etc.

Even though, practical activities have those purposes and aims, schools often fail to carry out experiments and scientific investigation parallel to the theoretical aspects in science teaching – learning process. However, this is due to several reasons like vast portion of science subject, large class size, lack of adequate time, lack of well trained lab technician/assistant, lack of interest and commitment from teachers and school principals, etc.

Concerning this, Kerr (1993) has identified some observed limitations.

- Practical work was frequently used as a verification of something known but rarely as a starting point for a new topic.
- The domination of science practical work at the advanced level by quantitative exercises limits the value of laboratory work.
- There was no time for individual work beyond the set course.
- The concern of most pupils during lab work is to get the right answer and this outlook will not lead towards the development of an inquiring mind.
- The teacher demonstrating an experiment and then the pupils repeating the same experiment or a slight modification of it is inefficient.
- Neglecting of demonstration in classroom teaching.

Project Faraday, launched in 2006, has encouraged practical and creative designs for secondary school science facilities which support more interactive and exciting ways of teaching and learning with innovative use being made of ICT. As Andy Piggott (2010) reported “Science laboratories and equipment are vital to pupils’ science education, not only directly (meeting curriculum need) but also indirectly by interesting them and enthusing them to study these subjects further.”

It is often argued that practical work is central to teaching and learning in science and that good quality of practical work helps to develop pupils’ understanding of scientific processes and concepts.

The UK has a long tradition of practical work in school science and of valuing fieldwork, particularly in biology. It is a reasonable assumption, based on what evidence is available, that students in UK schools undertake more practical work in science than do students in most other countries in the world.

There are many espoused purposes for doing practical work in school science. Some of the most frequently stated by teachers are: to encourage accurate observation and description; to make phenomena more real; to arouse and maintain interest; to promote a logical and reasoning method of thought. There is evidence that practical work can increase students' sense of ownership of their learning and can increase their motivation.

As Justin Dillon (2010) explained the importance of practical work in school science is widely accepted but its importance should be ensured that such practical work genuinely supports learning and teaching science, and that flexibility is given to the teacher to do this in relation to their pupils' needs and the courses they are studying. Wellington (1988) noticed that there are 'at least six types of activity' that take place in school science *'that we would probably all class as practical work'*. These are teacher demonstrations; class practices, with all learners on similar tasks, working in small groups; a circus of 'experiments' with small groups engaged in different activities, rotating in a carousel; investigations, organized in one of the above two ways; and problem-solving activities, for a degree of clarity when discussing the types of activities that teachers carry out.

In a report written for the US National Academy of Sciences, Robin Millar pointed out that when using the term 'practical work' he referred to 'any teaching and learning activity which at some point involves the students in observing or manipulating the objects and materials they are studying' (Millar, 2004). By way of explanation, Millar added: Such activities are: learning experiences in which students interact with materials or with secondary sources of data to observe and understand the natural world. As Millar cited in his paper is that "practical science" is used as 'shorthand for the full program of experimental and investigative activities (including fieldwork) conducted as part of science education in schools and colleges.'

It is also important to distinguish, and keep in mind, that the school science curriculum in most countries has two distinct purposes. First, it aims to provide every young person with sufficient understanding of science to participate confidently and effectively in the modern world – a

‘scientific literacy’ aim. Second, advanced societies require a steady supply of new recruits to jobs requiring more detailed scientific knowledge and expertise; school science provides the foundations for more advanced study leading to such jobs. These two purposes may lead to different criteria for selection of curriculum content, to different emphases, and to different rationales for the use of practical work (Abrahams and Millar, 2008).

In an attempt to make sense of the various aims, Wellington (1998) offers a ‘*general summary of arguments*’ for the use of science practical work as follows: -

**Affective arguments:** practical work, it has been argued, is motivating and exciting it generates interest and enthusiasm. It helps learners to remember things; it helps to ‘make it stick’.

**Skills arguments:** It is argued that practical work develops not only manipulative or manual, dexterity skills, but also promotes higher-level, transferable skills such as observation, measurement, prediction and inference. These transferable skills are said not only to be valuable to future scientists but also to possess general utility and vocational value.

**Cognitive arguments:** It is argued that practical work can improve pupils’ understanding of science and promote their conceptual development by allowing them to ‘visualize’ the laws and theories of science. It can illustrate, verify or affirm ‘theory work’.

Richardson (1957) confirmed that science laboratory contributes a lot of advantages to develop skills, habits and attitudes of the learner. It is one of the motivating powers for students’ attitude towards science. Therefore, learning is more likely to take place and interests and motivation develop as knowledge increases.

Husen and Postlethwaite (1994) also explained that practical works which are supplementing science teaching make students to develop positive outlooks and thinking towards science. In this regard the program of curriculum reform in science which commenced in the late 1950s in the United Kingdom and United States and which rapidly spread all over the world recognized the importance of favourable attitudes towards science.

### **2.3 Practical work in science teaching**

Berquist (1991) has defined the term laboratory as a place where experience will be gained upon which abstract concepts can be built instead of being only an illustration after an idea is presented.

EMA (2002) described a science laboratory as a place where an experiment is taking place. EMA further stated that laboratories are not only supportive of the theoretical part of science but also an important part of science courses.

Richardson (1957) considered laboratory as the heart/soul of science. He also argued that the laboratory is more than a classroom; it should be recognized as an approach or a method of science. Hence, Laboratory experiences are invaluable to science students because the laboratory approach to science is superior to any others. It can't be replaced by lectures, films, TV, or classroom demonstration (Sootin: 1964).

Tesfaye (2009) described "laboratory conducted by students has long been considered the hallmark, the unique feature of science education. Science students should be taught for at least part of the time in the laboratory classes, students laboratory work is the method of choice for teaching technical skills and increasing understanding of the apparatus involved. Students laboratory work can also be effective in teaching application of scientific knowledge and principles."

Regarding the importance of laboratory work in natural science, EMA (2002) has compared as "a fish can't survive without water and likewise teaching science that does not support with practical activities is incomplete and science students are not fully trained." So learning by doing can be achieved only by conducting experiments.

There are certain conditions necessary for successful accomplishment of practical works in schools. In this regard many factors bear on the success of a laboratory schedule that brings Science into the lives of students.

EMA (2002) identified some points that help to conduct laboratory work in a proper way.

- There should be a co-ordination between theory and practical activities and for this; students must possess sound theoretical background before they enter the laboratory.
- The number of students for lab class should be limited nearly 20 students and this helps the teacher to be in a proper position, for supervision and check on their work.

- The aim and purpose of the experiment should be made quite clear to the students, what they want to find and how they can achieve it.
- All the experiments along with diagrams and results must be complete in the laboratory.

### **2.3.1 Science laboratories and Equipments**

It is obvious that students must do experiments and observe different phenomena to learn science effectively with more understanding. However, due to lack of adequate materials and resources for laboratory activities purchasing of basic and adequate science equipments and improvement of science apparatus is almost very essential in secondary and preparatory schools of Ethiopia.

A resourceful and dedicated science teacher can easily improve a lot of science apparatus from the readily and locally available materials for experiments and demonstration EMA (2002).

Besides, EMA (2002) remarked that secondary and preparatory school science laboratories are expected to be equipped with the appropriate facilities so as to serve the purpose of it in science teaching. It is advisable that instead of expecting to use complex and unnecessary expensive equipment, it is better to carry out experiments and demonstrations with simple and easily handled equipment and apparatus.

Preparatory Science laboratory need to fulfill supplies, equipments and reagents. These facilities for science laboratory are paramount important for continuous and enormous range of experimentation, adjustment of apparatus, demonstration and laboratory equipments and supplies for on-going projects. It also requires enough space for storage and supplies as well as adequate electrical & water services, library resources like laboratory manuals, suitable demonstration desks, good ventilation and arrangement of the room (Tesfaye: 2008).

### **2.3.2 Experimental procedures in science teaching**

Chaudhry (1975) described an experiment as a process of taking observations, controlled conditions deliberately arranged so as to provide answer to a particular question. Experimental work in a laboratory should be an integral part of any science courses. It should help the learner to be a skilled observer and an imaginative thinker about his/her environment and natural events how and why they happen.

The experiment that has been designed in secondary and preparatory school science is to meet the following fundamental objectives (Zinaye and Dawit: 2001).

- Confirming a theoretical model and thus providing support for the theoretical section of the subject.
- Quantifying the experimental results.
- Observing a natural phenomenon.
- Designing an experiment to produce a specific effect.

Zinaye and Dawit (2001) further elaborated that based on the above objectives students will develop the following skills.

- Manipulating the apparatus according to the specification to produce a required out-come.
- Measuring and assessing the value of those measurements.
- Analyzing and interpreting their results where relevant they should make an objective comparison with an accepted value of a scientific quantity or with theoretical predictions and assumptions.
- Concluding and presenting their experimental results.

### **2.3.3 Demonstration in science Teaching.**

Aggarwal (1996) stated that demonstration means the presentation of a pre- arranged series of events or equipment to a group of students for their observation. This is followed by explanatory remarks. It can serve in giving information, knowledge and training. Demonstration is useful to give firsthand knowledge to the students. It correlates a proximate relationship between theory and practice. It helps to internalize facts and principles in science.

Demonstration along with laboratory activities, project work, field trips, etc is practical work in science. Demonstration is very useful practice in science teaching with various purposes. Some demonstrations verify facts, realities and principles, others may develop power of observation among students (Richardson: 1957).

Based on EMA (2002) a good demonstration has the following characteristics.

- Demonstration should be visible to all the students in the class.

- Demonstration should be clear cut.
- It should be rehearsed earlier.
- For recording data the students should be given sufficient time.
- The apparatus used for demonstration should be longer in size.
- Apparatus needed for demonstration should be arranged in order.
- Some other teaching aids should supplement demonstration.

Demonstration method is especially useful when an individual work is impossible due to lack of sufficient materials and apparatus (Richardson, 1957 and EMA, 2002). In addition, demonstration as a practical work has different functions for effective science teaching. Scholars have listed some of the following clearly defined functions of a demonstration as below.

- To solve a problem.
- To explain, to make clear by analysis.
- To verify, substantiate and review.
- To provide an application.
- To evaluate students' achievement.
  - To create/sort out a problem during demonstration and discussion.
- To show methods and techniques.
- To display objectives and specimens

#### **2.4 practical works and the science Curriculum**

In the United States, and in many other countries, scientists in higher (tertiary level) education have been very influential in the design and implementation of science curricula (Fensham, 1992, 1993). Yet, studies of freshman level university courses in the natural sciences showed that these courses had changed only slightly in style from university courses offered in the 1960s. Furthermore, teaching in university level courses has a powerful influence on the education, socialization, and subsequent behavior of science teachers at secondary and elementary school levels. Fensham claimed that the dominant perception of university science faculty members have been agreed that the principal goal of secondary school science education is to prepare students for success in the university level science.

“Thus, the content and knowledge of worth for senior secondary/preparatory sciences is to be determined by the knowledge and expression of it that is now well established as the content of freshman science courses in chemistry, biology and physics”. He wrote that the attitude of many university scientists toward the science curriculum inhibited the implementation of many of the new science education goals, strategies, and sites such as *science for all*, *inquiry*, *applications*, and *science–technology–society*. In addition, competent secondary science teachers have had limited voice and power to shape curriculum and policy decisions in school science. Policy decisions are often made at state (or in the United States at district) levels where people with expertise in science teaching have had very limited voice.

As Lunetta (2002, 2003) described, the need for meaningful, long-term professional development for science teachers on these and many related issues in science education and the need for better communication between the science education research community and the community of science teachers has become abundantly clear. Greater interaction has been inhibited, in part, by contemporary institutional structures that separate science teachers from the scientific community, from the science education research community, from meaningful professional development in science and in science pedagogy, and from participating in policy making as competent professionals. Reducing the institutional and cultural barriers that inhibit communication between these several science education communities and developing appropriate professional development and engagement systems is a very important task for policy makers and for members of those communities. To these ends, policy makers, teacher associations, departments of education, and schools need to collaborate and to set aside sufficient time and resources to enable that professional growth and empowerment guided by school realities and by relevant scholarship to occur. Policy changes, implementation, and careful research on the process are needed to achieve the very important ends that have been articulated.

As Ethiopian National Agency for UNESCO (2001), the curriculum reform has been basically government initiative although there has been pressure from the stakeholders that the system was obsolete by all standards. Thus, following the adoption of new education and training policy the curricular reform became essential to achieve the new vision and mission of education in Ethiopia. The science curriculum gives more concern for science fields such as Biology Chemistry and

Physics in order to produce competent scientists, engineers and medical doctors. So, to make science teaching effective it should be supported by the practical works as stated in the curriculum.

## **2.5 Major constraints for implementation of practical activities in Preparatory or Secondary schools**

As Tesfaye (2009) described most of the secondary as well as preparatory schools in Ethiopia and other countries in the world faced different problems that can hinder performing experiments and any practical activities as practical works in physics in particular and in science in general.

Kerry (1963) explained that the efficiency of practical work in science teaching is impaired not only by a critical shortage of well-trained science teachers but also by a variety of other factors such as:

- Insufficient laboratory facilities.
- Lack of skilled laboratory technicians.
- The over loaded laboratory time tables.
- Lack of time in some schools.
- Too large class size for practical work.
- The types and degree of problems may vary from country to country and from school to school.

Some of the factors which can influence/hinder laboratory activities in secondary and preparatory schools are:

### **2.5.1 Poor Organization and Management of the Laboratory**

Practical activity is crucial in schools where natural science courses have been taught as a subject (EMA: 2002). In order to conduct laboratory work the first thing is the presence of a functional laboratory. Even though, some schools have a good laboratory class room, they will face other problems like lack of well-trained technicians and teachers, lack of lab equipments and lack of effective organization and management of laboratory. Hence, organization of a laboratory is very important procedure for the effectiveness of science teaching with the help of practical works.

### **2.5.2 Lack of well-trained lab-technicians and teachers**

An effective science teaching in preparatory school is mainly based on experiments and demonstrations along with other practical activities that are performed either in the laboratory or inside and outside the classroom. Teachers' role is very important for involvement of students in practical activities. As Kerr (1963) identified that the most commonly mentioned factor for limiting the effectiveness of a practical work is the absence of a trained laboratory assistant/lab technician. In addition science teachers should know well the subject matter they teach and lab activities that are planned to be carried out by the students. They should give clear emphasis to their students in order to perform practical activities without any ambiguity and confusion. However, most science teachers in preparatory/secondary schools either don't have interest or don't have ability or skill to help students in doing practical work. So, teachers should get up to date training and workshop about practical activities.

### **2.5.3 Lack of Equipments and other facilities of laboratory**

As many studies revealed practical work can't be taken place without having the necessary equipment, apparatus and reagents in the school laboratory (Bekalo and Welford, 2001 and Kerr, 1963). Because of this students will have few or no exposure to practical activities and that is why they become confuse, how to conduct practical activities and operating equipment as a college and university student when they completed preparatory or secondary school and have joined Universities and colleges. Therefore, lack of materials and other facilities highly restrict students to perform practical works in the laboratory *and demonstrations and other practical activities in the classroom or in the field.*

*MOE (1994) declared that when the curriculum is designed depending on the education policy of the country, especially for science subjects, practical works like experiments, investigations, and demonstrations are included in the syllabus of each subject and grade level in order to achieve the desired goals of the subjects.*

*In line with this, Mayburn and Wilburn (1971) proposed that the expense of providing laboratories and equipments is a fundamental constraint on effective science teaching and the emphasis on the new science teaching programs on practical work for students has manifested this challenge for the developing countries.*

#### **2.5.4 Large Class Size and Inadequate Time Allotment**

As Tesfaye (2009) explained in his thesis, normally, it is assumed that number of students per class should be limited and manageable by the teacher in order to follow and check up every activity that the teacher teaches and disseminates to the students. This becomes more essential for science teaching and to carry out practical activities as planned by the teacher when the number of students per class is manageable. So, to make effective demonstration in the class and carrying out experiments in the laboratory the students must be grouped in small number and the chance of each student to involve in the practical activity will be high and the students will gain more exposure and experience sharing. On the other hand, as the number of students increases the opportunity of each student to participate in the group becomes low.

According to Nuffield foundation (1966) “if students are given a chance and ample time, they can design and modify their own experiment, meeting challenges as well as fruitful results, try things out with a careful eye and ready mind as any professional scientists do. They need this personal experience for that they need time and encouragement, but not too much detailed orders and instructions or precautions, since they need to feel that it is their own experiment and to learn by their mistakes as well as their success.”

#### **2.5.5 Students Assessment strategies**

As Tesfaye (2009) described “the assessment strategies practiced in the school play a great role in enhancing the practical work performed in science courses. Practical examinations are one of the main factors influencing, the importance to which experimentation is put in science teaching. Technique, attention and accuracy, lay out of results, estimation of error and above all, ‘getting the right answer’ were the factors commonly rated in the making of candidates’ work of practical examinations. Without an examination a serious neglect of practical work can occur.”

### **2.6 Status of Practical Work in Science Education in Ethiopia.**

In Ethiopia different types of curriculum were developed since the beginning of traditional education (4<sup>th</sup> century – 1908) to modern education (1908-post 1991) (Wobue, 2005). So, a frequent change of the curriculum from government to government due to various reasons has direct or indirect influence on science teaching as well as on practical works.

The science commission formed in the seminar held at Addis Ababa in January 1967 (Madsen, 1968) revised the area of general science as well as the three pure sciences i.e. Biology, Chemistry and Physics. According to the commission a number of handicaps to efficient instruction were listed and registered. These are inadequate lab facilities, inadequate supplies (often due to administrative carelessness), improper scheduling, lack of reference book and library facilities (due to poor administrative procedure), etc.

Concerning this, Solomon (2007) pointed out that there are a lot of resemblances between how the curriculum was implemented in the 1960s or 1970s and now a days in (2008), 30 years later. It has been observed lack of teaching materials and qualified teachers as well as language problems.

Furthermore, the New Education Policy itself admits the problems in those inadequate facilities, insufficient training of teachers, overcrowded classes, shortage of books and other teaching materials; all these indicate the low quality of education provided in Ethiopian schools (TGE, 1994).

Modern science and technology can help to promote economic and social growth more in the poor but developing countries like Ethiopia. In this regard, Ethiopia gives more concern to the sector and as one of the objectives of education of the country. The statement written in the policy document (TGE, 1994b:7-8) is quoted as below.

*“Bring up citizens who differentiate harmful practices from useful ones, who seek and stand for truth, appreciate aesthetics and show positive attitudes towards the development and dissemination of science and technology in society.”*

Despite of the policy intention to make science relevant, practical and suitable for the majority of people, much of the science taught in Ethiopia remains very much concerned with rote learning of factual knowledge. The passing of examinations predominantly valuing remember of knowledge even though, in science education the ambition is to device a curriculum and methods of instruction to promote learners’ conceptual and procedural knowledge by closely integrating the theoretical and practical work. In relation to this view, Tekeste (1990) stated that science education in Ethiopia is under crisis due to irrelevant and inappropriate methods which had failed to incorporate relevant practical experience.

The failure to promote the intended practical approach in Ethiopia can be attributed to a complexity of factors which act upon the education system and inevitably affect the quality of science teaching and learning. Therefore, one of the draw backs of educational reform in Ethiopia appears to be the apparent confusion inherent in conceptualizing practical work. There is an assumption among Ethiopian science educators, including teachers, that practical work in the science means only laboratory work involving sophisticated and imported expensive apparatus. Alternative practical activities, such as those that can be done outside the laboratory or with locally available materials are not considered to be practical work.

They are also perceived as low status activities (Bekalo, 1997). In general, in this modern world, having strong background in science fields such as Biology, Chemistry and Physics seems very crucial in getting into many careers and occupations like medical science, pharmacology, engineering and other technological oriented areas. Integrating theoretical knowledge with frequent practical activities in all courses of science and advancing science and technology in this rapidly changing world should be a great concern and the primary task of developing countries like Ethiopia to reduce poverty and to realize sustainable economic development.

## **CHAPTER THREE**

### **METHODOLOGY OF THE STUDY**

#### **3.1 Research Design**

Design of a study considers as a road map/blue print of a research work. Among the research designs the one which is suitable for the research of Science Practical work is **descriptive survey** in which the researcher can show current status and correlation among government, public private and church preparatory schools in practicing and implementing practical activities in science fields and constraints of science practical works.

#### **3.2 Sampling techniques**

We know that the sample should be representative of the population of the study. The population for this study is preparatory students, science teachers, laboratory technicians, school principals, department heads and Zone/Woreda educational expert in Addis Ababa in those selected schools and educational offices. There are ten sub-cities in Addis Ababa Administration. Preparatory schools under these sub-cities are Government, Public, Private, missionary, NGOs, Church, mosque or foreign community schools (MOE: 1994). Stratified random sampling technique is applied to select sample schools in those preparatory schools and the selection of participants in each school. The students and teachers are not of equal size in both types of school. Hence, the study employs proportional stratified random sampling method.

**Table 1: - Lists of sample preparatory schools, number of teachers and students categorized in their sex and sub-city of Addis Ababa where the school is located.**

Go	Government	Ch	Church
Pr	Private	Lc/Pub	Local Community/Public

Reg.	Sub-city	Preparatory school	ownership	# Enrolled students			# Teachers		
				M	F	T	M	F	T
Addis Ababa	1.Addis Ketema	Radical academy	Pr	130	135	265	12	3	15
	2.Yeka	Dej. Wondirad prep	Go	709	840	1549	50	18	68
	3.Addis ketema	Addis ketema	Go	1080	1221	2301	85	6	91
	4.Kirkos	Abiyot kirs	Go	296	428	724	36	8	44
	5.Kirkos	Assay	Lc	79	74	153	18	1	19
	6.Nefas Silk Lafto	FireHiwot No.2	Lc	152	215	367	30	4	34
	7.Lideta	Limat Minch prep.	Go	580	881	1461	51	17	68
	8.Gullelie	Elshadayi Holy Savior	Pr	71	74	145	14	5	19
	9.Bole	Yenegew sew	Pr	34	37	71	16	0	16
	10.Gullelie	Yekatit 12 prep.	Go	1243	1456	2699	121	17	138
	11.Akaki Kaliti	School of Aygoda	Pr	52	58	110	18	0	18
	12.Arada	Lideta Catholic Cathedral	Ch	250	158	408	20	1	21
Total				4676	5577	10253	471	80	551

**Source: - Educational bureaus of Addis Ababa city Administration**

Before data collection Sample schools have been selected by proportional stratified random sampling techniques, moreover samples of students and teachers have also been selected using

purposive sampling methods. The above table shows samples of schools, the total target population in which, sample of students and teachers have been taken for this specified research.

Five government schools, two public schools, four private and one church school from different sub-cities of Addis Ababa are selected as sample schools. The total number of students in 12 schools is about 10,253 and 3% of it has been taken as sample of students for the study which is roughly 320 students. Based on size of target population 180 (56%) students have been taken from government schools, 40 students (13%) from Public schools and 100 students (31%) from private and church schools.

There are about 551 teachers in the 12 selected schools and 14% (76) of the teachers are science teachers and they were included in the study. 40 (53%) science teachers from government schools, 6 science teachers (8%) from public schools and 30 science teachers (39%) from private and church schools.

Five School principals, twenty-three (23) department heads, and five lab technicians all were participants of the study. In addition in five selected sub-cities i.e. Addis ketema, Arada, Gullelie, Lideta and Yeka, concerned Zone/Woreda educational experts have been included as participants of this study.

### **3.3 Data collection instrument**

To collect sufficient and rich data a variety of instruments, such as questionnaires, Observational check list, interview and document analysis are used. Questionnaires were prepared and dispatched to science teachers, preparatory students and department heads. The interview of the participants was integrated and triangulated to enrich and elaborate the quantitative data gathered through questionnaire during the analysis of data.

**Table 2: Types and Description of instrument**

No.	instrument	Participants/ Implementers	Description of purpose
1.	Questionnaires	Students, teachers, department heads and lab technicians.	Questions were prepared to collect quantitative data regarding science practical works.
2.	Document analysis	The researcher	Helps to evaluate the presence of lab manuals, student profiles, plans of experiments, list and labels of lab tools and reagents
3.	Observation Check list	The researcher, teachers, students	Helps to record data about the actual practical activities in the lab.
4.	Interview	The researcher, teachers, students and lab technicians, department head, woreda education officer	Helps to gather views, experiences, and attitudes of participants directly from their mouth in the natural setting.

### **3.4 Research procedure**

After determining target population, sample size and deciding types of sampling techniques, the next step was revising and identifying previously done data collection instruments which are related to this research. So, related review literature has been thoroughly and deeply revised and samples of questionnaires identified and critically examined. Then questionnaires were prepared and piloted. After collecting comments, evaluating and correcting their clarity and level of difficulty, finally developing student and teacher questionnaires consisting of 23 and 24 questions respectively. Different questionnaires were prepared for department heads, lab technicians, and teacher and student participants, and then, distributed to and collected from respondents.

Semi-structured questions were also prepared for interviewing selected students, teachers, schools principals, lab technicians and educational experts at woreda and/or sub-city level. Responses of the participants were coded; categorized and major themes were developed and triangulated to the quantitative data at the time of analysis. In addition, observation check list was prepared and data was collected from actual practical activities in some selected school laboratories. During this time practical activities carrying out by the teacher and students in the school investigated. All the data was analyzed and the results were triangulated.

### **3.5 Methods of data Analysis**

The data collected was organized in tables and using coding systems. The main data analysis techniques that the researcher has been used are chi-square ( $\chi^2$ ), Percentage and frequencies.

Percentage and frequency are important data analysis techniques to show the comparison of practices, facilities and main constraints of laboratory activities among Government, public and private preparatory schools.

In addition the interview of the participant, field notes and data gathered from observation were coded and categorized into themes and analysis of document used to develop an important idea which can support and emphasize the numerical data analyzed by percentage, frequency, and chi-square.

## **CHAPTER FOUR**

### **ANALYSIS, INTERPRETATION AND DISCUSSION**

In this chapter the analysis of the quantitative and qualitative data collected from sample population (students of grade 11 and 12, preparatory science teachers, department heads, laboratory technicians, principals and educational experts from woreda and zones, and document analysis) are presented and interpreted. The gathered data are analyzed using tables followed by detailed discussions and showing the statistical relationship using the appropriate parameter. Related questions are analyzed together for the sake of removing redundancy and saving time. Responses collected from lab technicians, school principals and educational experts are incorporated to substantiate the data obtained from the students and teachers. Accordingly, the characteristics of the respondents, the data gathered, the analysis of the data, interpretation, discussion and conclusion presented following this sequence.

#### **4.1 Characteristics of Respondents**

Sample students were taken from Government, public and private preparatory schools in Addis Ababa city Administration. Science teachers in these schools were participants of the study. In selected schools, the principals were interviewed about the general activities of practical works and the allotted budget to fulfill the facilities and equipments of laboratories. In addition, educational experts from woreda and zone were interviewed as what kind of support and supervision they implement in various government, public and private preparatory schools to promote scientific literacy of students.

**Table 3: - Characteristics of respondents by their sex, Qualification, service of years, Teacher's average work load per week and grade level of students.**

N.	Variables	Respondents/Participants									
		Students N =320		Teachers N =76		Laboratory technicians N =5		Principals N =5		Educational experts N =5	
		No.	%	No.	%	No.	%	No.	%	No.	%
1.	Sex										
	Male	168	52.5	70	92	4	80	5	100	3	60
	Female	152	47.5	6	8	1	20	0	0	2	40
	Total	320	100	76	100	5	100	5	100	5	100
2.	Grade level										
	11 <sup>th</sup> grade	155	48.4								
	12 <sup>th</sup> Grade	165	51.6								
	Total	320	100								
3.	Qualification										
	Certificate			-----		1	20				
	Diploma			-----		2	40				
	BSc/BA/BEd			65	87	2	40	3	60	4	80
	MSc/MA/MEd			10	13			2	40	1	20
	Total			75	100	5	100	5	100	5	100
4.	Work Experience										
	< 5 years			10	13	1	20%				
	5-10 years			30	40	-----	-----				
	> 10 years			35	47	4	80%				
	Total			75	100	5	100				
5.	Average Work load/week										
	Government			16							
	Private			22							
	Public			14							

As the above table shows that out of 320 students, 168 (52.5%) participants were males and 155 (47.5%) were female participants. In terms of grade level, 155 (48.4%) are grade 11 students and 165 (51.6%) are grade 12 students.

From 76 teachers, 70 (93%) were male participants and 6 (8%) were female respondents. Regarding educational background and qualification 65 (87%) of the teachers have first degree and 10 (13%) of them have second degree. In terms of work experience, out of 76 teachers whose experience less 5 years are 10 (13%), teachers whose experience ranges from 5 – 10 years are 31 (41%) and those whose experience greater than 10 years are 35 (46%).

The average teaching workloads per week are 16, 14 and 22 periods for teachers teaching in government, public and private schools respectively implying that relatively public and government teachers have some extra time to plan and implement practical works better than private and missionary schools according to the syllabus of science courses in the preparatory level.

Regarding lab technicians/assistants 1 respondent is 12<sup>th</sup> grade complete and has got certificate in lab assistant, 2 respondents have diploma in laboratory technician and the other 2 respondents have a B.Sc degree in biology and chemistry and they work as laboratory technician in government schools. The lab assistant has work experience less than 5 years while the other 4 lab technicians have work experience greater than 10 years.

Out of 5 school principals 3 of them are first degree holders and the other 2 officials have master-ate degree. From 5 educational experts who were interviewed for this research 4 of them have first degree and greater than 10 years working experience in teaching and experts of education in Addis Ababa city administration, while, 1 of the expert has second degree and long work experience, more than 15 years both in teaching and experts of education in Addis Ababa.

When we carefully examine the data in table 3 above, female science teachers are very few in number revealing the existence of gender inequality and least participation of women science teachers in teaching science in preparatory schools.

## 4.2 Students' response on the current status of practical works in preparatory schools

**Table 4:** - Analysis of Student response on Organization, Facilities and Functions of Science Laboratories.

Item No.	Description of Item		Government		Private		Public		$\chi^2$ (df)
			No.	%	No.	%	N o.	%	
1.	Is there an organized science laboratory in your school?	Yes	108	63	85	80	33	79	<u>11.04*</u> (2)
		No	64	37	21	20	9	21	
2.	Is there a separate room for biology, chemistry and physics practical works in your school?	Yes	87	49	56	54	22	56	<u>1.21*</u> (2)
		No	91	51	47	46	17	44	
3.	Is science laboratory functional in your school?	Yes	50	28	61	60	20	53	<u>30.71*</u> (4)
		No	99	55	32	31	14	37	
		Seldom	31	17	9	9	4	10	
4.	Do you observe any science practical activities in the current academic year 2004 E.C?	Yes	78	43	71	70	29	76	<u>25.69*</u> (2)
		No	102	57	31	30	9	24	
5.	Number of students who observed science practical works in the first and second semester of 2004 E.C.	Sem-I	69	61	63	68	26	50	<u>4.81*</u> (2)
		Sem-II	44	39	29	32	26	50	
6.	From which field of science did you get sufficient skill?	Bio.	62	57	19	23	9	32	<u>33.87*</u> (4)
		Chem.	24	22	47	57	17	61	
		Phys.	23	21	17	20	2	7	
7.	Can you define what it means the term "laboratory" and "practical work?"	Yes	126	69	65	66	27	69	<u>0.402*</u> (2)
		No	56	31	34	34	12	31	
8.	Do you have a tangible reason to join and study science and is there a relation with practical works?	Yes	141	82	80	91	28	72	<u>7.58*</u> (2)
		No	31	18	8	9	11	28	
9.	How is lab session carried out in your schools?	S.C	20	12	11	11	8	21	<u>33.35**</u> (6)
		T.C	53	31	37	36	16	41	
		S & T Center	35	21	31	30	15	38	
		No Practice	62	36	24	23	0	0	
10.	Are there adequate facilities and laboratory equipments in your school?	Yes	57	32	53	51	21	55	<u>13.25**</u> (2)
		No	122	68	50	49	17	45	
11.	What is your opinion on the point that learning science should be supported with practical activities?	S.A	130	73	88	85	25	64	<u>13.90**</u> (4)
		Agree	37	21	15	15	13	33	
		D.A	11	6	0	----	1	3	

**Note:** - \* $P < 0.05$

\*\* $p < 0.01$

S.C=Student Centered, T.C= Teacher Centered, S&T=Student and Teacher, S.A strongly Agree, D.A=Dis-Agree

The data in table 4, item 1 indicates that 108 (63%), government, 85 (80%) private and church, 33 (79%) of public school students had a view that their schools have well organized science laboratory for practical activities. On the other hand 64 (37%) government, 21 (20%) private, and 9 (21%) public students responded that their schools have no well organized laboratory to carry out practical activities.

Overall 226 (71%) of the sampled students assured the presence of an organized science laboratory and the remaining 94 (29%) of the students responded the absence of well organized laboratory in their schools. However, there is significant difference among government, private, church and public school students view with regards to the presence of organized science laboratory,  $\chi^2$  (2,11.04).

Data in table 4, item 2 shows that 87 (49%) government, 56 (54%) private and 22 (56%) public students revealed the presence of separate laboratory classes for Biology, chemistry and Physics practical activities. It is clear that when there is a separate and large class it is suitable for both teachers and students to carry out practical activities as much as possible rather than sharing one room with other departments in science. To the contrary 91 (51%) government, 47 (46%) private and church, 17 (44%) public school students responded that their schools have no a separate room for biology, chemistry and physics practical works.

From the total sampled students in the four types of schools 165 (52%) of the students revealed the presence of a separate laboratory for each field of science, while 155 (48%) of the students responded that some of the preparatory schools have a combined laboratory rooms and the departments share this room to carry out practical activities. So, there is no significance difference among government, private and public schools regarding the presence or absence of separated classes for practical activities of each science field,  $\chi^2$  (2, 1.21). This indicates that more or less the schools have the same status and environment for practical activities and they share nearly the same common constraints arising from the absence of separate lab room for practical activities of each science subject. The data from the interview of lab technicians and science teachers confirmed that there is one laboratory room for Biology, Chemistry and Physics. Moreover the interviewee added that the existence of one common laboratory room creates an overcrowding and clashing of

laboratory programs and hence, there is limited period to carry out laboratory activities based on the schedule of each science discipline and this restricts teachers and students to perform laboratory session on an extended period of time. Therefore, one of the constraints for implementation of science practical activities is lack of separate room for Biology, Chemistry and Physics.

As table 4, item 3 shows 50 (28%) government, 61(60%) private and 20 (53%) public school students responded that their school laboratories are functional for practical activities. Whereas 99 (55%) government, 32 (31%) private and church, 14 (37%) public school students confirmed that their school laboratories are non-functional for most of the academic year and no practical activities at all. So, theoretical knowledge of science is not supported by practical activities in these schools and this makes science learning incomplete and students could not get practical skill and experience which is the core point in science to determine their destination. In addition, 31 (17%) government, 9(9%) private and church, 4 (10%) of public school students reported that practical activities are occasional and rarely functional in their schools. In general, from the total sampled students in the four types of schools 131(41%) responded as practical activities are functional in their schools, while 145 (45%) of the students confirmed that their school laboratories are non-functional and no practical activities in the fields of science. The other sample students 44 (14%) revealed that practical activities are rarely done and laboratory rooms open occasionally depending the will and interest of the school or science teachers.

Regarding the functioning of laboratories in preparatory schools, (item 3, from table 4) the chi square result indicates a significant differences among the government, private, church and public schools in terms of practical functioning of science laboratory activities,  $\chi^2$  (4, 30.71). Close inspection of the data indicates that there is disparity in the functioning of science laboratory in preparatory schools. These disparities in functioning of laboratories in the four types of schools make a difference in the knowledge and skills of students at the same grade level learning under a common umbrella of curriculum in the country.

Data from table 4, item 4 indicates that 78(43%) government, 71(70%) private and church, 29 (76%) of public school students responded as they have been observed demonstrations and experiments in the current academic year 2004 E.C in the first and second semesters. Those students who are responded as they did not observe any laboratory activities in the current academic year 2004 E.C

are 102 (57%) from government, 31(30%) from private and church, 9(24%) from public schools. From the total sample students 178(56%) confirmed that they have been observed practical activities in science laboratories in the current academic year 2004 E.C and 142 (44%) reported as they did not see any laboratory activities of science subjects. Here, the chi square shows a significant difference in the number of practical activities or experiments conducted and observant of students in the four types of preparatory schools in Addis Ababa in the current academic year 2004 E.C,  $\chi^2$  (2, 25.69).

Data from table 4, item 5 indicates that 69 (61%) of government, 63 (68%) of private and Church, 26 (50%) of public school students responded that they observed practical activities in the first semester of the academic year 2004 E.C and 44(39%) from government, 29(32%) from private and church, 26(50%) from public schools reported as they observed experiments and demonstrations in science subjects in the second semester of the current year. From the total responded sample students 158 (61%) they were able to observe practical activities in the first semester and 99 (39%) of the students assured that they were able to see practical activities/experiments in the second semester. Based on the data from the above table it is possible to conclude that relatively more activities have been carried out in the first semester than in the second semester.

According to the interview of department heads and school principals the reason why more activities have been conducted in the first semester than in the second semester is that teachers and students in the period of first semester they came from long vacation and they are fresh and there is potential to carry out several activities in the first semester, but in the second semester teachers and students would be exhausted and they carry out few laboratory activities.

Therefore, the chi square confirms that there is no that much difference among the four types of preparatory schools with number of experiments conducted in the first and second semesters of the academic year 2004 E.C.,  $\chi^2$  (2, 4.81). More or less the private, church, government and public schools carry out approximately equivalent number of experiments in the first and second semester of this current academic year (2004 E.C).

Table 4, item 6 shows that from government preparatory schools relatively more practical activities are carried in Biology than Chemistry and physics. So, students who gained some skills from biology practical activities are 62 (57%), 24 (22%) students from Chemistry and 23 (21%) students

from physics. Therefore, students have got better exposure and chance to carry out biology practical activities than the other two natural science subjects. Regarding private schools more students i.e. 47 (57%) of the private & church school students have got better practical activities in chemistry than biology and physics. Number of students who are responded as they gained some skills from practical works of biology are 19 (23%) and 17 (20%) of the students reported as they have got good practical activities from physics. Public school students responded that more practical activities are carried in chemistry than in biology and physics subjects. Based on the data 9(32%) of the students have gained good skills from biology, 17(61%) of the students have got better skills from chemistry and the rest 2(7%) of the students reported as they had good practical exposure from physics.

From the total sample of students 90(41%) responded that they have got sufficient skill from biology practical works, demonstrations and experiments; 88(40%) of the students have gained good practical experiences and skills from chemistry and 42 (19%) the students from physics. From the above data it is possible to say that more or less students have got equal chances of some practical skills from biology and chemistry, but less participation from physics practical activities. As students remarked and suggestion of teachers and department heads, some of the reasons for few practical activities in physics are lack of equipments, students' low interest to the subject and low commitment and encouragement of teachers towards the practical activities.

However, the chi square result indicates the presence of a gap and significant difference among the four science subject teachers towards implementing practical activities and participating students in laboratory session,  $\chi^2$  (4, 33.87). The statistical analysis also indicates that the extent to which experiments and demonstrations taking place in the four types of schools are quite different in their number, frequency, ways of doing the activities and duration for carrying out specific activities and the psychology/concern of teachers.

From the above table 4, item 7, the data analyzed as 126 (69%) from government, 65 (66%) from private and church, 27 (69%) from public school correctly define the term "laboratory" and "practical work." This means those students have good understanding, concepts and awareness about practical activities in science subjects. On the other hand 56 (31%) from government, 34 (34%) from private and church, 12 (31%) from public school responded that they have no idea to define the above terminologies. However, from the total samples, 218 (68%) of the students define those key

terms “laboratory” and “practical work” almost nearer to the correct definition. So, students in the four types of schools they have great awareness and idea about the meaning and importance of practical activities and experiments in science. They need encouragement, motivation and guidance from teachers to carry out practical activities with the available materials and reagents in the laboratory. Hence, the chi square indicates no significant difference in the knowledge of students in the four types of schools in defining and understanding the meaning of the terms such as “laboratory and practical work”,  $\chi^2 (2, 0.402)$ . As the statistics shows more or less preparatory students are under the same level about the theoretical background of the definition and function of laboratory and practical work in science.

The data from table 4, item 8 shows that 141 (82%) government, 80 (91%) of private and church, 28 (72%) of public school students were reason out why they join natural science stream. The others 31 (18%) from government, 8 (9%) from private and church, 11 (28%) public school students did not write a reason why they join natural science stream. Some of the students explained that they joined natural science because of family influence without their interest or by seeing when their classmates joined the field. In general from the total samples who responded 249 (83%) of the students described the reasons for joining natural science fields. Some of their reasons are to be a medical doctor, an engineer and because of job opportunity after completing higher education and government policy that gives more concern and emphasis to science graduates, etc. However, 50 (17%) of the students in the four types of schools have joined natural science stream with no tangible reasons, because of the influence of others. The calculated chi square indicates that there are some significant differences with reasons that government, private, Church and public school students join streams of natural science,  $\chi^2 (2, 7.58)$ .

Concerning the methodology of conducting practical activities, the data from table 4, item 9 shows that student center approach in government schools accounts 12%, in private and church school it is 11% and in public school it is about 21%. Teacher center approaches takes relatively the greater share and in government school it accounts 31%, in private and church schools it is about 36% and in public school it is about 41%. Both teacher and student center approach accounts 21% in government school, 30% in private and church school and 38% in public school. 62 students (36%) in government, 24 (23%) from private school students responded that there is neither student nor

teacher center approach. The students reported that generally no practical activities in some government and private schools at all. So in such schools the methodology of implementing practical activities would not be an issue of discussion. The aim of this study is to revive the spirit of practical activities and to bring such traditions in the right track by creating awareness and giving feedback to those schools which are late behind.

Hence, the chi square indicates that there is a significant difference in the methodology and ways of performing and implementation of practical activities in the four types of schools,  $\chi^2$  (6, 33.35). Based on the opinion of students in some schools, laboratory activities are more of student centered, in other schools may be dominated by the teachers and in others may be both teacher and student centered depending the condition and availability of materials and reagents but, in some schools practical activities may be done neither by students nor teachers and such traditions are absent.

Data from table 4, item 10 describes that 57 (32%) from government, 53 (51%) from private and church and 21 (55%) from public school students confirmed that laboratory facilities and equipments are sufficient to conduct practical activities in science subjects such as biology, chemistry and physics. On the other hand 122 (68%) of students from government school, 50 (49%) from private and 17 (45%) from public school revealed that no adequate facilities and laboratory equipments to carry out practical activities. From the total samples 131 (41%) of the students responded that schools have adequate laboratory material and facilities to implement practical activities whereas, 189 (59%) of the students confirmed that schools didn't have adequate laboratory tools and no sufficient facilities for conducting science practical activities.

So, based on the interview of students, lab technicians and science teachers it is clear that lack of adequate materials and facilities would be taken as one of the major constraints of practical activities in the four types of preparatory schools.

The calculated chi square value confirms that there is a significant difference inadequacy of laboratory facilities, equipments, and reagents among the government, private, church and public schools to carry out sufficient and frequent practical works,  $\chi^2$  (2, 13.25).

It is obvious that teaching science should be supported by practical activities. The data from table 4, item 11 shows that 130 (73%) of government, 88 (85%) private and church, 25 (64%) of public school students strongly agreed that learning science should be supported by frequent and regular

practical works such as demonstration, experiments and field trips as well to internalize the science subjects and to develop permanent skill in the students. About 37(21%) of government, 15 (15%) of private and 13 (33%) of public school students agreed as science learning should be supported by laboratory activities. To the contrary, 11 (6%) of government and 1 (3%) of public school students disagreed the view of supporting science learning with practical works. I think this is due to lack of awareness or losing hopes for practical activities as a result of a total non-functioning of laboratory activities in those schools.

From the total samples 243 (76%) of the students strongly agreed and 65 (20%) of the students responded to agree and only 12 (4%) of the students disagree on the idea of supporting learning science with practices. Hence, 308 (96%) of the respondents strongly believed that science learning must be supported with continuous and update practical activities to create competent and scientific literate students with high credibility.

The above explanation is also supported by statistical analysis, since chi square result shows the presence of a significant importance on students understanding and academic achievement,  $\chi^2$  (4, 13.90). The data also shows the presence of wide differences among government, private, church and public schools in the practicality of experiments and demonstrations as a tool to facilitate and apply for better and interesting science teaching and learning process.

**Table 5: - Analysis of Students' Response on Teachers commitment, skill, experience, contribution of science practical works and status of science lab clubs.**

Item No.	Description of Item		Government		Private		Public		$\chi^2$ (df)
			No.	%	No.	%	No.	%	
12.	In what extent, do science teachers give attention and emphasis to practical activities and encourage students to actively participate in practical activities?	GC & Com.	37	20	23	22	4	10	<u>14.17**</u>  (4)
		FC & Com.	83	47	58	56	30	77	
		No C & Com	58	33	22	21	5	13	
13.	What is your response on the skill, experience and professional responsibility of science teachers for conducting practical works?	S.Agree	14	8	21	20	3	8	<u>42.99**</u>  (4)
		Agree	87	49	72	70	29	74	
		D.Agree	77	43	10	10	7	18	
14.	What is your suggestion on the idea that practical works should carry certain amount of percentage from the total mark?	S.Agree	64	36	46	45	12	31	<u>9.43**</u>  (4)
		Agree	90	51	53	51	20	51	
		S.D.Agr	24	13	4	4	7	18	
15.	What do you say on the idea that laboratory activity has a greater contribution on students' achievement in science scores?	S.Agree	132	74	74	72	22	56	<u>7.39**</u>  (4)
		Agree	39	22	28	27	15	39	
		S.D.Agree	7	4	1	2	2	5	
16.	Is there a well trained lab technician/assistant in your school?	Yes	20	11	24	23	12	31	<u>13.44*</u>  (4)
		No	85	48	48	47	17	44	
		I don't know	73	41	31	30	10	25	
17.	What factors do you think that would hinder the performance of practical works at your school?	Lack of lab tools	121	30	54	25	26	30	<u>11.89**</u>  (10)
		Lack of reagents	83	20	44	21	10	11	
		Lack of commit	86	21	48	23	18	21	
		LCS	57	14	34	16	14	16	
		TWL	50	12	21	10	17	20	
		Others	12	3	11	5	2	2	
18.	To what extent, do you agree that the experiment demonstrated by the plasma TV replaces the real experiment taking place in the classroom or in the laboratory?	Agree	57	31	21	20	5	13	<u>16.25*</u>  (6)
		D.Agree	82	45	54	52	21	54	
		S.D.Agr	38	21	18	18	12	31	
		I don't know	5	3	10	10	1	2	
19.	Are there biology, chemistry and physics laboratory clubs in your school?	Yes	56	31.5	51	50	17	44	<u>10.99*</u>  (4)
		No	66	37	33	32	14	36	
		I don't know	56	31.5	19	18	8	20	
20.	If there is no, how do you express your opinion with the formation and functioning of science clubs in your school?	S.Agree	64	52	34	65	10	47	<u>9.13*</u>  (4)
		Agree	33	27	16	31	6	29	
		D.Agree	27	22	2	4	5	24	

Note: \*P<0.05

\*\*P<0.01

GC=Great concern, FC=Few Concern, com=commitment, LCS=Large Class Size, TWL=Teachers Work Load

Concerning the commitment and readiness of teachers to practical activities and encourage students to actively participate in laboratory works the data in table 5, item 12 analyzed as 37 (20%) government, 23 (22%) private and church, 4 (10%) public school students revealed that teachers have great concern and commitment to encourage and participate students in laboratory activities. However, 83 (47%) of government, 58 (56%) of private and church, 30 (77%) of public students responded that teachers have few concern and commitment to practical activities. Therefore, few practical activities are carried out and these are not satisfactory for students to get better exposure and skill from science subjects. As the data shows in the above table, 58(33%) of government, 22 (21%), of private and 5 (13%) of public school students confirmed that teachers have no any concern and commitment to practical activities at all.

From the total samples of students majority of them 171 (53%) reported that teachers have few concern and commitment to practical activities, on the other hand, 85 (27%) of the students revealed that teachers have no any concern and commitment to laboratory activities in science subjects they teach.

Therefore, there are disparities among teachers' opinion, concern, commitment and professional responsibility towards laboratory works and this will be taken as one of the constraints of science practical work in preparatory schools.

The statistical analysis i.e. the chi square result indicates that there are significant disparities among teachers feelings, interests, attitudes, commitments and professional responsibilities towards laboratory implementation and encouragement of students to carry out practical works,  $\chi^2$  (4, 14.17). Furthermore, the data from the interview of participants indicates that concern and commitment of teachers, students, school principals and educational officers widely differ and such conditions are responsible for low level/status of practical activities in preparatory schools in particular and in all educational levels in general.

The data from table 5, item 13 evaluates the skill, experience and professional capacity of teachers to carry out practical activities. Based on the data, most students 101 (57%) from government, 93 (90%) from private and church, 32 (82%) from public school students believed that teachers have skill and experience to conduct and participate students in science laboratory activities. Whereas 77 (45%) of government, 10 (10%) of private and 7 (18%) of public school students believed that teachers don't have sufficient skill and experience for conducting the various experiments and

activities listed in the text books of science subjects. From the total samples of students 226 (71%) of the students argued that teachers have good knowledge, skill and experience to practical activities but other factors such as lack of equipments, reagents, work load, large class size, etc restrict them to apply their maximum effort for teaching science supporting with frequent practical activities. The rest 94(29%) of the students disagreed with teachers skill, experience and capacity to fully implement and participate them in practical activities.

As the statistics has shown teachers skills, experience and professional responsibilities for carrying out practical activities significantly differ from one school type to another and among teachers of the different fields of natural science or teachers of the same field in different schools,  $\chi^2$  (4, 42.997).

Regarding giving value/credit for practical activities of science subjects, based on the data in table 5, item 14, most students 154 (87%) of the government, 99 (97%) of private and church, 32 (82%) of the public school students assured that practical activities should be regular in each semester of the academic year & it should carry certain marks from 10% – 20% of the total marks per semester. Those students who disagreed with carrying of certain marks were 24 (13%) from government, 4 (4%) from private and 7 (18%) from public schools. These students responded that practical activities should not carry certain marks out of the total scores. Some of their reasons are no practical activities in our school at all, no facilities and equipments in the laboratory, no chance to participate in practical activities and under such circumstances how we say that a practical activity should carry certain amount of mark for it. As one student said in such scenario, to say a practical activity should carry certain marks means “harvesting a crop without sowing seeds.”

From the total samples 285 (89%) of the students agreed with allotment/valuing of practical activities with certain marks out of the total scores in each semester. The remaining 35 (11%) of the total students disagreed the valuing/crediting of practical activities with certain amount of marks out of the total marks.

As the analysis of statistics has shown there is no a significance difference among the government, private and public school students regarding the idea that practical activities should carry certain marks out of the total science scores,  $\chi^2$  (4, 9.43). The interpretation of the data is that most preparatory students have agreed on the point in which practical activities should carry certain

credits and this increases the opportunities of students to involve in science practical works frequently at a regular schedule in each semester of the academic year.

Regarding the contribution of practical activities the data in the above table 5, item 15 analyzed as follow. Those students who responded agree or strongly agree are 171 (96%) from government schools, 102 (99%) from private and church school, 37 (95%) from public school. It is obvious that if there is a continuous and frequent practical activity in science fields such as biology, chemistry and physics, not only it contributes to improve students achievement in science scores, but also brings quality of education and great advancement in the skill of each student. About 7 (4%) from government, 1 (1%) from private and 2 (5%) from public schools students disagreed and they responded that practical activities have no contribution in students' achievement in science scores. However, when we examine the total sample from the four types of schools 310 (97%) of the students have agreed that practical activities have greater contribution to improve students achievement in science scores as well as their skills. About 10 (3%) of the students responded that doing practical work has no greater contribution to improve students' achievement in science scores.

Concerning the contribution of laboratory activities on improving the achievement of students score in science, the computed statistical analysis shows no significant difference in the beliefs of students,  $\chi^2$  (4, 7.39). Students strongly believed that the presence of continuous and sufficient laboratory activities, it contributes a lot for increasing students' achievement in science scores as well as progressing scientific skills and experience of students.

For continuous and strong implementation of practical activities, one of the inputs is assigning well trained laboratory technician for each field of science. According to the data organized in table 5, Item 16, 20(11%) of government, 24(23%) of private and 12(31%) of the public school students responded the presence of a laboratory technician or assistant in their schools. About 85 (48%) of government, 48 (47%) of private and church, 17 (44%) of public school students confirmed the absence of lab technician/assistant in their schools. moreover, 73 (41%) of the government, 31 (30%) of the private and 10 (25%) of the public school students reported as they don't know the presence or absence of laboratory technician/assistant in their schools. Therefore, the absence of lab technician or well trained assistant becomes one of the constraints of practical works in

preparatory schools. That why the quality of science education found at a lower standard and science graduates lack some basic practical skills and experience and face difficulty to actually change the progress of their students towards science practices after their graduation immediately when they come to work.

However, the computed chi square value  $\chi^2$  (4, 13.44) shows that there is a significant difference in the implementation and functioning of practical activities in the four types of schools that are government, private, church and public schools in Addis Ababa as well as in other regions of the country due to the presence or absence of well trained lab technician/assistant. Therefore, the assigning of a trained laboratory technician/assistant at schools is a great concern and emphasis for successful performance of science practical works and it actual builds the capacity and skill of students for producing more competent and highly qualified science graduates.

The current practical activities in preparatory schools face a lot of problems/constraints and its position is at lower standard. According to laboratory observation in most schools science practical activities have not given emphasis and students did not participate in laboratory sessions to relate the theory they learn in the class by conducting simple experiments. Based on this information the above data in table 5, item 17 stated as follow. Different possible factors were listed in the student questionnaire to identify whether they are major constraints of practical activities or not. Government, private and public school students responded to these factors in relation to practical activities. About 121 (30%) of government, 54 (25%) of private and 26 (30%) of public school students admitted as lack of lab tools are one of the major constraints of practical works in science. Inadequate laboratory tools hinder the practicality of laboratory session in preparatory schools in Addis Ababa and other regions of the country.

Regarding lack of reagents 83 (20%) of the government, 44(21%) of the private and 10 (11%) of the public school students pointed out as one important constraint of practical activities in their schools. Those students who have taken lack of commitment and awareness of teachers, students and schools principals as one of the constraints of practical activities in preparatory schools figure out as 86(21%) from government, 48(23%) from private and 18(21%) from public schools. large class size is considered as one of the constraints of practical activities and suggested by 57(14%) of government, 34 (16%) of private and church, 14 (16%) of public school students. These students

suggested that some government, church and private schools have range of 60 – 70 students per class. This is too large not only for practical activities but also difficult to teach the science course in the normal class. So this matters a lot to lag/discourage the teachers for conducting science practical activities. About 50 (12%) of government, 21 (10%) of private and church, 17 (20%) of public school students considered teachers' work load as one of the constraints of laboratory activities in their schools. In addition students suggested that other factors such as poor management of school principals, turnover of teachers, delay of purchasing lab tools and reagents, changing previously laboratory rooms into normal classes, etc as main constraints for low level of practical activities in government, private, church and public preparatory schools. Number of students who figured out these factors are 12 (3%) from government, 11(5%) from private and/or church, 2 (2%) from public schools.

In general, the above factors pointed out as major constraints of practical works and from the total samples, students' suggestion for each factor are stated as follow.

Number of students who suggested lack of tools as a constraint of practical work are 201 (28%), lack of reagent 137 (19%), lack of commitment and awareness 152 (22%), large class size 105 (15%), teachers' work load 88 (12%) and other 25 (4%).

Therefore, education officials, school principals and teachers should identify the major problems and try to forward immediate solutions to the problems for realizing regular and frequent implementation of practical activities. Regarding the major factors which hinder the successful implementation of practical activities in science is stated using the statistical result of chi square as follow.

The computed chi square value,  $\chi^2$  (10, 11.89) shows no significant difference in the responses of participant students to the question of major constraints of practical activities in preparatory schools. The interpretation illustrated that the above mentioned and other factors are more or less major constraints of the current practical activities in which all types of schools share in common. Because of such constraints the status of science practical work is at a low level and insufficient in its performance.

It is understood that, in government schools science teaching is mediated using plasma TV and some demonstrations have been given by the plasma. But this tradition is not implemented in private,

church and public schools. Based on this point students gave their opinion and their responses and the data in table 5, item 18 analyzed as follow. About 57 (31%) of government, 21(20%) of private and church, 5(13%) of public school students agreed and they said that it is better than nothing, really it doesn't substitute the actual experiment and demonstration carried out by students themselves and teachers in the laboratory and in the classroom. But under such scenario and disparities science demonstration transmitted through the plasma TV is good for schools that are unable to conduct practical activities because of various reasons. On the other hand students who opposed and criticized the demonstration transmitted by the plasma TV as it does not substitute and has no any relevance in developing practical skills of students are figured out as 120 (66%) from government, 72 (70%) from private and Church, 33 (85%) from public schools. These students disagreed or strongly disagreed about the demonstration presented by the plasma TV. About 5 (3%) of government, 10 (10%) of private and church, 1(2%) of the public school students responded as they didn't clearly know the negative or positive sides of demonstration by the plasma TV.

When the data is generalized, 83(26%) of the total students agreed that plasma TV can somehow replace the actual experiment and demonstration carried out in the laboratory or classroom, but around 225 (69%) of the students responded that experiments and demonstrations presented by the plasma TV does not replace the actual practical activities that take place in the laboratory and classroom or in the field. Therefore in addition to watching the demonstration and experiments transmitted in the plasma TV, teachers should be prepared and planned practical activities and encourage students to involve in practical activities in the laboratory. This makes learning science more interesting, reliable and conceptual.

The computed chi square value,  $\chi^2$  (6, 16.25) indicates that there is a significant difference in the belief that demonstration and experiments mediated by the plasma TV substitute the practical activities actually performed by the students and teachers in the laboratory. Therefore from this analysis someone understands that practical works in those government schools which use plasma TV as a medium of instruction have different trends and experience to practical activities comparing to private, church and public schools which do not use plasma TV.

In government schools usually, the plasma TV is the laboratory for students and the students passively listens when the TV instructor demonstrates some of the experiments of science subjects. But this does not mean that no totally actual experiment in the lab of government schools other than the plasma TV. Based on the information collected from the interview of students, teachers, lab technicians, department heads and school principals there are some dedicated and professionally responsible teachers to participate students in the actual lab session.

Whereas in private, church and public schools, since there is no plasma TV, by default students participate in laboratory session actively by doing, touching, and sensing all activities happening in the lab or classroom with their teachers.

Nowadays biology, chemistry and physics laboratory clubs are established in primary, secondary and preparatory schools and students can get ample time to conduct practical activities after the regular class with the supervision and guidance of the teacher who is a club coordinator. These students are beneficiary if the club is functional and the students involve in practical activities according to the schedule of the club. These students can demonstrate the experiments they did for other students during the normal class.

Based on this point, the data in table 5, item 19 interpreted as 56 (31.5%) of government school students, 51 (50%) of private and Church school students and 17 (44%) of public school students responded that science laboratory clubs are existing in their schools and some of the clubs are functional and members are participated and benefited from experiments and demonstrations they carry out. But, most clubs of science are non-functional and they are not working far from their establishment. Members complained that I was the member of either biology, chemistry or physics laboratory club, but no one lab activity is carried out throughout the academic year. So it is meaningless to be registered as member of science laboratory club unless otherwise the club actively functions and makes students to involve in it.

About 66 (37%) of government, 33 (32%) of the private, 14(36%) of public students gave witness that no biology, chemistry and physics laboratory clubs in their schools. Number of students who have no information about the presence or absence of science laboratory clubs were 56 (31.5%) of government, 19(18%) of private and 8 (20%) of public school students. However, when we examine

the total samples, relatively more students 124 (39%) have recognition and awareness about laboratory clubs, even though the clubs are not that much active and functional.

About 113 (35%) of the total students responded that no science laboratory clubs in their schools, whereas 83 (26%) of the total students do not know the presence of science laboratory clubs in their schools.

The statistical analysis, i.e. the calculated chi square result,  $\chi^2$  (4, 10.99) shows that the awareness of students to the presence of science laboratory clubs and their participation as members are significantly different in government, private, Church and public schools.

The responses of students in those schools with no established science laboratory clubs analyzed using the data in table 5, item 20 as below. Almost 97 (79%) of government, 50 (96%) of private and Church, 16 (76%) of public school students agreed and interested with the establishment of science laboratory clubs in their schools. Roughly, 27 (22%) of government, 2 (4%) of private and 5 (24%) of public school students disagreed with the formation of science clubs in their schools. when the data from the above table is generalized, from the total number of students who responded for this questionnaire, 163 (83%) of the students have interest and to participate in science laboratory clubs. So, establishment of Biology, chemistry and physics laboratory clubs is unquestionable and paramount advantageous to students to get additional skill from science practical works which would be carried out in the extra time after the end of regular class or during break time or lunch time as appropriate as for teachers and students.

The statistical analysis, i.e. the calculated chi square result,  $\chi^2$  (4, 9.31) indicates that there is no significant difference in the assumption of students on the formation and functioning of science laboratory clubs in biology, chemistry and physics in government, private, church and public schools. From the written question, students responded that laboratory clubs were formed, but they did not carry out activities after registering member students during their spare time. So, laboratory club activities are poor and carry out insufficiently.

### 4.3 Teachers' response on current status of practical works in Preparatory Schools

Table 6: - Analysis of Teachers Response on Function, Facilities, Organization, Annual plan and contribution of practical works.

Item No.	Description of Items		Government		Private		Public		$\chi^2$ (df)
			No.	%	No.	%	No.	%	
1.	Is there a functional laboratory with basic tools and facilities in your school?	Yes	26	65	23	77	5	83	<u>1.61*</u> (2)
		No	14	35	7	23	1	17	
2.	Is there a separate laboratory room for Biology, Chemistry and Physics practical works in your school?	Yes	39	98	13	43	4	67	<u>26.11**</u> (2)
		No	1	2	17	57	2	33	
3.	Do you include practical activities in the annual lesson plan of your science teaching?	Yes	16	40	10	33	5	83	<u>11.42*</u> (4)
		No	18	45	8	27	1	17	
		S.P	6	15	12	40	0	----	
4.	What is the current status of science laboratory organization and activities in your school?	Com	----	-----	4	13	3	50	<u>22.63**</u> (6)
		Av.	11	28	10	33	2	33	
		NS	17	43	14	47	1	17	
		Non	12	30	2	7	0	0	
5.	What do you say on the point that good science teaching should be based on practical works?	S.A	34	85	29	97	5	83	<u>2.74**</u> (2)
		Agree	6	15	1	3	1	17	
		D.Ag	----	-----	----	----	----	---	
6.	To what extent, do you agree that implementing practical activities frequently would bring significant change on the achievement of students' science results?	S.A	27	67	22	73	5	83	<u>2.10*</u> (4)
		Agree	12	30	6	20	1	17	
		S. D.A	1	3	2	7	----	---	
7.	How is lab session carried out in preparatory schools?	S.C	9	22	10	33	1	17	<u>6.83*</u> (6)
		T.C	11	28	8	27	2	33	
		S.C & T.C	14	35	12	40	3	50	
		No.P	6	15	----	----	-----	----	
8.	How do you evaluate the contribution of your school science practical activities on facilitating teaching learning process?	Suf.	10	25	13	43	3	50	<u>6.09**</u> (6)
		InSuf.	11	28	10	33	2	33	
		Poor	13	32	5	17	1	17	
		T.Nil	6	15	2	7	----	----	

Note: - \* $P < 0.05$  \*\* $P < 0.01$ , S.P = Separate Plan, Com=Commitment, Av=average, NS=Not Satisfactory, S.A=Strongly Agree, D.Ag=Dis-Agree, S.C=Student center, TC=Teacher Center, P=Practice, T=Totally, Suf=sufficient

Table 6, item 1 shows the presence or absence of functional science laboratory in Government, Private and Public schools in Addis Ababa. According to the data given above 26 (65%) of government, 23 (77%) private and church, 5 (83%) public school teachers confirmed that school laboratories are well organized and functional since, there are adequate lab tools and basic facilities. Whereas 14 (35%) of government, 7 (23%) of private and 1 (17%) private school teachers confirmed that their school laboratories are not functional because of inadequate lab tools and other basic facilities. From the total samples of teachers 54 (71%) of them responded that their school laboratories are functional and contain basic lab equipments and facilities. Around 22 (29%) of the teachers revealed that school laboratories have lack of basic laboratory instruments and no basic facilities and they did not give proper functions to carry out experiments and demonstrations in biology, chemistry and physics practical activities.

Government, private and church school owners and officials of public schools should give concern to fulfill the required lab tools and basic facilities to enable science teachers and preparatory students to conduct practical activities and to make science learning and teaching process more meaningful and tangible. The responses given by students and teachers regarding the presence of organized and functional laboratories in preparatory schools match together and this shows the validity and reliability of the research as well as data collecting instrument. The statistical analysis of chi square indicates that the responses of teachers to the functionality of school laboratories have no significance difference among the three types of schools,  $\chi^2$  (2, 1.61). This means laboratory organization and basic facilities in government, private and public schools share more or less similar constraints and found in the same level.

Table 6, item 2 indicates whether or not there is a separate laboratory room for biology, chemistry and physics practical works in the selected sample schools. Regarding laboratory classes for science practical activities the data in the table above stated as follow. About 39 (98%) of government, 13 (43%) of private and 4 (67%) of public school teachers responded as there are separate rooms for biology, chemistry and physics practical activities. On the other hand 1(2%) of government, 17 (57%) of private and church, 2 (33%) of private school teachers confirmed that their schools have no separate lab classes for Biology, Chemistry and Physics. There is one combined class for implementing practical activities for biology, chemistry and physics. So, in these schools there is sharing of one laboratory room to conduct experiments and demonstrations during science laboratory

sessions. In such kind of scenario implementation of practical work requires systematic plan and schedule for each department in order to remove clashes and overcrowding when teachers need to do activities of their respective subjects.

The overall sampled teachers show that 56 (74%) of the teachers assured that schools have separate rooms for laboratory activities, whereas, 20 (26%) of the teachers responded as schools use one common class for conducting biology, chemistry and physics practical activities. These schools face some problems since there is no separate room for each science subject/department and they are not free to use and conduct experiments at any available time. So, it is advisable to have a separate room for each science subjects in the near future. The total data of students and teachers match and correlate regarding the presence of a separate lab room for science practical works.

Regarding the presence of separate lab room for each field of science the statistical analysis,  $\chi^2$  (2, 26.11) shows that there is a significant difference in the setting of separate lab room for each field of science. Especially the difference has been seen between private and government schools in possessing separate classes for practical works of science in preparatory schools. Almost all government schools have a separate lab room for biology, chemistry and physics practical works, while in private schools the situation is the reverse.

There are some private and church schools possessing one combined room to carry out laboratory activities of the three subjects of natural science. In public school the setting is good and still some schools share one classroom for performing practical activities of the three subjects with overcrowded situation.

Table 6, item 3 shows about the scheduling of practical activities in the annual lesson plan of science courses. Based on the data given in the table above, 16(40%) of government, 10 (33%) of private and church, 5 (83%) of public school teachers revealed that they identify and briefly list out laboratory activities and experiments so they include in the annual plan of the respective science subject. Depending on this description and schedule they try to conduct laboratory activities in each semester of the academic year. About 18 (45%) of government, 8 (27%) of private and 1 (17%) of the public school teachers responded as they did not include in the annual plan of the lesson and no separate plan for science practical activities.

As interviewees confirmed, in such schools no follow up and monitoring system by school principals, department heads and other concerned bodies about science practical works. Teachers carry out lab session as they want and/or question comes from students or parents. So, this should be corrected and teachers must include lab activities and selected experiments either in the annual plan of science lessons or it is better to prepare a separate program for practical activities that a teacher performs in the academic year.

In government and private schools few teachers i.e. 6 (15%) and 12 (40%) respectively addressed that they have been prepared a separate plan for practical activities. From the total samples of teachers 31 (41%) of them reported as they prepare schedule for practical works in combination with the annual plan of the science lesson. While 17(27%) of the teachers responded that they did not prepare schedule for laboratory activities. About 18 (24%) of the teachers noticed that they prepared a separate schedule for practical activities in which they have been supposed to perform in the academic year.

Statistical analysis of annual plan of practical activities  $\chi^2(4, 11.42)$ , proves that there is a significant difference in the preparation of a schedule or program of practical activities in the four types of schools. In some schools teachers identify experiments and activities from the text book and include in the annual plan of the lesson, others they do not prepare plans/schedules at all and other teachers prepared separate plans consist of lists of experiments and activities to be done in each semester of the academic year. This is significantly a remarking factor in the awareness and responsibility of teachers to perform lab activities and encouraging students actively involved in practical works.

Table 6.item 4 indicates the presence or absence of suitable conditions and adequate materials to carry out practical activities. Concerning the current status of science laboratory and practical work in preparatory schools and its organization briefly stated as follow based on the data in table 6, item 4. The data reveals that laboratories in Government schools are not complete and fewer activities are carried out, since most of the time is taking away by the plasma TV transmission. Whereas 4 (13%) of the respondents in private, church and 3 (50%) of public school teachers assured that school laboratories are complete in its organization and activities are carried out in a better way. About 11 (28%) of government, 10 (33%) of private and 2 (33%) of public school teachers responded that the current status of science laboratory organization and practical activities are ranked at average level. This means their organization and activities are above 50%. Government teachers 17 (43%), private

school teachers 14 (47%) and public school teachers 1 (17%) reported that current school laboratories are not satisfactory in its organization and implementation of practical works.

Around 12 (30%) of government, 2 (7%) private school teachers confirmed that their school laboratory organization and its current capacity to carry out practices are almost none. Most laboratory facilities and equipments are absent because of under construction or due to newly opened schools and they are assumed to change the school in other areas. So, during my observation of the laboratory and interview with school principals, especially two schools one a government school and another a private school their laboratory organization and activities are almost none.

Elshadayi Holy Savior is one of the private schools with few lab tools and almost activities are null. This is because the school is under construction and laboratories are not organized well when this study was going on. From my interview school principals of this school promised that science laboratories will be re-organized with the basic facilities and lab equipments as well as reagents after the buildings are completed in the near future. The second one is a government school named as Limat Minch preparatory school in Lideta sub- city, in which practical activities are almost none and the current organization of the laboratory is not satisfactory. The school is founded in 2002 E.C. as explained by the school principal, this current year they only taught grade 12 students and starting next year 2005 E.C the school assumed to stop accepting preparatory students and it is planned to shift into secondary high school and only register grade 9 and grad 10 students.

Teachers in this school were young staffs and have no long experience in teaching and performing practical activities. Because of this dilemma and having fresh graduate staffs' practical activities in this school became almost none. So, this school expects to fulfill basic facilities and laboratory equipments in the near future when it starts teaching grade 9 and grade 10 students. Practical activities are essential for secondary school students as equal as preparatory students. This is the base and foundation of students to join either the natural science stream or social science stream. Basically, if there is a good exposure of practical activities at grade 9 and 10, students would have better skill and interest to join the natural science stream and this is necessary to fulfill the policy of the government i.e. 70% of students' natural science and 30% of students' social science.

As students seriously reported, Government schools like Dejzmach Wondiriad preparatory schools have little or no practical activities and students strongly stressed that this study should address the

school principals and teachers to participate us in preparatory activities. Many of the respondents recommended that school practical work in their school is passive and no idea and concern about practical activities, so they expect from this study to get feedback and to bring a change in the practical activities of the school. The statistical result of chi square shows that there is a significant difference about the current status of science laboratory organization and implementation of practical activities in government, private and public schools,  $\chi^2$  (6, 22.63).

Table 6, item 5 describes the relationship between science teaching and practical activities. The data in the table shows that 34 (85%) of government, 29 (97%) of private and church, 5 (83%) of public school science teachers strongly agreed that science teaching should be supported by practical activities for better understanding of students and to progress their academic results and to gain sufficient skills. In addition 6 (15%) of government, 1 (3%) of private and 1 (17%) of public school teachers responded as they agree that theoretical knowledge of science should support with experiments and demonstration that would be conducted in the laboratory by direct involvement of students through the guidance and facilitation of teachers. As the data shows no one is disagreed the idea that science learning should support and supplement by practical activities.

So, it is clearly indicated that 100% of the teachers in the four types of schools have been agreed and they reach in one consensus that learning and teaching science in secondary as well as preparatory schools must be supported by real and frequent practical activities for fruitful and improvement of students' scientific skills and science results. In addition, the calculated chi square value  $\chi^2$  (2, 2.74) justifies that there is no significant difference in the responses of teachers to the question that "does a good science teaching support with practical activities conducted in the laboratory?" Almost all teachers from government, private and public schools believed in common that science teaching becomes more successful and tangible when it is supported by consistent practical activities carried both by the teacher and active participation of students.

The data in table 6, item 6 above illustrates that about 39 (97%) of government, 28 (93%) of private and church, 6 (100%) of public school teachers agreed with great confidentiality that implementing practical works regularly could bring a significant and real change in the achievement of students' science results. Teaching science would be more successful when it is aided by frequent laboratory activities. About 1 (3%) of government, 2 (7%) of private teachers disagreed that practical activities would not bring a significant change or progress in the academic results of students in science

subjects. From the total samples 73 (96%) of the teachers confidently believed with practical activities as it brings a significant change in the academic progress of students in preparatory schools. But, only 3 (4%) of the teachers opposed the idea that doing practical activities may not bring a significant change in the achievement of students' science scores. According to the statistical result the calculated value,  $\chi^2$  (4, 2.10) indicates no significant difference in the belief that frequent implementation of practical activities and more participation of students in laboratory activities can bring paramount progress in the academic achievement of students science results.

The data in table 6, item 7 above was analyzed as 9 (22%) of government, 10 (33%) of private and 1(17%) of public school teachers responded that practical activities have been conducted by directly participating students in the laboratory to find the results of an experiment and to demonstrate the activities for other students. Participants who responded laboratory activities as it is teacher center are figured out as 11 (28%) are government teachers, 8 (27%) private teachers and 2 (33%) of the teachers were from public schools. about 14 (35%) of government, 12 (40%) of private and church, 3 (50%) of public school teachers reported that practical activities have mixed approach, i.e. if it is suitable students get the opportunity to carry out experiments with little support and guidance from the teacher or lab technician/assistant and make to present or demonstrate to their classmates.

Because of time constraints and shortage of lab equipments or reagents the teacher forced to do the experiment himself/herself and to demonstrate the findings or results of the experiment his/her students. So, this time the approach of laboratory activity became both student and teacher centered approach. Number of teachers who confirmed this method are 14 (35%) from government, 12 (40%) from private and church, 3 (50%) from public schools. on the other hand, 6 (15%) of government school teachers responded that since there is no any practical activities due to occupying with plasma TV transmission, there is neither teacher nor student center approach. Generally, about 20 (26%) of the total sample teachers confirmed that practical activities are student centered, 21 (28%) of the teachers gave witness as practical works are more of teacher centered, 29 (38%) of the teachers revealed that lab activities are carried both by students and/or teachers depending on the appropriateness of the atmosphere and availability of facilities and lab tools in the school. From the total sample teachers 6 (8%) of them addressed that because of absence of preparatory activities, this type of approach is unknown and totally nil.

The calculated chi square value,  $\chi^2$  (6, 6.83) signifies that there is no significant difference in the ways and procedures of implementing practical activities in government, private, church and public preparatory schools. More or less the method of implementing practical activities in government, private, church and public preparatory schools is the same. According to the interview of lab technicians and department heads, mostly science practical activities carried out by the teacher and therefore, it is mainly teacher-centered approach. Sometimes, science practical works may be either student centered or both student and teacher centered approach.

As it can be seen in table 6, item 8 above 10 (25%) government, 13 (43%) private and Church, 3 (50%) public school teachers responded that the implementation of laboratory activities conducted in biology, chemistry and physics are sufficient to facilitate science teaching-learning process. Whereas, 11 (28%) government, 10 (33%) private and 2 (33%) public teachers revealed that practical activities carried out in science fields are insufficient to supplement and facilitate the teaching learning process in science. About 13 (32%) of the government, 5 (17%) of the private and 1 (17%) of the public school teachers notified that practical activities carrying out in schools are poor and insignificant to facilitate science learning in preparatory schools. 6 (15%) teachers from government and 2 (7%) teachers from private schools informed that practical activities are general nil and science learning is not supported by practical activities and such schools have serious limitation in conducting practical activities and students did not get skills and experience from practical works. From the total samples of teachers 26 (34%) of them believed that practical activities in preparatory schools are carried out properly and it is sufficient to facilitate the process of science learning.

Out of the total sample teachers about 23 (30%) of them confirmed that current practical activities implementing in preparatory schools are insufficient to excel science teaching –learning process in the four types of schools. Around 27 (36%) teachers out of the total reported that present day science practical activities in some government, private and public schools are poor and in others are totally nil and have no significant contribution for improving and supporting the teaching learning process. In such schools the responsible bodies should give support in terms of workshops, seminars and creating awareness about practical activities and inspiring them is necessary for implementing practical activities and they should encourage students to involve in practical works.



The data in table 7, item 9 below interpreted and analyzed as follow. Regarding crediting certain marks for practical activities about 39 (98%) of government, 28 (93%) private and 6 (100%) of public school teachers agreed that practical activities should be part of science education and certain amount of points should be given to it for encouraging teachers as well as students to carry out experiments and activities on a regular base depending the curriculum and plan of the school. On the other hand, 1 (2%) of government, 2 (7%) of private school teachers disagreed with giving certain amount of marks for practical activities. Teachers who disagreed, they mentioned the reasons behind their response are under lack of laboratory tools, reagents and with no facilities for implementing practical works in science, talking about crediting certain marks for practical activities means “bringing the cart in front of the horse.” So, first laboratory equipments & other facilities should be fulfilled in those schools in which practical activities are totally absent and non-functional. From the total sampled teachers about 73 (96%) of the teachers confirmed and agreed that if there are practical works, they should contain certain amount of percentage from the total science marks. This creates more opportunities for students’ involvement and participation in various experiments and activities of science subjects. 3 (4%) out of the total teachers responded as they disagreed with allotment of some marks for practical activities in preparatory schools.

The calculated chi square value,  $\chi^2$  (4,1.45) shows no significance difference in the idea of teachers regarding practical activities which are conducted by the students in the laboratory should carry certain marks out of the total science scores.

As the data in table 7, item 10 indicates, suggested marks from 5% to greater than 25% for laboratory activities stated as follow. About 1 (3%) of a government teacher supposed a credit of 5% for practical activities. About 4 (10%) of government, 4 (13%) of private and 2 (33%) of public school teachers suggested 10% for students practical activities. Whereas number of teachers who suggested 15% for laboratory activities are figured as 1(3%) government, 2 (7%) private and 1 (17%) public schools. About 4 (10%) of government, 9 (30%) of private and church school teachers suggested the credit for practical activities to be 20% out of the total science scores. Number of Teachers who suggested the marks for practical activities to be greater or equal to 25% are 14 (35%) from government and 7 (23%) from private schools. whereas, 16 (40%) of government, 8 (27%) of private and 3 (50%) of public school teachers did not decide what percentage of marks to be given for practical activities. In general teachers who agreed to be given certain amount of marks to practical activities ranging from 5% to  $\geq 25\%$  are 49 (64%) out of the total teachers while 27 (36%) of the teachers did not approve and undecided with the valuing and giving certain credits for

practical works of students. Hence, the calculated chi square value,  $\chi^2$  (10, 14.24) confirms that there is no significant difference among government, private, Church and public school teachers in determining and general consensus on assigning some percentages for practical works in which students carry out in the laboratory. Based on pedagogy each and every activity that the student performs should assess and carry some credits to know the progress and failure of the learner. This is approved by the statistical data analyzed in the table above.

Depending on the data in table 7, item 11 above 30 (75%) of government, 8(26%) of private and church, 3(50%) of public school teachers agreed and revealed that demonstrations and experiments transmitted through the plasma TV can replace the activities that would be carried by students in the lab. These teachers believed that in some schools no sufficient laboratory facilities and no lab activities so, the only alternative is observing and watching science demonstration and experiments conducted in the plasma TV and relating it with their theoretical knowledge and internalize it to grasp the procedures and activities for future real activities. Of course if lab facilities are available and direct involvement of students in practical activities is un-replaceable as a general principle. But still demonstration by plasma TV has greater advantage over the experiment/demonstration performed by teachers or students. Some activities which cannot be done or demonstrated by teachers or students because of longer duration and complexity, these activities can easily be presented by the plasma TV on a given period of time with a correct order or flow.

To the contrary, 7 (18%) of government, 6(20%) of private and 3 (50%) of public school teachers disagreed with the replacement of real and life practical activities conducted by students, teachers or both in the laboratory by the demonstration and experiments transmitted through plasma TV. They strongly stressed that learning through plasma TV is one way communication and no active participation of students. Students have no chance to ask question while the lesson or demonstration is going on and it is too fast to get gap for internalizing the main points of the lesson or demonstration. Even the subject teacher may not have sufficient time or may not prepare well to revise what is transmitted through the plasma TV. But in general education through plasma TV is a new technology and it has its own merits and demerits and the main concern should be forwarding methods to fill the gap and minimizing the weak points of the technology and try to adopt the technology as a change of education. But, if the apparatus is malfunctioning, maintenance cost is very high and there might be interruption of the transmission relatively for longer time and this

brings disparities from one government school to another. Starting the adoption of plasma TV as medium of instruction in government secondary and preparatory schools the gap and disparities among government, private and public schools become large and no one standard for secondary and preparatory education as a whole, and in particular science teaching and practical activities. As some other studies confirmed these variations and disparities in the medium of instruction make a difference in the results and achievement of students in grade 10 national examinations and pre-college and University entrance examinations.

It is known that plasma TV transmission is not conducted in private, church and public schools because of high cost of the apparatus and no interest for it. As I informed from some private schools, at the beginning of the introduction of the technology they were started to teach students with plasma TV, but at the middle, because of the question of students and parents they stopped the plasma teaching and continue as usual with the traditional method of teaching. Lastly 3 (7%) of government and 16 (53%) of private school teachers responded as they don't know the advantages or disadvantages of the plasma TV. However, from the total respondent teachers about 41 (54%) of the teachers except with certain reservations agreed that demonstration/experiments transmitted by the plasma TV can replace the activities which are carried by students and teachers in the laboratory, classroom or field. About 16 (21%) of the teachers disagreed that plasma TV could not replace the actual practices done by the students and teachers in the lab. Teachers who don't know whether a plasma TV can replace the actual activities performed by students or teachers or not are about 19 (25%).

Therefore, the computed chi square value,  $\chi^2$  (6, 28.41) justifies that practical activities demonstrated by the plasma TV which took place in the government schools differ significantly from private, church and public schools in which the practical activities carried out by active participation of students in the laboratory or classroom. This analysis also shows that teachers' response to the question is significantly different depending belongingness to the plasma and non-plasma schools and the experience and general opinion of the teacher.

The data in table 7, item 12 above indicates that most teachers from the four types of schools, i.e. government 32 (80%), private and church 24 (80%) and public 5 (83%) expressed their need for regular workshops and seminars about the techniques and procedures how to conduct practical activities. This is necessary for science teachers to inspire and upgrade their laboratory skills and

opportunities of students' involvement in laboratory activities increased. About 5 (13%) of government, 5 (17%) of private and church, 1(17%) of public school teachers responded that regular workshops and training about practical activities are somewhat good to inspire teachers to apply practical activities according to the curriculum and the action plan of the school. But besides to this point, laboratory equipments and facilities should fulfill for successful implementation of practical activities in science subjects. Teachers who responded as they have sufficient skills about laboratory activities and they did not need training and workshops about practical works in science are 2 (5%) from government, 1 (3%) from private schools. Only one teacher (2%) from government school reported that laboratory training and work shop for science teachers is meaningless and not necessary.

This is because in some science fields totally no laboratory facilities. So, before giving training and workshop for teachers, school laboratory should be organized, fulfill lab tools and reagents and then teachers training come later on. Furthermore the teacher said that under such scenario, *“discussing teachers training and updating practical skills and experience is meaningless and not necessary for me.”* So, it is better to give emphasis and prioritize the needs, problems and doing it one after the other must be the concern for school principals and educational officials.

From the total sample of teachers about 61 (80%) necessarily need training and workshops for science lab activities, 11 (15%) of the teachers said that lab training is somewhat good, 3 (4%) of the teachers responded as they have adequate skill and experience in practical activities and they don't need training and workshop and 1(1%) of the teacher taking training and workshop alone is meaningless and not necessary, it doesn't bring any change unless otherwise many of the pre-requisites for science laboratory activities are complete and available. Since, training and workshop are the need and it is the key point for updating practical skills of teachers, laboratory training should be given regularly for science mentors. The calculated chi square result,  $\chi^2$  (6, 1.51) specifies that no significant difference among government, private and public school teachers in the need of workshop, seminars and laboratory training of teachers about practical activities on a regular time interval. It might be appropriate at the end of the academic year to refresh and update the practical skill of teachers for conducting more additional experiments and activities and this also helps the students to actively involve in the science practical works in a better way. Laboratory training for science teachers is very necessary to promote the implementation of practical works in all levels of a school.

Table 7, item 13 above contains data about the schedule of practical activities in preparatory schools. About 4 (10%) of government, 4 (13%) of private and 3 (50%) of public school teachers responded as they prepare regular schedule and program every year for laboratory session according to the curriculum and the annual plan of the school. Whereas, 36 (90%) of government, 20 (67%) of private and church, 2 (33%) of public school teachers reported as they did not prepare a regular schedule for laboratory sessions. So, they carry out practical activities without schedule randomly in their interest and the request of students. But, preparing a schedule which is matched with the annual plan of the science lesson and the school is a mandatory and the ethics of the profession. Around 6 (20%) of private and 1 (17%) of public school teachers leave the question without giving a response. They are not responded as “Yes” or “No” and this means they have no idea as they prepare schedule or program for practical activities. Statistical analysis of chi square value,  $\chi^2$  (4, 16.45) shows that there is a significant difference in the preparation and using a regular scheduled period for science laboratory session in the four types of preparatory schools.

This study approved that teachers in some schools prepare laboratory programs separately or with the annual plan of the science course they teach based on the experiments and activities listed in the text book, but teachers in other schools did not prepare schedule for laboratory sessions and no any supervision and follow up from school principals or department heads.

Depending on the data in table 7, item 14 above the factors which hinder practical activities in preparatory schools are elaborated as follow. One of the factors which assumed to hinder practical activities is lack of lab tools. So based on this point about 32 (23%) of government, 13 (17%) of private and 3 (17%) of public school teachers confirmed that practical activities are not implemented sufficiently because of lack of tools in the laboratory to conduct lab session in biology, chemistry and physics. About 24 (17.3%) of government, 10 (13%) of private and church, 3 (17%) of public school teachers reported that lack of reagents become a major constrain for successful implementation of practical activities in preparatory schools.

Teachers who reported “**lack of commitment and awareness**” as one of the constraints of practical activities in science subjects are figured out as 18 (13%) from government, 9 (12%) from private and 4 (22%) from public schools. About 24 (17.3%) of government, 13 (17%) of private and 3 (17%) of public school teachers informed that large class size becomes as one of the constraints of science practical activities in preparatory schools. Regarding teachers workload as a constraint for laboratory

session, 21 (15%) of government, 22 (29%) of private and 2 (11%) of public school teachers mentioned it as one of the factors which can hinder the full implementation of practical activities. This point is supported by the data collected from profile of teachers presented in table 3. Based on the data a few teachers in private and some government school teachers have workload greater than 20 periods per week. Especially private schools like Elshaday Holy Savior science teachers workload is about 26 periods per week and having this in mind and carrying out practical activities becomes more difficult and teachers will be exhausted to guide and encourage students during lab sessions. Finally, lack of workshops and training of practical activities have been taken as one of the constraints of practical activities.

Teachers in the four types of schools argued that the absence of regular workshop and training contributes for less activities of practical work in preparatory schools as well as in primary and secondary schools. So, about 20 (14.4%) of government, 9 (12%) of private and church and 4 (22%) of public school teachers responded as lack of current and regular workshop and training of practical activities as it takes some shares for low implementation of science practical works in secondary and preparatory schools.

when factors hindering practical activities are summarized from the total respondent teachers about 48 (21%) of teachers have given the share for lack of tools, 37 (16%) of the teachers argued that lack of reagents takes the share, 31 (13%) of the teachers pointed lack of commitment and awareness of teachers, students and school principals as a barrier for implementation of science practical activities, 39 (17%) of the teachers were also mentioned large number of students per class/large class size as one of the constraints for limited activities of science practical work. Teachers workload considered as a constraint of practical activities and around 45 (19%) of the teachers argued as it hinders practical activities. About 33 (14%) of the teachers reported lack of work shop and seminars as it contributes some impacts on practical works in the lab. In addition, as respondents informed in the open ended question, poor co-ordination and management by the school principals and department heads are also contributed for low activities of science practical activities in preparatory schools.

Statistical analysis of the computed chi square value,  $\chi^2$  (10, 9.76) implies that there is no significant difference among the four types of schools in sharing several constraints of practical work that the schools face. All the factors listed in the table are problems in one or another way for successful

implementation of practical activities in all government, private, church and public preparatory schools.

Regarding the formation and contribution of science laboratory clubs in preparatory schools have been illustrated as follow using the data in table 7 item 15 given above. In Government 27 (67%) of the teachers, in private and church 23 (77%) of the teachers and in public school as well about 4 (67%) of the teachers strongly agreed that formation of science laboratory clubs and participating and training member students have great contribution in developing practical skills and experience of students. Those teachers who partially disagreed with the formation and contribution of science laboratory clubs are 9 (22%) from government, 5 (17%) from private and 2 (33%) from public schools. On the other hand, 3 (8%) of government 2 (6%) of private school teachers responded as they disagreed with the formation of science lab clubs in their schools and only one teacher (3% of them) from government school who strongly disagreed with the formation and contribution of science lab club for better involvement and participation of students in practical activities.

Generally, from the total sample of teachers, 54 (71%) of the teachers strongly agreed with the formation and active functioning of science laboratory clubs in preparatory schools, about 16 (21%) of the teachers partially agreed on the formation of clubs, whereas 6 (8%) of the teachers disagreed with science club formation in preparatory schools.

So, the calculated chi square value  $\chi^2$  (6, 2.31) implies that there is no significant difference among teacher respondents in government, private, church and public schools in the idea of formation of science laboratory clubs and participation of students to gain better experiences and skills of science practical works. Formation of science laboratory clubs has more advantages by giving more exposure and ample training time to students to actively engage in experiments of natural science subjects (Biology, chemistry & Physics) during their spare time after and/or in between the regular class.

Table 8: - Analysis of Teachers Response on Monitoring and Evaluation of practical works and presence or absence of Trained lab Technicians/Assistants.

Item No.	Description of Items		Government		Private		Public		$\chi^2$ (df)
			No.	%	No.	%	No.	%	
16.	How often do school principals and department heads monitor and evaluate the implementation of practical activities at a given frame of time?	Quarter	6	15	9	30	3	50	<u>17.92*</u> (8)
		Semester	7	17	9	30	3	50	
		Yearly	----	----	1	3	---	----	
		Rarely	8	20	9	30	----	----	
		Not at all	19	48	2	7	----	----	
17.	Is there well trained lab technician/assistant at your school?	Yes	10	25	4	13	5	83	<u>16.87**</u> (4)
		No	21	53	23	77	---	---	
		I don't know	9	22	3	10	1	17	

\*P < 0.05

\*\*P < 0.01

In preparatory schools, the performance of practical activities should be co-ordinated by school principals and department heads. There should be a tradition and system to monitor and evaluate the activities of laboratory activities carried in biology, chemistry and physics departments on a given frame of time. Therefore, to justify this concept the data in the table 8, item 16 given above is briefly stated as follow. About 6 (15%) of the teachers from government schools, 9 (30%) from private and church, 3 (50%) from public schools confirmed that practical activities have been evaluated every quarter. Again 7 (17%) of government, 9 (30%) of private and 3 (50%) of public school teachers reported that the implementation of practical activities monitored and evaluated once every semester in the academic year. Only one teacher (3% of them) from private school informed that monitoring and evaluation of practical activities takes place once a year. Moreover, 8 (20%) of government, 9 (30%) of private school teachers justified that monitoring and evaluation of science practical works takes place rarely or it is very seldom. Those teachers who reported as there is no such secular and scheduler monitoring and evaluation systems are figured out as 19 (48%) from government and 2 (7%) from private schools.

In these types of government and private schools no a system and tradition as well to monitor and evaluate what science practical activities are carried out. So, in this regard there is poor co-

ordination and management of the school principals and department heads of science subjects. This poor management and loose co-ordination among school principals, department heads and teachers will be taken as one major constraint of poor laboratory activities in preparatory schools. Therefore from total samples of teachers, 18 (24%) of the teachers reported that monitoring and evaluation takes place every quarter, 19 (25%) once a semester, 1 (1%) once a year, 17 (22%) rarely done and 21 (28%) of the teachers confirmed that no monitoring and evaluation system at all. Monitoring and evaluation are the backbone of all organization to identify strong and weak points and to get feedback from subordinates and to find solutions for problems and help to minimize weak points as well as to increase strong sides on a sustainable condition.

Schools should establish a system on monitoring and evaluation for different activities and especially a system or tradition to evaluate the implementation of science practical activities in schools at different levels. In this regard there are disparities & variation among the four types of schools in the systems and ways of monitoring and evaluation of practical activities.

Furthermore, statistical analysis of chi square result,  $\chi^2$  (8, 17.92) shows that there is a significant difference in monitoring and evaluation of practical activities in government, private, church and public preparatory schools. From the interpretation of the statistical analysis someone can visualize that school principals and department heads monitor and evaluate the implementation of practical activities based on a variety of time frame and in some cases no system/tradition of monitoring and evaluation at all.

The data in the table 8, item 17 given above illustrated about the response of teachers on the presence or absence of lab technicians/assistants and their contribution on science practical activities were analyzed as follow. About 10 (25%) of government, 4 (13%) of private and 5 (83%) of public school teachers reported as there are well trained lab technicians or lab assistants. This means that these schools are supposed to carry out lab activities better than those schools which did not assign technicians or well trained lab assistants. I confirmed this idea during my observation of practical activities in the laboratory of some selected government, private schools and one public school. Around 21 (53%) of government and 23 (77%) of private teachers justified that their school laboratories have no lab technicians/assistants at all. Let assume that in some schools teachers are tight in their workload and routine activities and under such circumstances; teachers are unable to conduct lab session effectively and efficiently without the aid of lab technician or lab assistant.

Because of this the implementation of practical activities becomes poor and insufficient in various schools of the country. Teachers who responded as they don't know the presence of lab technicians or lab assistants are 9 (22%) from government, 3 (10%) from private and church, 1 (17%) from public schools. In general, from the total respondents about 19 (25%) of the teachers revealed the assignment of lab technicians/assistants in their schools for better performance of practical activities if provided that other facilities are fulfilled. Teachers who reported as laboratory technicians/assistants did not assign in their schools are 44 (58%) and about 13 (17%) of the teachers responded as they don't know whether there is or no lab technician/assistant in their schools.

Therefore, in most schools there are no laboratory technicians or well trained assistants and this factor is taken as one of the core constraints for less implementation of science practical activities in preparatory schools. It is advantageous to assign a lab technician or to train an assistant for effective and sufficient implementation of laboratory activities at the different levels i.e. primary, secondary and preparatory levels of education. The other point is teachers' workload should be minimum and encourage them to focus and conduct lab activities as students able to relate the theory they learn in the class to approve by conducting practical activities in the laboratory.

Regarding the presence or absence of lab technicians/assistants, the calculated chi square value,  $\chi^2$  (4, 16.87) confirms that there is a significant difference in the assignment of trained lab technician or assistant in the four types of schools. Most government and some private and/ or public schools have trained lab technician/assistant for adequate implementation of practical activities/works in natural science fields. As I am informed during my laboratory observation, in government schools, even though, there are assigned laboratory technicians in most schools because of the continuous transmission of Plasma TV, actual practical activities were not carried out. In addition, in government schools students and teachers were not available during the afternoon class for normal teaching and learning process as well as for practical activities.

#### 4.4 Responses of Department heads on current status of Practical work

Table 9: - Check list filled by department heads from government, private, church and public preparatory schools to know the influences of determinant factors on practical works.

No.	Item/determinant factors	Rating				Remark	
			S	NS	SL		Total
1.	Time allotment for lab work	No.	6	6	11	23	
		%	26	26	48	100	
2.	Laboratory facilities	No.	6	10	7	23	
		%	26	44	30	100	
3.	Current supply of equipment	No.	8	12	3	23	
		%	35	52	13	100	
4.	Availability of trained lab technician/assistant	No.	8	5	10	23	
		%	35	22	43	100	
5.	Class size and number of students	No.	4	9	10	23	
		%	17	39	44	100	
6.	Science teachers' interest & commitment to conduct lab session	No.	8	9	6	23	
		%	35	39	26	100	
7.	Students' participation and interest to lab works.	No.	19	4	0	23	
		%	83	17	---	100	
8.	Support and encouragement offered by school principals.	No.	4	13	6	23	
		%	17	57	26	100	
9.	Provision of laboratory Workshops, seminars and training to teachers	No.	2	4	17	23	
		%	9	17	74	100	
10.	Annual budget allocated for purchase of equipments, reagents and other resources.	No.	3	9	11	23	
		%	13	39	48	100	
	Total	No.	68	81	81	230	
		%	30	35	35	100	

**Note: S = Satisfactory, NS = Not Satisfactory, SL = Serious Limitation**

Table 9 contains 10 items which are rated by government, private, church and public school department heads about their impacts on practical activities which are stated as follow.

##### 1. Time allotment for lab work

About 6 (26%) department heads confirmed that time allotment for practical activities is satisfactory and again the number of science departments i.e. 6 (26%) of them noticed that time allotment for laboratory activities are not satisfactory and practical works are not sufficiently implemented in some government, private and public schools in general. 11 (48%) of the department heads in the four types of schools revealed that time allotment for science practical works has serious limitation and practical activities in general are poor and insufficient in several preparatory schools of

government, private and public schools. According to the interview of school principals and department heads as they briefly stated that the problem of time allotment has begun when the curriculum has been developed and did not allocate sufficient time for practical activities. School plans try to address the distribution of period allotment for both covering science courses and some extra time for practical activities. School principals and department heads also elaborated that they also encouraged teachers and students to carry out practical activities during extra time outside the regular session i.e. after the end of regular class and/or on the weekend such as Saturday. By doing in such a way it has some contribution to compensate the time limitation for practical activities and students would get some opportunities to involve in practical activities.

## **2. Laboratory facilities**

About 6 (26%) of the department heads justified that laboratory facilities are satisfactory in their schools. During my laboratory class observation I checked that more or less laboratory equipments, reagents, seating chairs and sinkers, water and electric supplies are fulfilled and well furnished in their schools. Therefore, some of the four types of schools have the capacity to implement practical activities more efficiently than the others. On the other hand 10 (44%) of the department heads in the four types of schools confirmed that laboratory facilities in their schools are not satisfactory and they create some problems to implement practical activities more effectively and efficiently as teachers and students require. The rest of department heads i.e. 7 (30%) of them rated that there are serious limitations regarding practical activities in their schools and these limitations require a co-ordinated effort to minimize their shortage and to facilitate the implementation of science practical works.

## **3. Current supply/availability of equipments**

About 8 (35%) of science department heads assured that the current supply/availability of lab equipments are satisfactory to implement science practical activities in the laboratory. Around 12 (52%) of department heads confirmed that their schools face some problems with the current supply/availability of laboratory equipments in their schools. These problems are common in government, private, church and public preparatory schools. So, based on this information schools above average are not satisfactory with the availability of lab equipments and practical works take place partially. On the other hand, 3 (13%) of science department heads revealed that some schools

have serious limitation concerning the availability/supply of laboratory equipments and practical activities are highly influenced and undergoing insufficiently or totally non-functional.

#### **4. Availability of trained lab technician/assistant**

About 8 (35%) of department heads justified that their schools have lab technician or trained laboratory assistant that support the main science teacher during the implementation of practical activities. So, these schools carry out satisfactory practical activities as they want to do. Whereas, 5 (22%) of the department heads reported that the assignment of lab technicians or assistants is not satisfactory and this means that some departments have lab technician or assistant and the other departments in natural sciences have not lab technicians or assistants. Because of this the status of practical activities in these schools becomes low and insufficient. Students have very limited opportunities to involve and carry out practical activities in their schools. The remaining 10 (43%) of the department heads responded that lab technicians or assistants are not assigned in their schools and regarding this issue it is a serious limitation for practical activities to be implemented by teachers as well as by students according to the schedule or plan of the school. In some schools and departments, science teachers are overloaded and they would be exhausted to support students to perform practical activities in the laboratory or the classroom on a regular schedule efficiently and effectively.

#### **5. Class size and Number of students**

According to the response of department heads, only 4 (17%) of them confirmed that class size is manageable and it is suitable for conducting practical activities effectively and efficiently provided that other facilities are adequately available. About 9 (39%) of the department heads in the four types of schools revealed that number of students per class is still relatively larger comparing to the small size of the laboratory class and teacher will be forced to demonstrate the experiments by doing themselves instead of encouraging students to perform each activity or experiment by themselves or alternatively, teachers try to divide a class of students into two halves and doing the experiments using shifts one after the others. This consumes time of the teacher and the students and it also affects the regular period to cover the course content according to the annual plan. Because of this teachers leave practical activities and they rush to cover the theoretical part of the course. Other department heads 10 (44%) of the total respondents recognized and underlined that class size in

some schools of government and private schools are surprisingly too large and class management is so difficult even to give discussion and lecture in the normal teaching-learning hours. So, it is very challenging to implement practical activities using a large number of students per class. Large class size becomes a serious limitation for several government and private schools to conduct practical works such as experiments and demonstrations of science subjects adequately.

## **6. Science teachers' interest and commitment for practical activities**

It is too difficult to know the interest, opinion and attitude of a person towards specific job/activities, but to get some idea about the general assumption and feelings of teachers towards teaching science and their initiative and passion to conduct practical activities stated as follow using the data collected from department heads of science teachers in the four types of schools in Addis Ababa. About 8 (35%) of the department heads reported that science teachers interest and commitments for laboratory activities are satisfactory. While 9 (39%) of the department heads proved that teachers interest, feelings and commitments are not satisfactory for implementing practical activities and they have few initiative to encourage students in practical activities. The remaining 6 (26%) of department heads informed that teachers' interest and commitments are serious limitation for implementing practical activities in their schools.

## **7. Students' interest and Participation to practical works**

Most department heads 19 (83%) in the four types of schools argued that students have more interest to show their participation in science practical activities.

They are eager and more ambitious to conduct practical activities/experiments to relate their theoretical knowledge they learned in the classroom. The department heads further elaborated that if students get encouragement from their teachers and lab technicians they are ready and eager to do experiments and demonstrate to their classmates. On the other hand, 4 (17%) of department heads reported as students' interest and participation are not satisfactory in their schools. Based on this point they proposed that these students need encouragement, motivation and continuous follow up to actively participate in science practical activities. Generally students' interest towards practical activities is not a serious limitation in science laboratory activities of preparatory schools. If lab facilities are sufficiently available and students get more support from their teachers and conditions for practical activities are comfortable they can actively involve for performing experiments and

they are able to demonstrate and present what they have observed in the laboratory for other students.

### **8. Support and Encouragement of school principals**

According to the responses of 4 (17%) department heads, they argued that support and encouragement of school principals for science teachers and students is satisfactory and practical activities carried out more or less in a better way. While about 13 (57%) of the department heads responded that support and encouragement of school principals is not satisfactory and because of this there are limited and insufficient practical activities in preparatory schools. The rest of the department heads around 6 (26%) of them informed that because of ignorance and no support as well as encouragement from school principals there is serious limitation in practical activities of some government and private schools. Based on the interview of department heads and written responses of students, it is clearly explained that laboratory activities in Limat Minch and Dejzmach Wondiriad which are government preparatory schools and Elshaday Holy Savior, a private school are seriously limited because of low concern and no support from school principals or owners of the school. So, the feedback from this research paper is necessary for such schools to bring a change in attitude and awareness to support and encourage teachers and students to participate as much as possible with the available resources in the school laboratories and the teaching learning process in science should be supplemented with practical activities.

### **9. Provision of workshops, Seminars and Training to Teachers**

About 3 (13%) of the department heads proved that workshops, seminars and training about practical activities have been given to upgrade and develop the experience of science teachers. This exposure builds the capacity of the teachers and teachers would be confident and initiative to perform practical activities, pre-investigation test before allowing and bringing students to involve in the practical activities. For successful practical activities, first a teacher or a group of teachers or selected students accompanied by their teacher or lab technician, a pilot experiment must be conducted and tested before participating all students with untreated experimental procedures. Because they may try to perform an experiment with a wrong procedure, reagents and un-appropriate apparatus or measuring unit and the final results of the experiment become incorrect and this brings doubt and confusion to approve the theory with practical activities. In addition there would be wastage of time, energy,

chemicals and discouragement of students. Therefore a preliminary practical activity conducted by the teacher for functioning of apparatus, chemicals, and procedures of an experiment has paramount importance by saving resources and it should be taken as a universally governing principle for science practitioners. From the responded department heads 9 (39%) of them reported that workshops, seminars and training of practical activities giving to science teachers are not satisfactory and it contributes some impacts for poor and insufficient implementation of practical works in their schools. so, school principals, concerned educational bodies, owners of private and church schools, parents and the community should participate to raise fund and to give laboratory workshops and seminars for science teachers to empower and build their capacity for successful implementation of practical activities accompanying with their students. The remains of the department heads 11 (48%) of them confirmed that no workshops, seminars and training for teachers regarding practical activities and they explained that these conditions are serious problems and limitation of science practical works. Especially the problems are highly magnified in most private preparatory schools and some government and public schools.

#### **(10) Annual Budget Allocation**

Regarding the allocation of annual budget for purchasing laboratory tools, reagents and other facilities responses of department heads and school principals stated as follow. About 3 (13%) of the department heads proved that budget allocation for fulfilling laboratory facilities in the four types of schools is satisfactory. From my laboratory observation, organization and availability of laboratory facilities are very good and sufficient in Addis ketema and Yekatit 12 preparatory schools from government, Lideta Catholic Cathedral School and Yenegew Sew private schools and Assay a public school. In the above mentioned schools the current status of laboratory facilities and implementation of practical activities are satisfactory except empowering and initiating teachers to use the resources and participate students to carry out practical activities frequently. Other department heads 9 (39%) of them reported that annual budget allocation for purchasing lab equipments, reagents and other facilities is not satisfactory and practical activities are carried insufficiently.

Laboratories lack some important materials and reagents for implementing practical activities and showing students experiments and demonstration become impossible. The rest of the department heads 11 (48%) of them stressed and addressed that budget allotment for laboratory facilities is

almost none and it faces serious limitation for most schools in government, private and as well public preparatory schools.

For some years, no purchasing of lab tools, reagents and other facilities because of not allocating annual budget for laboratory works. This is because of ignoring the contribution of practical activities and lack of awareness as well as concern to the functioning of laboratories in their schools. In some schools what is needed is to show simply the presence of non-functional laboratory classrooms with different materials and reagents. The presence of a laboratory is aimed with getting/renewal of license, since it is one of the standards by showing the room and the contents in it, but students don't actually involve to conduct practical works in order to acquire skills of science by approving the theory with practices done in the laboratory. So, school principals from government, private, church and public schools reaffirmed that budget for the laboratory is scarce in general, and this shortage of finance is also aggravated because of the increment of the cost of laboratory tools, reagents and other facilities at the present time. Therefore, no sufficient money to purchase and fulfill the materials as it is required and this has its own impacts on practical activities in addition to other constraints and limitations.

## 4.5: - SCIENCE LABORATORY OBSERVATION CHECK LIST

Table 10: - Summary of Science Laboratory Observation

No	Name of school	Availability						Functionality of the lab.		Conditions of lab. tools & reagents		
		Science Lab. room		Regular lab. schedule		Lab. technician						
		Se	C	P	A	P	A	FN	NFN	S	NS	NF
1.	Abiyot Kirs	✓			✓	✓			✓		✓	
2.	Addis Ketem	✓		✓		✓		✓		✓		
3.	Assay	✓		✓			✓	✓		✓		
4.	Aygoda	✓			✓		✓	✓			✓	
5.	Cathedral		✓	✓			✓	✓		✓		
6.	Dej. Wondiriad	✓			✓	✓			✓		✓	
7.	Elshaday Holy Savior		✓		✓		✓		✓			✓
8.	Fire Hiwot	✓			✓		✓	✓				✓
9.	Limat Minch	✓			✓		✓		✓		✓	
10.	Radical academy	✓			✓		✓	✓		✓		
11.	Yekatit 12	✓		✓		✓		✓		✓		
12.	Yenegew Sew	✓		✓			✓	✓		✓		
Total No.		10	2	5	7	4	8	8	4	6	4	2
%		83	17	42	58	33	67	67	33	50	33	17

**Se= Separate P = Present FN = Functional C= Combined A = Absent NFN = Non Functional S = Satisfactory NS = Not Satisfactory NF = Not Found**

From my overall observation of the twelve (12) preparatory sample schools, I try to identify the presence or absence of separate laboratory classes for each department of science i.e. biology, chemistry and physics subjects. In addition through document analysis I try to examine the schedule, recording system of practical activities carried out by the teachers and students, monitoring and evaluation of each school. The presence or absence of laboratory technicians, whether the school

laboratory functions or not and the materials and equipments found in the school and their status and present conditions of the tools have been checked and examined.

Based on the above table 10, from 12 schools regarding the presence of a separate laboratory rooms for biology, chemistry and physics practical works, 10 (83%) of the selected sample schools have a separate lab rooms for each field of natural science to perform practical activities, whereas, 2 (17%) of the preparatory school both are private schools have a combined laboratory room to carry out the three subjects of natural science. As respondents confirmed the previous separated rooms in the school have been changed into normal classes for teaching-learning process. The second private school has one combined room because the construction of the building has not been completed. As the school principal explained after the completion of the building the school will have a separate laboratory room for each field of natural science.

The second point that assessed through laboratory observation and document analysis is the schedule for laboratory session. According to this examination, 5 (42%) of the preparatory schools have prepared a regular annual schedule for implementation of practical works, on the other hand as document analysis proved that 7 (58%) of the preparatory schools didn't have regular schedule for practical activities. Most schools don't have annual regular schedule for preparatory activities means that there is less monitoring, follow up and concern for implementation of science practical activities. But this trend should be changed and department heads, school principals and other subordinate bodies interact and encourage schools and science teachers for preparation of annual regular program for practical activities to improve and accelerate the present status of laboratory activities.

The third point that I thoroughly examined is the assignment of laboratory technicians or trained lab assistants. According to my laboratory observation in each sample school the data that indicates the availability of lab technicians/assistants stated as only 4 (four) government schools (33%) have an assigned laboratory technician for laboratory activities, whereas, including a newly established government school i.e. Limat Minch preparatory school in Lideta sub-city of Addis Ababa and the remaining private, church and public schools in general have no an assigned lab technician or a well trained lab assistant in their schools. in short, 8 (67%) of the preparatory schools, most of them are private and the two public preparatory schools don't have lab technician/assistant and this becomes one of the determinant factors for low standard of practical activities in preparatory schools.

Laboratory technicians should be trained for each type of natural science subjects for efficient and successful implementation of science practical activities in all levels of education and in particular pre-University preparatory schools.

The fourth point, I try to summarize in my laboratory observation and document analysis is that the current working or functioning of the laboratories for science practical activities. Based on the data in table 10, has shown that 8 (67%) of the sample schools are more or less functional, teachers and students are involved to carry out some experiments and demonstration in their school laboratories. Whereas, 4 (33%) of the sample preparatory schools have poor standard and almost they are non functional. In these schools, students have no opportunities to participate and carry out experiments in the laboratory.

Lastly; **conditions of laboratory tools and reagents** are carefully observed and I arrived on the following data for description. The data regarding the current status of equipments and reagents in preparatory school laboratories stated as 6 (50%) of the preparatory schools have lab equipments, reagents and other facilities and they are satisfactory to perform preparatory activities in these schools unless otherwise other factors hinder the ongoing of practical activities . On the other hand, 4 (33%) of the sample preparatory schools have very few laboratory equipments and reagents and therefore the organization of the laboratory is not satisfactory. Likewise the implementation of practical activities is insufficient. These schools are expected to import new and up-to-date equipments and reagents as well as other inputs of laboratory for better and improved activities of science practical works. About 2 (17%) of the preparatory schools have no most of the laboratory equipments and reagents to perform preparatory activities of science subjects. Because of scarcity of budget and under construction laboratory tools and reagents are not available adequately for realizing practical works in these schools.

## **4.6 Discussion**

The discussion gives more and detail emphasis and elaboration on the results of the current study relate the data or information analyzed regarding the presence of a lab room for practical activities, the functionality of the laboratories, actual experiments and demonstrations done by students and teachers in preparatory schools, availability of lab equipments and reagents, understanding of students for practical works, the importance of practical work, contribution of science laboratory activities for facilitating teaching - learning process, teachers experience, skill, commitment and interest to carry out practical activities, problems that hinder the implementation of practical works in preparatory schools, etc.

### **Students and teachers view on the setting of laboratory rooms for science practical works**

Based on the response of students and teachers, the result/analysis of the current study indicates that most schools have well organized laboratory and more than 50% of the schools have separate rooms for practical activities of biology, chemistry and physics. Still other government, private and public preparatory schools go further, work hard and give more emphasis to expand the activities of practical works by having a separate lab room for each field of science and the size of the class should match with the number of students in the class-room. From the total samples of teachers about 56 (74%), and from the total samples of students about 165 (52%) of them confirmed as preparatory schools have separate rooms for each field of natural science. The remaining 20 (26%) of the teachers and 155 (48%) of the students revealed that no separate laboratory rooms for Biology, Chemistry and Physics. These schools share one common room to carry out practical works in science. In this combined laboratory room to carry out practical activities there should be a regular, weekly based program/schedule for each subject.

### **Functioning of laboratory rooms in preparatory schools**

The analysis of data obtained from teacher respondents, 54 (71%) of them revealed that laboratories are functional and science practical works/activities are implemented well in preparatory schools. whereas 22 (29%) of the teachers responded that because of lack of equipments, reagents, and other laboratory facilities. practical works are carried out insufficiently and most students have not the

opportunities to perform experiments and demonstrations in their school laboratories. The results of data obtained from the total student respondents 131 (41%) of them informed that preparatory science laboratories are functional and students have the opportunities to observe practical activities performed by the teachers or by their classmates. So, students are directly involving in practical works and they are able to gain basic science skills and experience. But, the figure/data given by students to functionality of laboratory activities did not match with the data obtained from teachers. Out of the total sample students about 145 (45%) of them confirmed that laboratory activities in preparatory schools are not functional and they are performing insufficiently. For improving this status schools and other stakeholders should co-operate to fulfill laboratory equipments, reagents, trained lab assistant/technician, other laboratory facilities and creating awareness of teachers and students through orientations, seminars, workshops and short term training about the importance and contribution of practical activities as it facilitates the teaching-learning process of science education. The remaining 44 (14%) of the students out of the total samples approved that practical activities are carried out rarely and occasionally, because of low commitment and concern of teachers, poor management of school principals and large number of students per class. So, teachers don't encourage students to participate in laboratory activities or they are not interested to perform experiments and demonstrations in the lab. Science teachers in some preparatory schools don't use the resources available properly.

### **Experiments and demonstrations done by students and teachers in science subjects**

As the current study shows there are limited experiments and demonstrations done in government, private, church and public schools in the academic year 2004 E.C., relatively more practical activities are carried out in the first semester and number of experiments implementing the second semester is fewer in number. This is related with the exhausting of teachers and students potential as well as diversion of students' attention for comprehensive or national examinations and short duration in the second semester. This has been supported by some statistical data obtained from students and teachers as follow. From the total sample of students 178 (56%) of them confirmed that they have seen experiments once or more times in biology, chemistry and physics practical activities in the current academic year 2004 E.C. Whereas about 142 (44%) of the students gave witness that they did not observe any experiments in the current academic year at all. On the other hand about 158 (61%) of the students reported that as they have seen laboratory activities in the first semester

and about 99 (39%) of the students responded as they observed laboratory activities in the second semester of the academic year 2004 E.C. So, in the above data it is obvious to understand that from limited science activities carried out in preparatory schools, usually most of the activities are performed in the first semester and a few of them in the second semester. In terms of subjects, relatively more experiments and demonstrations have implemented in Biology and Chemistry due to the designing of more workable experiments, availability of lab tools, reagents and the commitments and interests of teachers towards practical activities. As the data indicated few numbers of experiments are carried out in physics lab activities. Therefore, from the total respondent students 90 (41%) of the students have reported as they observed biology experiments, 88 (40%) of them reported as they participated in chemistry laboratory works and 42 (19%) of the students informed as they observed physics practical works in the current academic year 2004 E.C.

### **Availability of laboratory equipments, reagents for science practical works**

Regarding the adequacy of laboratory equipments, reagents and other facilities, this current study emphasizes and presents as follow using some figure taken from respondents of students, teachers, laboratory technicians and laboratory observations. As I have seen from laboratory observation some private, government and one of the public school **Assay** have relatively most of the laboratory equipments, reagents and facilities in their schools for implementing science practical works in their laboratories. Whereas some of the government schools, private and Fire-Hiwot no. 2, the second public school have shortage of school facilities, lab equipments and reagents to carry out science practical works properly and sufficiently. As students responded concerning laboratory instruments, reagents and other necessary facilities summarizes as below.

Out of the total sample students about 131 (41%) of the students responded as their schools have basic lab equipments, reagents and other facilities for carrying out practical activities, whereas 189 (59%) of the remaining students reported as their schools have lack of adequate lab instruments, reagents and other basic facilities to perform practical works effectively and frequently. On the other hand, teacher respondents examined and the data stated as 30 (39%) of the teachers confirmed that their schools have average and complete basic facilities including lab equipments, reagents, stools, sinkers as well as devoted teachers and lab assistants/technicians to conduct lab activities adequately and regularly. About 32 (42%) of the teachers on the contrary responded that school laboratory facilities are not satisfactory and limited practical activities are carried out. The last and surprising

report came from 18 (24%) of the teachers and these teachers revealed that their school laboratories are not organized well and lack most of the basic facilities and practical activities of science subjects are almost none. So, these schools need to take urgent actions and to fulfill the basic required laboratory facilities and should organize their laboratories in the way that they would be in the right track to start implementation of experiments and activities. Otherwise, teaching science without any practical activities means just a fish living out of water. So, the purpose of this current study is just to make alarm for those schools to investigate and find themselves and to furnish their laboratories with the necessary equipments, reagents and make their laboratory functional in order to provide service to their students.

### **Importance and contribution of practical works in science teaching and learning process**

It is known that practical work includes experiments, demonstrations, field trips, project works, group activities, etc. Therefore, respondents strongly stressed and confirmed the undeniable importance and contribution of practical works for effective and successful teaching and learning process in science subjects. As the results of the current study have shown that the majority of students (96%), all science teachers (100%), all lab technicians, all school principals from government, private and public schools and all educational experts have argued without reservation that practical work contributes a lot to facilitate and support science teaching in the classroom. In addition almost all the participants approved the importance of practical works in improving the academic achievement of students. At present, practical works have no significant impacts on students' achievement, because, the assessment technique did not employ in preparatory schools in Addis Ababa and other levels of education all over the country. So, the assessment technique should be revised and included practical activities in the total scores of science subjects. The involvement and participation of students in practical works should contain certain credits and the scores should be added to the dominant pencil-paper assessment results of science subjects Biology, Chemistry and Physics.

In general, students in government, private and public schools have great awareness and consciousness that implementing practical works has a paramount educational value and a broad contribution in progressing and developing positive attitudes and concern towards science disciplines.

## **Students view, understanding to practical work and reasons for joining science**

A science student expects to know the meaning and uses of key terms such as “what is a laboratory?” what does a practical work mean? What is the meaning of experiment? What are the major functions of practical activities?, etc.

Based on this, the results of the current study revealed that from the total student respondents about 218 (68%) of them have the knowledge and define those key terms related with science practical activities. In addition they briefly described the functions and contribution of practical work and laboratories. So, this is one step ahead and students have interest, zeal and commitment to involve in practical activities if conditions are suitable and they get the opportunities. Surprisingly, about 102 (32%) of the students are unable to define those terminologies which are related to science laboratory activities.

Concerning, students choice of science stream, most students after discussing the issue from different aspects with their parents, teachers and friends, finally, they decided to join the science stream.

Some of the reasons proposed by student respondents are: -

- Interest to practical works, experiments and demonstration in science subjects.
- Since I want to be a doctor.
- To fulfill the dream of being an engineer.
- To be a scientist.
- Since I like biology.
- Due to my favorite subject chemistry.
- Since I have special interest to master physics.
- Since, I dislike social science subjects such as history.
- Since government gives more attention to science and technology.

- Since there are more job opportunities after graduation.
- Due to the influence of my parents to join science stream, etc.

One of the core points of this research investigated is that most students decided to join science stream, because of assuming that science learning is interesting when it is supported by practical activities/experiments conducted by teachers and students. Students thought that learning science supporting with practical activities determine their future destiny on a strong base, so they join the science stream. From the responded students, 249 (83%) of them have written the reasons why they join the science stream. The other 50 (17%) of the students didn't write their reason for joining the science field. This means they have no vision from the beginning to the choice of stream and they join the stream either by the influence of parents or by their friends.

### **Importance of practical examination/Assessment of practical works and giving credit**

This current study deeply examined the assessment of practical activities in sample preparatory schools through the interview of department heads, school principals and lab technicians and the study revealed that no regular assessment and registering of marks of practical works in science fields. So, there is exclusion of practical examination in the school assessment program and this becomes the main reason for undermining practical activities in the schools or the Ethiopian science education system. Therefore, the current way of assessment/examination of practical work is one of the most outstanding findings of this research work. There is a predominant ideology in Ethiopian system of science education is that students expected to score high marks by thorough reading and memorizing facts, theories, formula and steps of calculations in the fields of science subjects. However, school principals and educational experts from their interview strongly believed that if there were regular and frequent practical works to supplement theoretical parts of the science subject, the effort required and the time lost to internalize the concepts & procedures of the subject matter will be minimum. Therefore, the results of this research revealed that almost all teachers 73 (96%) out of 76 and most students 285 (89%) out of the total 320 students of government, private and public schools believed and agreed that the assessment/evaluation on the laboratory activities has paramount importance and should carry a certain amount of percentage in the total scores of biology, chemistry and physics subjects.

## **Teachers interest, Commitment and professional responsibility in teaching science by performing experiments**

It is clear that the teacher is the first and most important element of schools to encourage students and to bring them into success by their effort and tasks. So, teacher's role is in the front line regardless the presence of all inputs, facilities, highly sophisticated instruments and all other preconditions for effective learning of the theoretical as well as the practical works of science. Teacher's effort in schools can't replace by any means. In order to do this teachers are expected to show interest, professional responsibility, commitment, passion and model to their profession and largely dedicated to support their students with great spirit and morals. Students would be inspired and encouraged if they thought that teachers are being more interested and committed to their profession and tried to support them using all their knowledge, experience and efforts. In this regard, the results of this research approved that although majority of teachers were interested in teaching science and performing practical activities, still there are few teachers who showed lack of interest, initiative in teaching as well as doing practical works. Moreover some students (29%) assured that teachers are not interested and volunteer to do practical works in order to encourage them. A few students (12%) believed that their teachers are committed and interested to the subject they teach and carrying our experiments using the available resources in school laboratories and show their dedication by helping students even in their extra time at the end of school hour or in the weekends on Saturday.

## **Necessary conditions for laboratory sessions**

This research work has addressed a number of conditions that are crucial for the performance and accomplishment of practical activities in preparatory schools. The necessary conditions for practical activities can include laboratory equipments, facilities, well trained lab technicians, budget allotment, time allocation for practical activities, class size or number of students per class, teachers interest and commitment, the support and encouragement received from the school principals, educational experts, parents and the government in general.

As most government, private and public school students, teachers, department heads, school directors clearly raised that lack of interest and commitment, lack of laboratory tools and facilities, no regular time allotment, no assignment of trained lab technician/assistant, deficit of the annual

budget, teachers work load and routine activities, and large number of students per class are the main constraints for non-suitable situations for current practical activities in preparatory schools.

Owners and academic directors of private schools responded that the school always tries to available the essential laboratory devices and reagents by allocating the finance each year and practical activities are carried out properly with the exception of some teachers who are busy, due to assigning additional responsibilities to carry out and a few of them may lack commitment and interest to do practical works. In addition, interviewed educational officers assured that as they give support to the government, private, church and public schools such as offering short term professional trainings and workshops regarding practical activities, school improvement programs, continuous professional development and the likes. However concerning budget or finance allocation the sub-city educational offices have no authority to support financially. Schools could request the budget from the finance of the government or management/owners of private schools or fund raising or contribution of beneficiaries of local community schools to purchase necessary materials and facilities when it is needed.

### **Major constraints that obstacle practical works in preparatory schools**

According to the responses of students, teachers ,department heads, a few lab technicians and school principals, through written answers for open ended questions and interviews of the participants, the common constraints or problems facing the current practical activities in secondary and preparatory schools are listed and identified simultaneously by all participants. The most common constraints in which government, private, church and public schools confront are: -

- Small class size for practical activities and no separate rooms for each field of natural science practical works.
- Insufficient laboratory equipments, reagents and other facilities.
- Lack of teacher's commitment and low efficiency to carry out practical activities
- Lack of well-trained lab technicians/assistants and teachers as well.
- Lack of students' concern and awareness towards science practical works.
- Absent and un-functional laboratory settings.

- Absence of separate prepared laboratory manuals.
- In some government and most private and church schools high teachers' workload per week.
- The ignorance of practical examination in the assessment process and not giving credit for practical activities.
- Less attention and concern given to practical works by school managements and government as well.
- Shortage of time, especially large teachers work load in private schools and plasma TV transmission in government schools.
- Deficit of budget or finance allocation.
- Costs of laboratory equipments and reagents become expensive and no access on the market.

These and other factors are the main findings of this research as prevalent hindering constraints of practical activities in most government, private, church and public schools. Because of such problems the current status of practical activities in preparatory schools found at the grass root level. The other findings of the current study related to the constraints of practical activities are now days, in most schools science teaching is not supported by practical activities. Even fresh graduates from faculty of natural sciences have been graduated by insufficient experience and skills of practical works in which they become less active in teaching the course and performing experiments when they begin their work in science teaching. Moreover, the other point I visualized in this study is the number of female graduates in science fields are very few and this creates gender in-balance in science professional graduates.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Summary**

The main purpose of this research work is to investigate the present status of practical works in those selected preparatory schools in Addis Ababa City Administration (AACCA) and to understand the integration of theory and practice in science teaching. In the new education Policy of the Federal Democratic Republic of Ethiopia (FDRE), it is clearly stated that the country demands more science graduates in order to enhance its growth and development in terms of science, technology economy and infrastructures (MOE: 1994). Thus, more number of science graduates is expected to fulfill the objectives of the new education policy of FDRE. Therefore, Science education delivering in primary, secondary and preparatory education levels should be effective and fruitful in order to produce more talented, skillful, creative, internationally competent science graduates in the country. To accomplish this learning science in all levels of education, particularly in the preparatory schools, should be supported by practical works and practical activities which can be carried in the laboratory, classroom, field or elsewhere. Therefore, this research has been designed to know the correlation between science teaching and practical activities in government, private, church and public schools in Addis Ababa. The research aims to answer the basic research questions formulated earlier in chapter one.

Thus, to accomplish the study appropriate research methods and sampling techniques and instruments have been developed and employed. In this research both quantitative and qualitative research approaches and a descriptive survey study were implemented. As a sampling technique stratified random and purposive sampling methods are used. From preparatory schools of Addis Ababa 12 schools have been selected by purposive sampling techniques and the schools divided into government, private, church and public schools. Students as respondents were selected by stratified sampling methods, whereas principals from each sample school and experts from each sub-city were selected by purposive sampling methods. Regarding teacher samples, all preparatory science teachers were taken from sample schools for the research. The numbers of sample students made to be vary depending on the total number of students in each school and school types.

Separate questionnaires were prepared and dispatched to teachers and students. Interviewing of school principals, department heads, lab technicians and experts have been conducted to obtain qualitative data which are used to elaborate and emphasize the quantitative analysis after categorizing and developing into main themes. Rating check list was prepared to be filled about the determinant factors of science practical works in preparatory schools. In addition observation check list and document analysis format were also used to strengthen and enrich the data obtained from the questionnaire and interview. The collected data and responses were tabulated and analyzed and interpretation has made using statistical methods such as percentages and Pearson's chi-square computations.

After the analysis and interpretation of the triangulated data, the following are the main findings of this research work.

1. In the selected government, private, church and public schools the extent and frequency in which practical work implementation found in a very low level and it is poor and insufficient. This finding is supported by the analysis of chi-square result as there is no significant difference among the four types of schools concerning the implementation of practical works and utilizing it for conceptualizing and supporting the theoretical background of students.
2. The current study confirmed that there are schools without basic equipments, reagents and other facilities and practical works in these schools are not carried out totally and the laboratories are dis-functional.
3. In principle, most students from the four types of schools, all science teachers, school principals, experts and the other participants all together argued that science practical work is very necessary and relevant and played a great role in supporting and facilitating science teaching and learning process. This also attributed for developing positive attitude of students towards science and improving the academic achievement of students in science scores. Having this understanding in mind, no satisfactory implementation of practical activities in any of the sample schools as it is required to be.
4. The majority of students, almost all science teachers, department heads, lab technicians and school principals of government, private, church and public schools and all educational experts strongly believed that the dominant ideology and tradition on paper-pencil examinations in schools

assessment program made schools to forget and ignore the contribution of practical works and not giving credit to science achievement of students.

5. According to the views and responses of student and teacher participants the demonstration and experiments mediated by the plasma TV is a one way communication and they agreed that it did not replace the actual practices that are carried out in the laboratory by full and active participation of students. But it has a very good contribution for those schools seriously suffer from lack of lab equipments, reagents, lab facilities and no well trained lab technicians or teachers for performing practical activities and in general their school laboratories which are totally non-functional in any way. In addition if the demonstration and experiments transmitted by the plasma TV is aided by the practical activities of students and teachers, it becomes more relevant and significant to develop the skills and experience of students. Thus, the plasma TV should be taken as a supplementary to the real practical works performed by the students in the laboratory, classroom and the field.

6. The four types of schools (government, private, church and public schools) have suffered from serious limitation of inadequacy of laboratory equipments, reagents and facilities, absence of separate lab rooms, lack of well trained lab technicians and lack of commitment and interest of teachers. Relatively government schools have serious problems in shortage of annual budget allocation large class size when compared to most private, church and public schools. On the contrary, the private and church school teachers are suffering from lack of time to engage themselves in practical activities due to occupied by routine tasks and large period allotment and in some schools assigning to teach various grade levels from grade 9 – 12. So, carrying out practical activities for such grade levels became very tiresome and not practical.

7. The investigation of the study searched out the following factors as the main constraints and limiting conditions of the current practical works in preparatory schools.

- a. Absence of separate lab rooms and small sized laboratory rooms for the accommodation of all students of a large class.
- b. Lack of laboratory facilities, well trained teachers, and lab technicians.
- c. Lack of attention and concern given to the practical works by school principals and government.
- d. Financial problem and shortage of time

e. Poor monitoring, evaluation and supervision of practical activities by department heads, school principals and educational experts.

f. Low commitment and interest of teachers either to conduct experiments and demonstrations or not volunteer to encourage students to involve in practical activities both in the regular period and during extra time.

## **5.2 Conclusions**

Depending on the major findings of this current study, the following conclusions are made: -

1. The research work confirmed that the status of laboratory activities and science practical works in government, private, church and public preparatory schools of Addis Ababa is very low and insufficient.

2. This low level of practical works that are performed in the government, private, church and public schools have the same nature and they are simple demonstrations and experiments that elaborate only how to use or how to measure and operate the apparatus and showing the resulting after preceding certain steps.

3. Some of the practical activities that are performed in school laboratories mostly carried out in the first semester than the second semester of the academic year. Number of experiments conducting in school laboratories usually decreases in the second semester.

4. The incorporation of practical examination in the students' assessment techniques of science results is believed to revive the dead practical activities in the schools.

5. Formation of science laboratory clubs and make them to be functional is very necessary to increase the opportunities of students to involve and actively participate in practical works of biology, chemistry and physics subjects during their extra time at the end of regular classes. This helps students to develop their scientific skills and experience.

6. This study searched out that there are financial problems in government, private, church and public schools to reorganize and fulfill the required facilities of laboratories in preparatory schools. This deficit in budget is responsible for poor and insufficient practical activities in preparatory schools.

7. This study disclosed that the necessity of workshops, seminars and short term training for teachers about practical activities in their fields of specialization is a national call for the revival of practical works in all levels of education in general and in preparatory schools in particular.

8. This study clearly identified the core problems of government, private, church and public schools as listed out below. The major constraints of practical activities are inadequacy of laboratory facilities, lack of well trained lab technicians and teachers, lack of proper attention given to practical activities by the concerned stakeholders.

### **5.3 Recommendations**

The main recommendations which are suggested after analyzing the results and findings of this research work are the following: -

1. The introduction of practical examination in the students' assessment procedures of science results and the students that carry out practical activities should be credited and it has to be added to the total science scores of the student.

2. School managements, teachers, the community and the government at large must give consideration to the capacity building of the schools in terms of finance and training. So, schools would be able to prepare laboratories with basic facilities, carrying out project works, field trips in order to produce highly qualified, skillful and creative personnel.

3. The curriculum designers should give emphasis to the practical works of science subjects in relation to the assessment techniques, the time allocation for conducting practical works, the class size, training systems of teachers and technicians, standard of practical activities, realizing 70:30 student ratio of natural science to social science and Humanities, etc to students future promising of successful endeavour and sustainable development of the country.

4. Developing team works of teachers in each science subject to carry out a preliminary experiments and demonstrations before participating students in practical works. This saves resource wastage, time and energy of teachers and students.

5. Preparation of separate manuals for Biology, chemistry and Physics subjects.

6. Scheduling a regular time table for implementation of practical activities, planning to monitor and evaluate performances of teachers and students every quarter or every semester.

7. Concerned authorities in education sector should encourage the participation of female students in education Colleges and Universities who are specialized in natural science fields to teach science subjects and to carry out research in various fields of science such as chemistry, biology and physics.

8. Inviting other researchers for further investigation on practical activities to come up with new approach and more additional findings.

## REFERENCE

Abraham I. and Millar R. (2008), Does practical work actually work? A study of the effectiveness of practical work as teaching method in School Science.

Aggarwal J.C (1996), Principles, methods, and techniques of teaching, 2<sup>nd</sup> edition, New Delhi, Vikas publishing house pvt ltd.

Aklilu Yilma (2010), The implementation of Biology practical work in selected general secondary schools in East Wollega zone of Oromia region, Addis Ababa, AAU

Amdissa Teshome (2008), A review of Educational Policy strategies of programs (47-90), Digest of Ethiopian National Policies, Strategies and Programs (Ed) by Taye Assefa, Addis Ababa (UnPublished)

Andy Piggott (2010), Science Preparatory Rooms in Secondary Schools

Bekalo S. A. and Welford A.G. (1999), International Journal of Science Education VOL. 21, NO. 12

Bekalo S.A (1997), Factors influencing the place and development of Practical work in secondary science, the case of Ethiopia, (Unpublished Ph.D Thesis)

Berquist W. (1991), "Role Reversal: Laboratory before the lecture"

Blosser P. (1980), A critical review of the role of the laboratory in science teaching, Columbus OH: Center for Science and Mathematics Education.

Bryce T.G.K. and Robertson I.J., (1985), what can they do? A review of practical assessment in science. Studies in Science Education, 12, 1-24.

Chaudhry S.S, Sharma A.P. & Hooda H.C. (1975), *New Practical physics* (4<sup>th</sup> edition).

Educational Media Agency (EMA: 2001): - Methodology of teaching natural science, teaching methods, teaching aids and laboratory work in natural science. Addis Ababa: Ministry of Education.

EMA (2002), Methodology of Teaching Natural Science: Foundation for modern science teaching. Addis Ababa: Ministry of Education.

EMPD (1994a, b), The New Education Policy and Sector Strategy, Addis Ababa

Encarta Dictionary: -

Ethiopian National Agency for UNESCO (March 2001), The Development of Education, National Report of Ethiopia, Addis Ababa.

Fensham (No date), Development and Dilemmas in Science Education

Hodson D., (1993), Re-thinking old ways: towards a more critical approach to practical work in school science, Studies in Science Education

Hofstein A. and Lunetta V.N., (2004), The laboratory in science education: foundation for the 21<sup>st</sup> century, Science Education

Hofstein A. and Lunetta V.N., (1982), The role of the laboratory in science teaching: neglected aspects of research, Review of Educational Research

Hofstein A., (2004), The laboratory in chemistry education: thirty years of experience with developments, implementation and evaluation, Chemistry Education Research and Practice

Hofstein A., Navon O., Kipnis M. and Mamlok-Naaman R., (2005), *Developing* students' ability to ask more and better questions resulting from inquiry-type chemistry laboratories, Journal of Research in Science Teaching, 42, 791-806.

Husen T. and Postehwaite T.N. (1994), The International Encyclopedia of Education (2<sup>nd</sup> edition), Great Britain, BPC Wheaton Ltd, Exeter, Vol. 19

Internet Web Sites, On Science Laboratory and Practical Activities.

Justin Dillon (March 2008), Practical Work in school science, King's college London.

Kerr J.K (1963), Practical work in school science, England and Wales, Leicester University press.

Krajcik J., Mamlok R. and Hug B., (2001), Modern content and the enterprise of science: science education in the 20<sup>th</sup> century. In: L. Corno (Ed.). Education across a century: the centennial volume, Chicago, Illinois: National Society for the Study of Education (NSSE).

Lazarowitz R. and Tamir P., (1994), Research on using laboratory instruction in science, in D. L. Gabel. (Ed.) Handbook of research on science teaching and learning (pp. 94-130), New- York: Macmillan.

Lunetta V, N., Hofstein A. and Clough M., (2007), *Learning* and teaching in the school science laboratory: an analysis of research, theory, and practice, In N, Lederman. and S. Abel (Eds.), Handbook of research on science education. (pp. 393-441), Mahwah, NJ: Lawrence Erlbaum

Lunetta V.N., (1998): - The school science laboratory: historical perspectives and centers for contemporary teaching, In P. Fensham (Ed.). Developments and dilemmas in science education (pp 169-188), London, Falmer Press.

Madsen H.S. (1968, "The curriculum-ESLC seminar of 1967", Ethiopian Journal of Education Faculty of Haile Silassie-I University, Vol.2, No.1

Mayburn R.H and Wilburn A.S.Y (1971), "Science Education International", "The encyclopedia of Education, vol.8.

Millar R. (2004), The Role of Practical work in Teaching and Learning of Science.

MOE (1994a), Education and Training Policy, EMPDA. Addis Ababa.

\_\_\_\_\_ (1994b), Education sector Strategies, EMPDA, and Addis Ababa.

\_\_\_\_\_ (1997, 1998), Reform of School Education and Teacher Training Program, Addis Ababa.

National Research Council, (1996), *National* science education standards, National Academy Press: Washington, D.C.

National Research Council, (2000), Inquiry and the national science education standards, Washington DC: National Academy Press.

Nuffield Foundation (1966), Physics Teacher's Guide-I London, Longmans, Green & Co.Ltd.

Richardson J. (1957), Science Teaching in Secondary Schools, United States of America:Hasll,Inc.

Sime Fida (2004): - A study of the practices and the problems of preparatory Education program in Oromia region. Addis Ababa, AAU

Solomon Araya (2007), The contradiction between the Ethiopian government Rhetoric of new Education Policy and the reality of adaptation of earlier unsuccessful reform proposals". Journal of Education for Development, Vol-II, No.1

Sootin H. (1964): - Science Experiment with Sound, York: W.W. Norton and Company.inc

Tekeste Negash (1990), The crisis of Ethiopian Education: some implication for national –building/Uppsala Sweden.

Tesfaye Abebe (2009), Status of Physics practical work implementation, the case of some selected government and private secondary schools in Addis Ababa city Administration, Addis Ababa, AAU

Tobin K.G., (1990), Research on science laboratory activities; in pursuit of better questions and answers to improve learning, School Science and Mathematics

Transitional Government of Ethiopia (1994, 1994b: 7-8), New Education and Training Policy, Addis Ababa, Ministry of Education (MOE)

UNCSTD (1979), The World Conference on Education for All, UN Printing press

Wellington, J. (Ed.) (1994), *Secondary Science: Contemporary Issues and Practical Approaches*. London: Rout ledge.

Wellington, J. J. (1981), 'What's supposed to happen sir?': some problems with discovery learning, *School Science Review*, 63(222), 167–173.

Wellington, J. (1998), Practical Work in School Science. *Which Way Now?* London: Rout ledge.

World Bank Report (1993), Equipment for Science Education, Constraints and Opportunities.

World Book Dictionary (No Date)

Woube Kassaye (2005), An Overview of Curriculum Development in Ethiopia: 1908-2005 Addis Ababa.

Zinaye T. and Dawit M. (2001), Teaching High School Physics, Teaching material, Bahirdar, Bahirdar University.

## DECLARATION

I declared that this thesis is my original research work and that all sources of materials and data used for the thesis have been acknowledged & approved by the assigned advisor.

Name of post graduate student: - TSEGAYE ENGIDA MINALE

Signature: - \_\_\_\_\_

Submission Date \_\_\_\_\_

This thesis has been submitted for examination by my approval as a University advisor of the student.

Name of Advisor: \_\_\_\_\_

Signature \_\_\_\_\_

Date of Approval: - \_\_\_\_\_



# Addis Ababa University

## School of Graduate studies

### Institute of Educational Research

#### Questionnaire to be filled by students

*The purpose of this questionnaire is to collect information about the current status of science practical work implementation at the government, private and public preparatory schools in Addis Ababa.*

*The information gathered through this questionnaire will be used only for the research purpose and you are confidently assured that your response will be held in strict confidentiality. Therefore you are kindly requested to fill the questionnaire genuinely and responsibly for it is the chief determinant to the success and truthiness of the study. The researcher would like to express his thanks to you in anticipation for devoting your time, experience and energy to complete this questionnaire.*

**Remark:** *for the purpose of this inquiry the term “practical work” or laboratory activity means experiments/investigations performed by the teacher as demonstration, series of experiments and observational exercises carried out by students in the laboratory or in the classroom or elsewhere.*

Please refer to your own experience, take it easy and complete the form independently of your fellow students.

#### General Direction

1. Do not write your name.
2. Please write other relevant information following the request of the format.
3. Tick with a Mark (✓) your responses to the space provided except the items which require written responses.
4. Additional comments in any section of the form will be welcomed.
5. Since this research is designed for improvement of your practical skill fill free and confident to write any relevant idea for this study.
6. Do a mental gymnastic with the questions here given below. Thank you in advance, for your cooperation.

#### **Part-I: - General Information**

A. Name of the school\_\_\_\_\_

B. Sub-city\_\_\_\_\_

- C. Woreda \_\_\_\_\_
- D. School type
- i. Government
- ii. Private
- iii. Public
- E. Sex : - Male  Female
- F. Your Grade level: - Grade 11  Grade 12
- G. No. of students in your class: \_\_\_\_\_

### *Part-II*

**Instruction: - indicate your responses by circling the appropriate answer for the questions except the questions which require written responses.**

1. Is there an organized science laboratory (i.e. Biology, Chemistry and Physics laboratories) in your school?
 

A. Yes                      B. No
2. Is there a separate lab room for each science discipline (Biology, chemistry and Physics).
 

A. Yes                      B. No
3. If your response in Q.1 and 2 is 'yes' is it functional?
 

A. Yes                      B. No
4. Have you ever observed any science demonstration during the first and second semester of the current academic year 2004 E.C?
 

A. yes                      B. No
5. If your answer for Q. 4 is 'Yes' how many times do you involve in practical activities in each semester?
 

i. First semester \_\_\_\_\_

ii. Second semester \_\_\_\_\_
6. From Which stream of science do you get sufficient practical skill and opportunity for lab activities?
 

A. Biology lab \_\_\_\_\_ reason \_\_\_\_\_

B. Chemistry lab \_\_\_\_\_ reason \_\_\_\_\_

C. Physics lab \_\_\_\_\_ reason \_\_\_\_\_

D. More or less there is equal chance \_\_\_\_\_
7. Do you know the meaning and use of "Laboratory and practical work in science?"



17. What is your agreement on the idea that laboratory/ practical work has a great contribution on students' achievement in science scores?

- A. Strongly agree            B. Agree            C. strongly disagree

18. Do you have well-trained laboratory technician/lab assistant at your school?

- A. Yes            B. No            C. I don't know

19. What factors do you think that would affect or hinder the performance of practical work at your school?

A. Are they lack of tools? \_\_\_\_\_

B. Are they lack of reagents? \_\_\_\_\_

C. Lack of commitment and awareness? \_\_\_\_\_

D. Large class size? \_\_\_\_\_

E. Teachers work load? \_\_\_\_\_

F. Mention others? \_\_\_\_\_

20. To what extent do you think the experiments demonstrated by the plasma TV replace the real experiment taking place in the class room or in the laboratory?

- A. Agree            B. Disagree            C. strongly disagree

21. Is there a science laboratory club (i.e. Biology, chemistry and Physics lab clubs) in your school?

- A. Yes            B. No            C. I don't know.

22. If your answer for Q. No. 21 is "Yes" and if you are the member of the club write its contribution to encourage the implementation of practical activities in your school and advantages you get from the club? \_\_\_\_\_

---

---

23. If your answer for Q. No. 21 is "No" what will be your agreement with the formation of science laboratory club in your school?

- A. Strongly agree            C. Disagree  
B. Agree            D. Strongly disagree

Thank you a lot!

# Addis Ababa University

## School of Graduate studies

### Institute of Educational Research

#### Questionnaire to be filled by teachers

*The purpose of this questionnaire is to collect information about the current status of science practical work implementation at the government, private and public preparatory schools in Addis Ababa.*

*The information gathered through this questionnaire will be used only for the research purpose and you are confidently assured that your response will be held in strict confidentiality. Therefore you are kindly requested to fill the questionnaire genuinely and responsibly for it is the chief determinant to the success and truthiness of the study. The researcher would like to express his thanks to you in anticipation for devoting your time, experience and energy to complete this questionnaire.*

**Remark:** *for the purpose of this inquiry the term “practical work” or laboratory activity means experiments/investigations performed by the teacher as demonstration, series of experiments and observational exercises carried out by students in the laboratory or in the classroom or elsewhere.*

Please refer to your own experience, take it easy and complete the form independently of your fellow teachers.

#### **General Direction**

1. Do not write your name.
2. Please write other relevant information following the request of the format.
3. Tick with a Mark (✓) for some responses to the space provided or encircle the letter of the choice except the items which require written responses.
4. Additional comments in any section of the form will be welcomed.
5. Since this research is designed for improvement of your practical skill fill free and confident to write any relevant idea for this study.
6. Do a mental gymnastic with the questions here given below. Thank you in advance, for your cooperation.

#### **Part-I: - General Information**

- A. Name of the school \_\_\_\_\_
- B. Sub-city \_\_\_\_\_



5. To what extent do you believe on the idea that good science teaching should be based on practical works such as demonstration, experiments and project works, etc?  
 A. Strongly agree      B. Agree      C. Disagree
6. Please write the total number of activities, experiments or demonstrations that are suggested to be done in the text book of the grade (s) to which you have been teaching.

Subject	Lab activities at each Grade level	
	11	12
Biology		
Chemistry		
Physics		

7. How many of the activities did you perform in the last three years including the current academic year?

2002 E.C \_\_\_\_\_ 2003 E.C \_\_\_\_\_ 2004 E.C \_\_\_\_\_

8. For the above question, if you did not perform some or all of the suggested activities, what would be your reason for not doing so?

Mention briefly \_\_\_\_\_

\_\_\_\_\_

9. To what extent do you believe that implementing practical activities frequently would bring significant improvement on the achievement of students' science results?

A. Strongly agree      B. Agree      C. Disagree

10. If your response to Question no. 9 is "agree" in which way does it affect? If your answer is "disagree" what is your reason? Write briefly. \_\_\_\_\_

\_\_\_\_\_

11. Is it science laboratory activities more of

a. Student-centered? Reason \_\_\_\_\_

\_\_\_\_\_

b. Teacher centered? Reason \_\_\_\_\_

\_\_\_\_\_

c. Both teacher and student centered? \_\_\_\_\_

\_\_\_\_\_

d. Mention any other \_\_\_\_\_

\_\_\_\_\_



20. What is your agreement with the formation of science laboratory club in your school for better participation and involvement of students in practical activities and promoting scientific literacy?

- A. Strongly agree
- B. Partially agree
- C. Disagree
- D. Strongly disagree

21. How often do school principals and department heads monitor and evaluate the implementation of practical activities as planned by the curriculum parallel to teaching the theoretical aspect of science?

- A. Yes, it quarterly based.
- B. Yes, it is semester based
- C. Yes, it is once a year.
- D. It is rarely done.
- E. No such tradition at all.

22. Is there well-trained laboratory technician/lab assistant at your school?

- B. Yes
- B. No
- C. I don't know

23. What is your general opinion about the relevance of practical activities in science teaching at preparatory school? \_\_\_\_\_

\_\_\_\_\_

24. What are effective ways for successful implementation of practical activities at preparatory schools in order to produce scientifically qualified and practical- oriented students?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Thank you very much!

## Check list filled by Department head

### PART-III

Instruction: - For the following items about the adequacy of conditions for practical work, please indicate your response using the scale by putting a tick mark (✓) in front of each statement.

Rate each item as S= Satisfactory, or NS= Not Satisfactory, SL= Serious Limitations

No.	Item/determinant factors	Rating			Remark
		S	NS	SL	
1.	Time allotment for lab work				
2.	Laboratory facilities				
3.	Current supply of equipment				
4.	Availability of trained lab technician/assistant				
5.	Class size and number of students				
6.	Science teachers' interest & commitment to conduct lab session				
7.	Students' participation and interest to lab works.				
8.	Support and encouragement offered by school principals.				
9.	Provision of laboratory Workshops, seminars and training to teachers				
10.	Annual budget allocated for purchase of equipments, reagents and other resources.				

## Interviews with school principals

### I. General information

Sub-city \_\_\_\_\_ Kebele/Woreda \_\_\_\_\_

Name of School \_\_\_\_\_ Date \_\_\_\_\_ Time \_\_\_\_\_

### II. Interview Items

1. Could you tell me your responsibility/position in the school?
2. How do you explain the implementation of science practical activities in your school?
3. Is there a budget for science laboratory activities, where does the source come?
4. If there is no budget to the laboratory, how could you repair when laboratory tools, electrical apparatus or pipe lines are damaged and when you need to purchase new tools and reagents?
5. Please explain your plan/strategy of monitoring and evaluating the report from department heads about the implementation of laboratory activities? How often do receive science lab reports from department heads/respective teachers?
6. What measures do take to solve the problems or weak/low performance in science laboratory activities?
7. What is the contribution of the school administration in organizing and implementing science practical works in your school?
8. As a school director do you make regular supervision to evaluate and inspire teachers if the classroom lecture is supported with the practical activities or not?
9. Do you believe that practical works in science (i.e. Biology, Chemistry and Physics) play a great role in promoting the teaching-learning process and progressing academic achievement of students and scientific literacy?
10. What is your opinion about the relevance of practical activities for preparatory students who are joining science stream?
11. If there is a plasma TV in your school, does it replace the actual practical work done in the laboratory? Explain briefly
12. What is the need/trend of the school to train, updating and developing practical skills of teachers through seminars, workshops and sharing experience for frequent practice of science laboratory works?
13. Did the school provide training and workshops for teachers about laboratory activities previously?
14. Do you confirm that laboratory activities should carry certain amount of percentage from the total marks of science subjects?
15. What are the major constraints that face your school to implement all stated practical activities in science text books efficiently and effectively at preparatory level?

Thank you for your time, energy and genuine interview and response!

## **Interviews with Educational Officials (Region, Sub-city & Woreda)**

### **I. General information**

Sub-city \_\_\_\_\_ Kebele/Woreda \_\_\_\_\_

Name of School \_\_\_\_\_ Date \_\_\_\_\_ Time \_\_\_\_\_

### **II. Interview Items**

1. What is your particular responsibility in facilitating the work of schools in producing creative and all rounded citizens?
2. What kind of support does your office deliver to schools in order to improve the status of practical activities in science subjects especially for preparatory students?
3. It is known that under your region/sub-city/kebele there are governments, private and/or public preparatory schools. What kind of support does private and/or public schools receive from the government?
4. Government schools use plasma TV to transmit the lesson where as private schools do not use it, so, how could you explain your expectation of the achievement of the desired objectives of the curriculum based on the New Education and Training Policy of the country under such disparities?
5. What are advantages and disadvantages of the plasma TV in demonstrating practical activities and experiments in science disciplines? Does it replace the real examination and observations conducting in the classroom and the laboratory in the school?
6. What is your opinion about the role of practical works in facilitating the teaching learning process of science subjects and preparing students for higher education?
7. What is your comment in general about the implementation of practical activities in preparatory schools?
8. Do you prepare workshops, seminars and training about laboratory activities to update the skill and capacity of science teachers?
9. What is your opinion on the quality of science graduates in the country?
10. Does access and quality of science teaching go hand to hand?
11. If your answer for Question No. 10 is “No”, what measure should be taken to improve the quality of graduates from various fields of science in the country?
12. How do you monitor and evaluate the successful implementation of practical activities in government, private and public preparatory schools as planned by the curriculum?
13. What is your feedback to schools in order to improve the status of practical activities in science subjects?
14. What do you suggest the main problems of science practical activities in secondary schools in Addis Ababa in general and in preparatory schools in particular?
15. Do you agree with the necessity of this research that is aimed to assess and investigate the current practices, traditions and major constraints of lab activities in preparatory schools?

*Thank you for your time, energy and genuine interview and response!*

## Observation check list

Name of the school \_\_\_\_\_ School type \_\_\_\_\_  
 Sub-city \_\_\_\_\_ Kebele / Woreda \_\_\_\_\_  
 Date \_\_\_\_\_ Time \_\_\_\_\_  
 Grade and section \_\_\_\_\_ Period \_\_\_\_\_

*Instruction:* - For the following Criterion put a tick mark about the implementation of practical activities when observation takes place in the classroom or laboratory in front of each item.

V.G= Very Good (4), G= Good (3), F= Fair (2), P= Poor (1), N =None (0)

No.	Criterion/Item	Rating scale					Remark
		V.G	G	F	P	N	
1.	Teachers preparation and awareness to lab activities						
2.	Time allotment /duration of time						
3.	Students involvement (student centered)						
4.	Conducting experiments/demonstration						
5.	Motivation to practical works						
6.	Clarification of concepts and terms relation to laboratory activities						
7.	Project works and group work assignments						
8.	Engaging students for lab report after conducting experiments						
9.	Conducive environment for lab activities (ventilation, light, class size, silence, etc)						
10.	Measurement and Evaluation of practical work/mark allotment						
11.	Management of practical work						
12.	Overall assessment						

## Document analysis check list

Sub-city \_\_\_\_\_ Kebele/ Woreda \_\_\_\_\_

Name of the School \_\_\_\_\_ Type of school \_\_\_\_\_

Date \_\_\_\_\_ Time \_\_\_\_\_

***Instruction: - Check and confirm the following points concerning document analysis***

1. Does the school include laboratory program/experiments to be done in its annual plan?  
A. Yes                      B. No
2. Is there a posted/prepared practical work schedule in the laboratory classroom?  
A. Available                      B. Not available
3. Does the school have separate laboratory classroom?  
A. Yes                      B. No, it is combined
4. Is it currently fully functional and have the basic facilities?  
A. Yes, complete                      B. partial                      C. Not functional
5. Is there any science manual for Biology, Chemistry and Physics in the school?  
A. Yes, available                      B. Not, available
6. Does the school record and document teachers and students' participation of science practical works?  
A. Yes, available                      B. Not, available/ not recorded.
7. Are there lists of lab equipment and reagents posted on the laboratory board?  
A. Yes, it is posted                      B. No, lists of equipment and reagents
8. Regarding laboratory assistant  
A. Well- trained  
B. Un-trained/not receiving any training nor workshop  
C. No lab assistance /technician
9. Is there a copy of a report document prepared by the department head or the teacher on time frame that has been submitted to the school director?  
A. Available                      B. Not available or No report preparation.
10. Is there a syllabus or curriculum in the school laboratory for reference regarding the objective, relevance and process of implementation of practical activities in science subjects?  
A. Available                      B. Not, available
11. Is there a laboratory manual for Biology, Chemistry and Physics?  
A. Yes                      B. No
12. Is there a science laboratory club for exercising practical activities outside the regular schedule and for more understanding and to enhance the regular science teaching learning process?    A. Yes                      B. No
13. Is annual budget allotted for the science laboratory?    A. Yes                      B. No

