THE IMPACT OF PHYSICS PRACTICAL WORK ON STUDENT'S ACADEMIC ACHIEVEMENT IN PHYSICS EDUCATION (THE CASE OF GHIMBI PREPARATORY SCHOOL OF WEST WOLLEGA OROMIA REGIONAL STATE)

BY:- GEMECHIS MATHEWOS FITE

A THESIS SUBMITTED TO THE DEPARTMENT

OF PHYSICS, SCHOOL OF APPLIED NATURAL SCIENCE

OFFICE OF GRADUATE STUDIES

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

Adama

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DECLARATION

I hereby declare that this MSc thesis is my original work and has not been presented for a degree in any other university, and all sources of material used for this thesis have been duly acknowled ged.

Name :- Gemechis Mathewos Fite

Signature:- ______________________

This MSc thesis has been submitted for examination with my approval as thesis advisor.

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ADAMA SCIENCE AND TECHNOLOGY UNIVESITY

GRADUATE STUDIES PROGRAM

Examination Committee Approval Sheet

This is to certify that the thesis prepared by Gemechis Mathewos :- The Impact Of Physics Practical Work On Student's Academic Achievement In Physics Education (The Case Of Ghimbi Preparatory School Of West Wollega Oromia Regional State) and submitted for partial fulfillment of the requirement for the degree of master of science in physics complies with the regulations of the university meets the accepted standards with respect to originality and quality.

Singed by the Examining Committee

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Chairman, Exam Committee

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Advisor Signature

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Examiner (Internal) Signature

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Examiner (external) Signature

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DEDICATION

This research is dedicated to the creature of everything Almighty God, forever faithful: Source and custodian of all knowledge, next my happy parents Ato Mathewos Fite and W/o Yeshimabet Bekele for they paid a grateful sacrifice for my education starting from the lower class up to the higher institution and also for my all brothers and sisters for their initiating and supporting me for the success of my education. Finally my lovely wife Urge Aga may God bless you in Jesus name, Amen.

ACKNOWLEGEMENT

First of all I like to thanks our Almighty God for that he gave me a support and healthy to accomplish this work, and I wish to convey my sincerest gratitude to Dr. Mesfin Asfawu for that he help me throughout my entire work. I also thank my sister Hillina Mathewos and her husband Teferi Tobo and my wife Urge Aga for their generous support of this work.

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LIST OF ABBREVIATION AND ACRONYMS

AAPT---------------American Association of Physics Teachers

ABL-----------------Active Based Learning

EMPDA--------------Educational material Production and Distribution Agency

FDRE-------------------Federal Democratic Republic of Ethiopia

H----------------------Alternative hypothesis

HO-------------------Null hypothesis

Lab---------------------Laboratory

MCQ------------------- Multiple choice question

MOE-------------------Ministry of Education

NSTAP-----------------National science teachers Association of Pakistan

SME--------------------- Science and Mathematics Education

UNESCO-------------United Nations Educational, scientific and cultural organization

DEFINITION OF KEY TERMS

The key terms used in this study defined as below:

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

Experiment:- A scientific activity carried out under planned, determined conditions or 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).

Laboratory:- a place where scientific work is done, a room or building fitted with apparatus

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

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

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

Laboratory experiments:- a set of procedures carried out by the students using the laboratory equipment and material besides data recording to obtain information under the supervision of the teacher of the subject.

Instructional materials:- refers to the tools used in the instructional process and they range from piece of chalk to computer.

ABSTRACT

The aim of this study was to investigate the impact of practical- based teaching on the student's achievement in Physics at secondary level. Ten (10) lessons were selected from 12th grade Physics for this study. All the natural science students of Ghimbi preparatory school studying Physics at the 12th grade, constituted the population. A sample of 50 students was randomly selected from Government Ghimbi preparatory school. Pretest-Post test Control group and experimental group design of experimental research was selected for this research study. Two MCQs type achievement tests were used as research tools for the data collection. Experimental group was taught with the help of activities whereas the control group was taught the same lessons through traditional method of teaching for the period of six (6) weeks. T-test was used to analyze the data. The study revealed that the performance of experimental group was better than the performance of the controlled group of the students. Furthermore there was significant difference between the performance of the experimental group as compared to the control group with reference to knowledge, comprehension, and application skill. Overall, the findings of the study show that the practical based teaching was much effective than the lecture method teaching of science at preparatory.

Keywords: Practical work, performance in physics, attitude change, science process skills acquisition

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

Our world is profoundly shaped by science and technology, preserving the environment, reducing poverty and improving health: each of these challenges and many more require scientists capable of developing effective and feasible responses – and citizens who can engage in active debate on them. In order to achieve this, the 1999 Budapest Declaration underlined the importance of science education for all.

Indeed, science and mathematics education (SME) that is relevant and of quality can develop critical and creative thinking, help learners to understand and participate in public policy discussions, encourage behavioral changes that can put the world on a more sustainable path and stimulate socio-economic development. SME can therefore make a critical contribution to the achievement of the Millennium Development Goals adopted by the world's leaders in2000.Recognizing this, UNESCO created the International Group of Experts on Science and Mathematics Education Policies, whose first meeting on SME in basic education was held from30 March to 1 April 2009.

The conclusions from this meeting, which form the basis for this publication, show remarkable consensus on the challenges faced by SME today and how these can be addressed. All the experts agreed that the last decade has witnessed the development of a substantial body of knowledge on SME and the production of valuable tools and resources, many of which are now widely accessible thanks to technological advances. These are a firm basis to build on and open new perspectives for evidence-based policy for SME.

This publication therefore defines the challenges faced in the implementation of quality SME in basic schooling and, using case studies, sets out ways of improving its delivery. It will be of use not only to decision-makers wanting to mainstream quality SME education into their systems, but also to stakeholders who wish to participate in the change process. UNESCO hopes that this publication will help mobilize the energy and enthusiasm of children, teachers and parents for improving SME. Indeed, working together on developing quality basics ME in a sustained and coordinated way is the *sine qua non* for ensuring a fairer and more sustainable future for all.

Scientific development in recent decades has, and will continue to have, a significant influence on topics that have great importance for humanity, quality of life, the sustainable development of the planet, and peaceful coexistence amongst peoples. From the immediate basic essentials of life such as access to water, food and shelter, to important issues that affect us all (management of agricultural production, water resources, health, energy resources, biodiversity, conservation, the environment, transport, communication), all have a strong science component to which everybody should have access to take part in local, regional, national and transnational decisions in a meaningful way.

We also live in a world where poverty and riches live side by side and where the gap between them is increasing. The Declaration of Budapest argues that what distinguishes poor people or countries from rich ones is that not only do they have fewer possessions but also that the large majority remain excluded from the creation and the benefits of scientific knowledge. The data clearly show that the greater benefits that science brings are unequally distributed. This translates into inequality and injustice between countries and between social groups. It reinforces the continuing exclusion of groups from the knowledge of science and the benefits of its use, through belonging to particular ethnic, gender, social or geographic groups. Science must not only respond to the needs of society in order to improve the quality of life of the majority population which lives in poverty; it should also be used by all citizens, men and women. To be usable, scientific advances have to be known and owned. The philosopher Fernando Savater, writing on this issue, is clear on the importance of science for all and the impact of being excluded from such knowledge.

Therefore, practical activities are essential in all level of science education and in particular it is highly significant in high and 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. (Ethiopian National Agency for UNESCO: 2001).

Activity-based learning (ABL) as defined by Prince (2004) is a learning method in which students are engaged in the learning processes. In Activity-based learning (ABL) teaching method, in the words of Harfield, Davies, Hede, Panko Kenley (2007) "students actively participate in the learning experience rather than sit as passive listeners erHarfield, Davies, Hede, Panko and Kenley (2007) by quoting Prince (2004) say that active learning method is different from traditional method of teaching on two points. First, active role of students and second collaboration among students. Suydam, Marilyn and Higgins (1977) define activity –based learning as the learning process describes in which "student is actively involved in doing or in seeing something done." According to them Activity –Based teaching (ABT) method "frequently involves the use of manipulative materials". Meaningful learning, according as AlemayehuBishawu(2012) engages activity. According to Churchill (2003), ABL helps learners to "construct mental models that allow for 'higher-order' performancesuch as applied problem solving and transfer of information and skills".

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.

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 affect ting 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 Educational 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 example, several studies suggest that teachers' view, 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.

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). Designing experimental activities can enhance the student's knowledge through certain process such as analysis, synthesis, demonstration and prediction.

Science teaching has the following objectives to achieve:

1. Acquiring the proper functional information.
2. Developing the students' scientific thinking and problem-solving abilities

3. Fostering student proper functional attitudes.
4. Developing certain functional scientific skills.
5. Fostering functional scientific trends.
6. Fostering appreciation scientific attitudes and enhancing recognition of scholars efforts.

These objectives cannot be properly attained without effective use of the science laboratory and experimentation. This attainment can be realized through the teacher's readiness to effectively use the laboratory in teaching science. But, failure to achieve the objectives of science teaching in the upper basic stage is mainly due to the fact that lots of teachers evade laboratory work and science activities though they can easily use the school laboratory (zaytoun, 1996).

The learner has the capacity to learner through personal actions and experience and start developing their ideas about world. They interpret things according to their own thoughts and experiences. Activity based teaching method helps them to swim by getting into water; likewise, a child best learns science by doing science". Doing science construct their knowledge. According to Rillero 1994 "A child best learns to is not only limited to reading or hearing but it holds students in laboratory work to test ideas and develop understanding (Ewers, 2001). Hence, science-teaching plan is incomplete without science experiences Theory and practice must support each other to form an integrated experience.

There is research evidence which shows that students will retain limited knowledge if they are involved passively in teaching- learning process (McKeachie, 1998). The same is indicated in the 'Dale‟s cone of experience' developed Dale (1969) shown below.

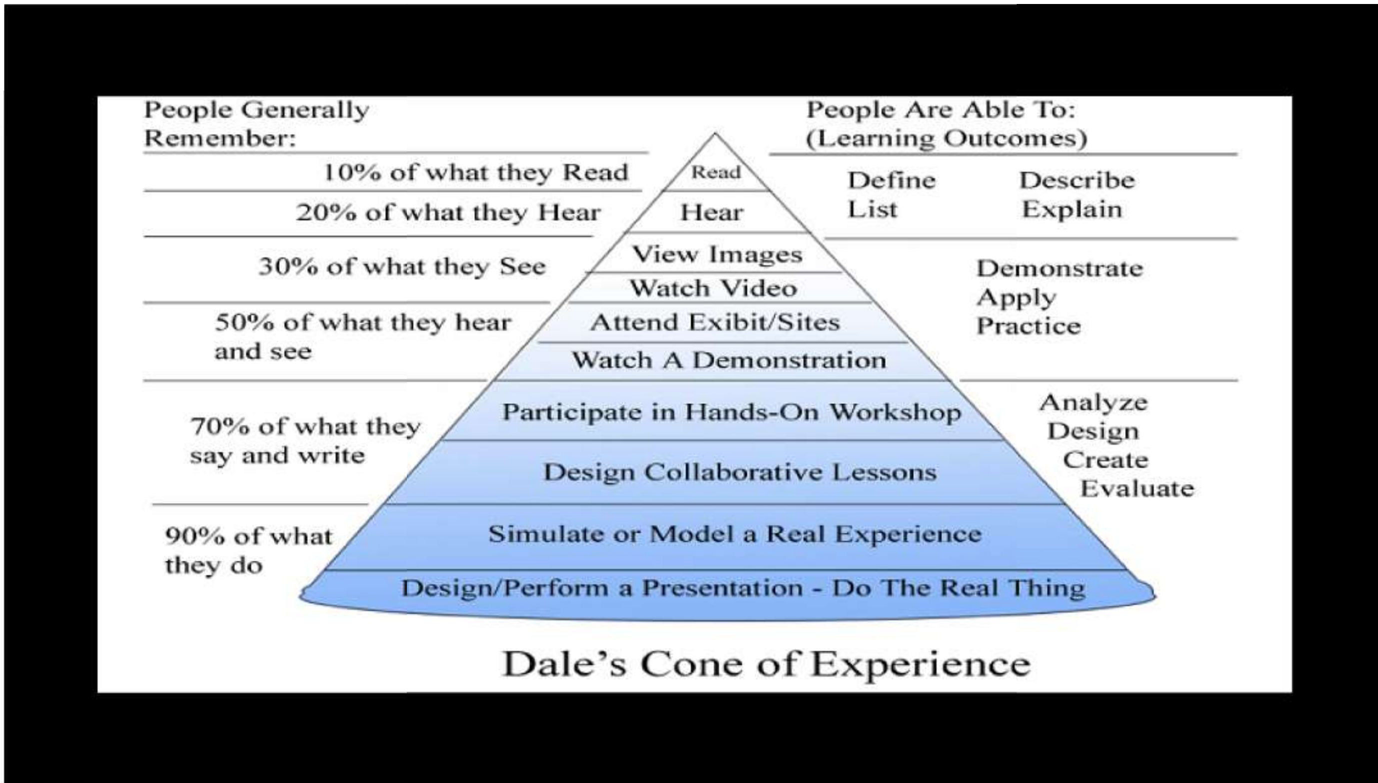

Figure 1: Source: Principles of teaching <http://teacherworld.com/potdale.html>

To develop research in the field, the science education community and especially the research community must be careful to provide detailed description of the participating students, teachers, Classroom 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 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.

1.2. Statement of the Problem

Practical work has been identified as the heart of a good scientific program which allows students in the school to have experience which are consistent with the goals of scientific literacy. Practical learning constitutes a major part in physics education, if it is not taught properly the education of the students in the other science course will be affected negatively. Therefore preparatory schools require properly equipped and functional laboratories. When the students are taught physics theoretically, without the practical aspects done in the laboratory, the students will not learn properly.

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.

The implication of this means that the role of the laboratory on the academic achievement of the students in physics is being ignored. Consequently, the students lack;

- ✓ Scientific attitudes
- ✓ Problem solving skills
- ✓ Acquisition of scientific skills
- ✓ Scientific research environment, as a result learn physics poorly
- ✓ Perform poorly in practical physics in internal and external examinations.

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 problems 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 physics works in schools. I want to understand the actual practices of schools in carrying out in adequate physics practical activities, how it improves the result of students and the constraints that impede these activities. Moreover, department heads on practical works as they are implementing according to the curriculum or syllabus. The solution to the above mentioned impacts constitute the problem of this study. Therefore by considering physics as most difficult subject to learn and to get fruitful achievement relative to other subjects. The experience shows most of the students have low achievement in learning physics. This is reflected by having low participation in physics classes like answering question and asking unclear idea in physics lessons and also most students don't work their class work as much as possible on time, do not work properly their homework and also having low practical (laboratory). Therefore based on the above investigation the study aims to find out the impact of physics practical work on student's academic achievement in physics teaching that need practical work to teach (the case of high school of west wollega oromia regional state) in government schools.

1.3. Objective of the Study

This study seeks to establish the impact of physics practical work on student's academic achievement in physics teaching that need practical work to teach (the case of high school of west wollega oromia regional state) in government schools, in addition, the study seeks to recommend and show measurements to take and to identify effects in order to solve the problem.

1.3.1. The General objectives of the Study

To find out if there is an overall difference in academic achievement by students taught using practical activities compared to those taught using conventional teaching methods.

1.3.2 Specific objective of the Study

- To assess how practical activities are being conducted parallel to the theoretical lessons in physics lesson in high schools.
- To identify the main cause that influence practical activities in the department of physics in high schools.
- To check the preparation and experience of school in implementing practical activities as planned by the curriculum and syllabus.
- To examine the availability and adequacy of physics laboratory equipment to practical work for students.

1.4. Research hypothesis

The following hypotheses were tested at 0 .05 level of significance.

- There is a significant difference in academic achievement by students taught using intensive practical activities compared to those taught using conventional teaching methods.
- No change in academic achievement by students taught using traditional teaching method and intensive practical activities with theoretical method of teaching.

1.5. Significance of the Study

The study may be significant in the following regards

- The study can help as the source of information about impact of practical activities teaching on physics students' achievement in high or preparatory schools.
- It helps the physics teachers to have an interest for practical activities and attract their students to science.
- It enables school principals to motivate teachers and laboratory technicians to use local materials to teach practical activity and make students use it.
- The study may help in giving appropriate solutions for the students, physics teacher and other concerned bodies to take measurements to overcome the problems.
- The study besides, the above importance it will also help as for other researcher for further investigation of the problems.

1.6. Delimitation of the Study

This study is delimited to selected Government preparatory schools in west wollega zone Gimbi town. The researcher wants to assess and address the impact of practical activities teaching on physics student's achievement in preparatory school in selected school.

1.7. Limitation of the Study

While conducting the study, the researcher believes that the following challenges will face during the study;

- Shortage of time, cost limitation, shortage of materials and references related with the study to dig out all possible data for its sources.

- Permission and co-operation of school principals and educational experts.
- The respondent will be delayed in participating in teaching learning process to get continues evaluation.

1.8 Rationale of the study:

Because of ongoing invention and scientific discoveries, events in a year is witnessed, many changes and transformations in most of the educational cabochon took place. The main reason of such new growing has been focus on the practical activities that looked as root for the problem solving expansion. As a result of this, class room teaching has become an indispensable element in teaching science since the introduction of the new science curriculum abounding with tremendous experiments and practical activities that emphasize the student role as the essential element in the teaching-learning process. Then students can discover facts, recognize concepts, can deduce theories and invent new laws and principles.

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 hypothesis, objective, significance, delimitation, limitation, organization of the study, rationale of the study, objectives of practical work in teaching physics, and definition of key 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 THE LITERATURE

2.1 The Meaning and Nature of Practical Work

To acquire specific knowledge systematically in depth, the most important means of teaching is activity based teaching that it gives an increased emphasis in enhancing student involvement in scientific investigation. The emphasis arises from the view that science cannot be effectively learnt from books and lectures alone and neither can it be taught by simply telling students about science. An activity based teaching has dual purpose. It gives the students the subject knowledge, on one hand, and it provides the student some understanding of scientific investigation, on the other hand. Subjects that require practical work to teach are Physics, Chemistry and Biology. Hence, in order to administer practical work in those subjects, there should be adequate demonstr ation room, which encompasses separate demonstration equipment, store and preparation rooms, equipped with different instructions and reagents as well.

Kerr (1963) described practical work as experiments performed by the teacher as demonstration, co-operation 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).

Constructivism as defined by Piaget (1983) serves as theoretical frame work for this study. According to the theory of constructivism, each child creates, or builds, or constructs meaning from experiences. In physics practical activities the child is the active agent, processing information and experience from the world. Using his or her mind like an erector set the child builds an increasingly complex set of cognitive structures to figure out what is going on in the real world. According to this theory, it is the discrepancy between the previous knowledge and the recent activities that create “cognitive conflict „which positions the learner for reflection and resolution through interactions with the learning environment. The constructivist approach is based on the following principles:

1) Learning is an active process. Learners, based on their own prior knowledge or and experience, extend the system of knowledge through personal work or interaction with other sources in the learning environment. Learners are given more responsibility and ownership for learning to structure knowledge and solve problems actively according to their own interest, needs and learning purpose.

2) Sets learners in a learning community for developing, testing and modifying their ideas and sharing the intelligence of others by means of dialogue, debate, discussions and negotiation.

3) To gain practical knowledge and skills for other situations, learners have to be furnished with tools and resources to solve authentic problems

4) It is also essential to provide learners with learning scaffolding to excite the zone of proximal development.

2.2 Science Education, Equity and Equality

In the 21st century, science must become a good shared by all, for the benefit of all people. The view of science that this document proposes will make a significant contribution to combating the forms of ignorance identified by Savater. It is a view of science learning that will deal with scientific principles through an approach where children are taught, and learn, to write and talk about science, to argue for their views of the world and how they can draw on this knowledge to help in decision-making. This is no small challenge yet we are inspired by the ideas of AmartyaSen (2001) on the link between poverty and freedom, education and liberty

People need access to the necessities of life in a world where there is more than enough for everybody. They also need access to ways in which they can expand the freedoms they experience, and develop the capacities needed to take advantage of such opportunities, and so become more human. We propose an approach that shows how school science can make a significant contribution to this enterprise by outlining a view of school science that deals with the challenge of ways of learning science and ways of learning through science. This approach is designed to contribute to the challenge of the ever-growing realization of the need for scientific understanding to support decision-making, and to be able to take an active part in decisions that affect all our communities. Every citizen needs to be able to take decisions that affect individuals, communities, regions, our countries and the world, decisions that need a science education based on an understanding of ethics and of interdependency. Thus, science learning has to be seen as necessary for the full realization of a human being. When the majority population is scientifically illiterate, it not only aggravates inequity but also presupposes the exclusion of this majority from true participation in and influence on their environment.

Therefore, we are obliged, not simply from an educational perspective, but also from that of ethics and social commitment, to increase efforts to ensure that all have access to an appropriate scientific and technological culture. While some argue for the need to concentrate resources on high-achieving students in science, international studies such as TIMSS (2008) and PISA show that where systems are more equal, country outcomes in international comparisons are higher.
This right to universal access to quality science education has been recognized for some time by UNESCO, with recent refinements of the arguments in its favor (Macedo 2006, 2008). The challenges to achieve this quality basic science education are many. First, access alone presents many facets.

Whilst science has come to have an important place in basic education in many parts of the world, sometimes it is almost non-existent in primary education. In less favored countries, primary education is often the only education for the majority of students. It is essential, therefore, to establish the place of science for all in elementary or primary education and thus meet the challenge of quality science education for all. Without access for all and the ability to make use of the opportunities that school offers there can be no quality science education. What is proposed below is a new way of doing school science to meet the challenges that we will identify. We hope such a school science will go some way to combat the poverty of mind and body that is a daily experience for so many of our fellow human beings. In our interconnected world, their restricted humanity affects us, as our continued living with this situation inhibits our ability to become ever more human (Singer 2009). We should all fight to ensure that we can all become more human, and school science has a key role to play.

2.3 practical works in physics teaching

Tesfaye (2009) described "practical work 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 several studies about the effects of the laboratory experiments on students' achievement. Conrad (1983) states that the practical work positively affects students scientific attitudes, thought and mental faculties. Students who use scientific thinking strategies and laboratory skills achieved higher than those who are taught by the traditional method. El-Safy (1988) conducted a study involving (140) students of the third intermediate grade , divided equally into control and experimental groups. The study investigated the effect of the presentation method versus the experimental method on the students' achievement in chemistry .As the experimental group scored higher than the control group, the study indicated that there were statistically significant differences between the achievements of both groups.

Kok and Brian (1993) in their study compared knowledge cognition and the learning outcomes of the preparatory stage students, who studied science through laboratory investigations, and the students who were taught by the traditional teaching method in the capital city of Singapore. The study showed that there were significant differences in the mean scores of the students who studied science through experiments and those who studied through the traditional method. The students taught by using the laboratory experimental method scored higher than the students taught by the traditional method.

El-Shemaly (2006) studied the laboratory effect on the tenth grade students achievement of physics concepts. The sample of the study consisted of 96 students divided equally into an experimental group and a control one. The study showed that there were statistically significant differences in the mean scores of both groups. The students of the experimental group scored significantly higher than those of the control group, but there were no significant differences at $\alpha=0.05$ that could be attributed to the student gender in both the control and the experimental groups.

Harty and Al- Faleh(1983) conducted a study about the effect of lecture- presentation method and the small groups experiments on the Saudi secondary school students' achievement in chemistry and their attitudes to science. The study involved a sample of seventy-four secondary students in Riyadh, the capital of Saudi Arabia. They were divided into a control group, taught by lecture- presentation method, and an experimental group, taught by the small group experiments. The study showed that there were statistically significant differences between the achievements of both groups; the experimental group scored higher than the control group.

Lemlem Telila(2010) proposes that the school laboratory has a significant role in accomplishing the cognitional, emotional and psychomotor objectives . To carry out laboratory experiments, the teachers must have the readiness and positive attitude toward laboratory work, and should be able guide the students and advise them so that they can carry the work successfully.

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Hussein (2001), also investigated the effect of laboratory experiments on the send grade secondary students' achievement in chemistry in Abyan Governorate in Yemen .The sample of study consisted of 126 students divided into an experimental groups and a control group. The study showed the experimental group students scored higher than the control group students, due to the positive effect of laboratory experiments on the students' achievement.

According to Brophy(1995)students learn concepts in depth if these concepts are learnt in a different context which may include classroom lecture, laboratory experiments, textbook readings etc. Moreover, they can apply this knowledge in novel situations in a better way. To familiarize students with scientific knowledge is one of the aims of science teaching(Carey & Smith1993) so they can apply this knowledge in problem solving situations.

According to National Research Council (1996), it is "a process of inquiry that requires asking questions, observing, data exploration and data manipulation. It requires learning to apply and generalize scientific knowledge". Creating such learning environment requires engaging learners in different activities.Active engagement inlearningactivities develops conceptual understanding and motivates students to seek further information (Brophy, 1995).

There are mixed findings of different researches about the effectiveness of ABL. Suydan, Marilyn and Higgins (1977) reached on the conclusion that ABL in elementary mathematics is more effective than traditional method of teaching. According to Brophy (1995) students learn concepts in depth if these concepts are learnt in a different context which may include classroom lecture, laboratory experiments, textbook readings etc. Moreover, they can apply this knowledge in novel situations in a better way. To familiarize students with scientific knowledge is one of the aims of science teaching (Carey & Smith, 1993) so they can apply this knowledge in problem solving situations. Science is more than collecting and manipulating data or memorizing knowledge. According to National Research Council (1996), it is “a process of inquiry that requires asking questions, observing, data exploration and data manipulation. It requires learning to apply and generalize scientific knowledge”. Creating such learning environment requires engaging learners in different activities. Active engagement in learning activities develops conceptual understanding and motivates students to seek further information (Brophy, 1995).

Hake (1998) found that ABL significantly improves conceptual understanding of the students in a physics class. Magno et al. (2005) reached on the conclusion that “the classes receiving the PBL activity on memory had significantly higher performance accuracy in the test and had higher attitude as compared with the other classes who received instruction through traditional method”. While conducting research on teaching experimental economics for high schools, Brock and Lopus (2004) concluded that “ABL do a good job of satisfying the conditions sufficient for economic experiments”.

Teo&Wong (2000) view that traditional teaching approaches do not encourage learners to associ ate with previously acquired knowledge. On the other hand, Boud & Feletti (1999) remarked that activities based learning encourage students to learn how to learn through different activities and real life problems. ABL is more effective to teach physics at secondary level as compared to trad itional method ofteaching. However, Lieux,(2001)and Zumbachetal.(2004) found no significant difference in knowledge acquisition between students who learned through ABL method and who learned through traditional method of teaching.

Doucet et al. (1998) and Blake et al. (2000) found that students who were taught through ABL performed significantly better on both basic and clinical sciences. Verhoeven et al.‟s (1998) partially while Dochy et al. (2003) completely agreed with their findings. Berkson (1993) and Colliver (2000) could not find any evidence to maintain the superiority of ABL method over traditional method of teaching. Gallagher and Stepien, (1996) found no significant difference on “short-term retention‟ assessment between students of traditional learning and ABL.

Norman and Schmidt,(1992) cited Dochy et al., (2003) and Mårtenson et al.(1985) that , on long term retention assessments‟ students of ABL performed better than traditional students. Hung, Jonassen, and Liu (2008) referred Eisensteadt et al. (1990) that traditional students retained more than ABL students in the recall test conducted immediately .However, retention rate of traditional student declined fast as compare to ABL students. In higher order thinking skills, ABL students performed significantly better than traditional students in one of the study conducted by Polanco et al. (2004) to investigate the impact of ABL on „students" academic achievement" in mechanics. Shelton and Smith (1998) conducted a research study on biomedical students and found better performance of the biomedical students of ABL in the achievement test than their counterparts. In a study, Gallagher et al. (1992) noted remarkable improvement in the results of ABL students than their counterparts and viewed that ABL is an effective method of developing „problem-solving processes and skills". Hung, Jonassen and Liu (2008) mentioned that ABL has "*positive impact on students" abilities to apply basic*

2.4 Science Education and the World of Work

All schools and schooling systems accept that part of their role is to prepare children for the world of work, sometimes implicitly and, more and more, explicitly. To achieve this aim, school systems and their stakeholders will see that affective and motivational aspects of science learning are important not only in the classroom, but also in the wider societies. In two lectures given at the University of Montreal in 2008, the former Assistant Director-General for Education of UNESCO, John Daniel, presented a convincing argument for education as the way to development for all and in particular for the development of less developed countries. President Obama in his address to the national Academy of Sciences in April 2009(Obama 2009) took the same approach.

His administration is attached to the idea that the United States, which has one of the most influential economies of the world, must increase its scientific activity and, above all, improve the quality of science education at all levels as a way for the country to overcome the financial crisis and its effects. Obama acknowledges that the connection between, national and personal development on the one hand, and increasing the quantity and quality of science education on the other hand, is not simple or direct. However, he argues that action is necessary. This example suggests that every society must pay particular attention to the scientific and technological education of its future citizens. Work on student attitudes to science suggests that this increase cannot be achieved by more of the same school science. Decreasing interest in school science shown by students across the world is an important challenge (Royal Society 2008a).

There are well-documented studies of declining interest in science and science careers in both primary (Jarvis and Pell 2002) and secondary schools (Royal Society 2008b; Sturman and Rudduck 2009, TIMSS, PISA). In his 2009address, President Obama identifies this as a global issue. It is vital that we increase the interest of students in science. In addition, certain groups are under-represented in science careers: girls, minorities, people from lower socio-economic groups. We need to take steps to explore reasons for such inequality and move to remove barriers to participation. While this trend is clear and may at times seem overwhelming in its demands, similar studies also show that students in basic education (Jarvis y Pell 2002, Talentito-Neto, 2008), teachers in initial education and those working in the classroom (Osborne y Collins 2000, NFER2008), all overwhelmingly agree that science and technology are interesting and important for them and that they should be included in basic education.

Teachers (Duckworth 1995) and children (Jarvis y Pell 2002, Clarke et al. 2008)enjoy working with science ideas, especially when they have the opportunity to investigate their own ideas and compare them with the ideas of standard science. Challenges facing society, such as energy, genetics, and climate change, are of great interest for a variety of people. The implication from this is clear and goes some way to providing an answer to the challenge of declining student interest in science. Students reject a school science that is disconnected from their own lives, a depersonalized science, where there is no space for themselves and their ideas. The international review comparing 15 year-old students' views of science with other subjects, carried out by the International Council of Associations for Science Education (ICASE) and the Australian Science teacher Association (ASTA) with the support of UNESCO, reached a clear conclusion on why students might lose interest.

2.5 The Purpose of Practical Work in Teaching Physics Subject

Objectives of practical work had been stressed from as far as the early nineteenth century and special attention had been given to practical work by the teachers and researchers (shah, 2004).

Hodson (1996a) has stated some of the purposes of the practical work in science education which are summarized here:

1. To help students learn science means acquiring conceptual and theoretical knowledge;
2. To help students to learn about science means developing an understanding of the nature and methods of science;
3. To enable students to do science means engaging in expertise in scientific inquiry.

This is very much in line with the view of Berry etal.(1999,page 27) when they say that, practical work is a thinking task supported by laboratory equipment, a view strongly endorsed by the work of Carnduff and reind(2003). After a comprehensive review of the literature, they provide a set of possible reasons for the inclusion of practical work in undergraduate courses in chemistry. While these refer specifically to undergraduate chemistry work, the set of aims has wider significance and can be interpreted in terms of physics laboratories at school level.

As Tefaye (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. These 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.

Pedagogy for conceptual, procedural and NOS (Nature of Science) learning in science education could be more effective and inclusive when:

- the existing ideas and beliefs that learners bring to a lesson are elicited, addressed, and linked to their classroom experiences;
- science is taught and learned in contexts in which students can make links between their existing knowledge, the classroom experiences, and the science to be learnt;
- the learning is set at an appropriate level of challenge and the development of ideas is clear – the teacher knows the science;
- the purpose(s) for which the learning is being carried out are clear to the students, especially in practical work situations;
- the students are engaged in thinking about the science they are learning during the learning tasks;
- students' content knowledge, procedural knowledge, and knowledge about the nature and characteristics of scientific practice are developed together, not separately;
- the students are engaged in thinking about their own and others' thinking, thereby developing a meta cognitive awareness of the basis for their own present thinking, and the development of their thinking as they learn;
- the teacher models theory/evidence interactions that link conceptual, procedural, and NOS outcomes and discussion and argumentation are used to critically examine t relationship between these different types of outcomes, (Hipkins et al 2002, p230).

CHAPER THREE

RESEARCH DESIGN AND METHODOLOGY

This chapter deals with the research design, source of data, sample population and sampling technique, data gathering tools procedure of data collection and methods of data analysis.

3.1. The Research Design

A researcher plan is, a structure and strategy of investigation conceived as to obtain answers to research hypothesis. It is plan of research practice that indicates what researcher will do from problem formulation to suggest operational implication. The research design that was adopted in this study is the hypothesis-testing research. In this design, population of the study is studied through the result of pre and post test extracted from both experimental group and controlled group. The finding from the sample of the population generalized to the entire population.

3.2 Research Area

The study was conducted in the Oromia region:-west wollega zone Gimbi town. Gimbi town is found in oromia region in west part of Ethiopia and 431km far from the capital city of Ethiopia Addis Ababa. In Gimbi there is one governmental preparatory school and one non-governmental preparatory school.

3.3 Sampling Size and Sampling Techniques

It is impossible to include every member of the population in the study due to a number of constraints (time money and others) and effort. To make the sample area manageable and representative, one preparatory school was selected purposively on the assumption that they are relevant source for the case under study. The total number of twelve grade students in schools is about 489 and 10% of it has been taken as sample of students for the study which is about 50 students were taken as sample of students for the study which is grouped in two group namely experimental and controlled.

Table 1: Sample size of Experimental group and Controlled group

Group	Number of students			Age
	Male	Female	Total	
Experimental	16	9	25	17-20
Controlled	17	8	25	17-20

3.4. Data Collection Instruments

The study was focused on the preparatory school students' opinions in physics, experiences in physics class, experiences out of school about physics and the environment of the school in physics education to assess on the impact of practical work on physics students achievement in preparatory school at this area. The sources of the population are all preparatory school students, physics teachers, laboratory assistances and school directors. This study used quantitative and qualitative methods to prove reliable information about the problem. To collect sufficient and rich data a t test such as pre and post was administered and the scored result was analyzed with a controlled way. In order to achieve the goal of this study the researcher was used the result registered from pre and post test achievement.

3.5 Sample selected topics and duration of teaching topics

Those two groups namely experimental and controlled student was learned the selected topics from physics for grade twelfth; electrostatics, electricity, electromagnetism. Those two topics was presented in form of theory and active based teaching. The controlled group was learned theoretical part of the lesson and the experimental group was learned both theoretical and active based learning. Both groups was taught for one month.

3.6 Observational Check List

The observational check list has to be taken from the record data about the actual practical activities in the laboratory and it is most commonly involves insight or visual data. Here the researcher was used his naked eyes to observe supplementary situation to strength the information that were found in the school selected.

3.6.1 Academic Achievement Test

A pre-test was administered to check the equivalence of the experimental group and controlled group before treatment on the topics selected above. The same post-test was administered on the topics from the beginning of the experimental approach up to the end for both experimental group and controlled group. The scores of the students on post-test used to determine whether the experimental group and control group the same or not in academic performance after treatment.

3.6.2 Informal classroom observations and interview

The researcher employed informal classroom observations and interview for both group of students. Each group was taught by two different teachers. The researcher made four observations during teaching learning process in the classroom and two interviews with the students. The informal observations were made to determine whether the practical based learning methods encouraged the students to participate actively or not in the classroom.

3.7 Research Procedure

The researcher required the next steps for studying this particular research. Identification of the problem, important literature was reviewed to get satisfactory information about the title, objectives were formulated to show the direction of the study, data were collected by using academic tests scores of both experimental group and controlled group, the data was tabulated and analyzed by using statistical method such as frequency, percentage, mean, range, t-test and standard deviation. Before distributing and administrating the pre test a brief explanation and guidance was given for the participants about the purpose of the study advised to provide genuine response. The test was given in a controlled manner out by the participants in the presence of data collector under restrict exam like discipline to minimize the risk of exchanging information. And also the paper was collected in a well disciplined manner and after this post test was given for both group and the data was organized in a good manner again. Finally, the researcher made interpretation and generalization based on analyzed data.

3.8 Instrument

MCQs type written tests were developed for the collection of data. Pre-test was developed from the selected topics of 12th grade Physics, keeping Blooms ‟taxonomy in view. Out of 20 questions, four (4) of knowledge, four (4) of comprehension, four (4) of application, four (4) of analysis, and four(4) questions of synthesis were constructed.

3.8.1 Reliability of the test

Reliability is the extent to which a questionnaire, test, observation or any measurement produces the same results on repeated trials. In short, it is the stability or consistency of scores over time or across scores. In this study 20 item MCQs pre and post test were developed by researcher using text book, Ethiopian university entrance examinations based on lesson's objectives. Test-retest reliability was estimated with correlation between the scores at time (1) and the scores at time (2). The reliability of the coefficient of alpha of the academic achievement test was 0.87. This indicated that the tests were reliable.

3.8.2 Validity of test

The validity of the test was checked by the physics department head and other two physics teachers in the school. They comment on it is adequate, it is suitable, it can provide information about the status of academic performance of students, there is a good match between the content of the lesson and the objective of the lesson and it can adequately measure all objectives of the lesson. Item difficulty and item discrimination index were calculated and test items of mixed difficulty were selected finally. Content validity of the tools was established by discussing them with two different subject specialists and an educationist in the field of science education. Reliability of the Pre-test and post-test was estimated at 0.86 and 0.89 by using split-half reliability method.

3.9 Data Analysis

After collecting all the data through test results, their result is organized, checked in right way and analyzed through SPSS soft ware and the data analysis from the test was collected, organized and tabulated on a table of each variable. The information from the gathered data was checked for accuracy and completeness. In this study, the descriptive statics like as mean and standard deviation and other software packages including SPSS was been implemented.

CHAPTER FOUR

RESULT AND DICUSION

4.1 Discussion

The study determined the academic performance of students taught with practical learning approach and those taught with non practical learning method were significantly different. Two hypotheses were tasted.

4.1.1 Discussion of finding based on hypothesis

Hypothesis one is: there is a significant difference in academic achievement by students taught using intensive practical activities compared to those taught using conventional teaching methods. The result of post-test administered to the students of both experimental group and controlled group after treatment indicates that students those taught by active learning methods achieved better than students those taught by traditional teaching method. Hypothesis two: no change in academic achievement by students taught using traditional teaching method and intensive practical activities with theoretical method of teaching. That means;

From the finding the students who learned with clear demonstration that means learned the subject matter in depth and has a skillfully to understand the objective of the learned physics subject while compared to students who learned the subject or the content selected to teach them. This implies that teaching physics with practical activities will help learners to have knowledge of the subject matter in good manner.

To find the significant difference between the mean scores, “independent samples t-test” was applied at the significant level of 0.05. Different null hypotheses were developed to test the significant difference between the control and experimental group.

$H0_1$. There is no significant difference in the achievement scores of the students of control group and experimental group in the pre-test.

Table 2: Achievement Scores of the students of control group and experimental group on pre-test

Domain	Group	N	Mean	Df	t- value	P(0.05)
Knowledge	**Experimental**	**25**	**5.24**		**0.67**	**0.67 < 2.01**
	Control	**25**	**5.04**			
Comprehension	**Experimental**	**25**	**5.08**		**-0.75**	**-0.75 < 2.01**
	Control	**25**	**5.28**			
Application	**Experimental**	**25**	**5.28**	**48**	**0.95**	**0.95 < 2.01**
	Control	**25**	**5.04**			
Analysis	**Experimental**	**25**	**4.80**		**1.17**	**1.17 < 2.01**
	Control	**25**	**4.52**			
Synthesis	**Experimental**	**25**	**5.24**		**0.68**	**0.68 <2.01**
	Control	**25**	**5.08**			

Critical value of t at 0.05 = 2.01

The calculated t-values are less than the table values. It is clear from the results shown above in the Table that there is no significant difference between the mean scores of the experimental and control group in the cognitive domains of knowledge, comprehension, application, analysis and synthesis. Hence, It is concluded that both the experimental and control groups were the same in the cognitive skills before the treatment.

$H0_2$.: There is no significant difference in the achievement scores of the students of control group and experimental group on post-test in the domain of knowledge.

Table 3: Achievement Scores of control group and experimental group on post-test t in the domain of knowledge

Group	N	Mean	Df	t-value	P(0.05)
Experimental group	**25**	**5.76**	**48**	**1.00**	**1.00 < 2.01**
Control group	**25**	**5.48**			

The calculated t-value is less than the table value (calculated t=1.00 and table value=2.01). Hence, it is concluded that there is no significant difference in the achievement of the students of experimental group and control group in the domain of knowledge.

H_{03}. There is no significant difference in the achievement scores of the students of control group and experimental group in the post-test in the domain of comprehension.

Table 4: Achievement Scores of control group and experimental group on post-test in the domain of Comprehension

Group	N	Mean	df	t-value	P(0.05)
Experimental group	**25**	**5.96**	**48**	**1.11**	**1.11 < 2.01**
Control group	**25**	**5.72**			

As the calculated t-value is less than the table value (calculated t=1.09 and table value=2.01), there is no significant difference in the achievement of the students of experimental group and control group in the domain of comprehension.

H_{04}.: There is no significant difference in the achievement scores of the students of control group and experimental group in the post-test in the domain of application.

Table 5: Achievement Scores of control group and experimental group on post-test in the domain of application

Group	**N**	**Mean**	**df**	**t-value**	**P(0.05)**
Experimental group	**25**	**5.8**	**48**	**3.60**	**3.60 < 2.01**
Control group	**25**	**4.92**			

The calculated t-value is greater than the table value (calculated t=3.60 and table value=2.01). It is clear from the result shown above in the Table 5. That there is significant difference between the mean scores of the experimental and control group which means that there is significant difference in the achievement of the students of experimental group and control group in the domain of application.

Hence, It is concluded that activity-based teaching method is more effective than the traditional method of teaching to develop higher order thinking skill(application).

H_{05}. There is no significant difference in the achievement score of the students of control group and experimental group in the post-test in the domain of analysis.

Table 6: Achievement Scores of control group and experimental group on post-test in the domain of analysis

Group	N	Mean	Df	t-value	P(0.05)
Experimental group	**25**	**5.52**	**48**	**3.06**	**3.06 < 2.01**
Control group	**25**	**4.76**			

The calculated t-value is greater than the table value (calculated t=3.06 and table value=2.01). Hence, it is concluded that activity-based teaching method is more effective than the traditional method of teaching in developing analyzing ability in students.

H_{06}. There is no significant difference in the achievement score of the students of control group and experimental group in the post-test in the domain of Synthesis.

Table 7: Achievement Scores of control group and experimental group on post-test in the domain of Synthesis.

Group	N	Mean	df	t-value	P(0.05)
Experimental group	**25**	**4.84**	**48**	**4.18**	**4.18 < 2.01**
Control group	**25**	**3.76**			

The calculated t-value is greater than the table value (calculated t=4.18 and table value=2.01). It is clear from the result shown above in the Table 6. that there is significant difference between the mean scores of the experimental and control group. Hence, It is concluded that activity-based teaching method is more effective than the traditional method of teaching to develop Synthesizing ability.

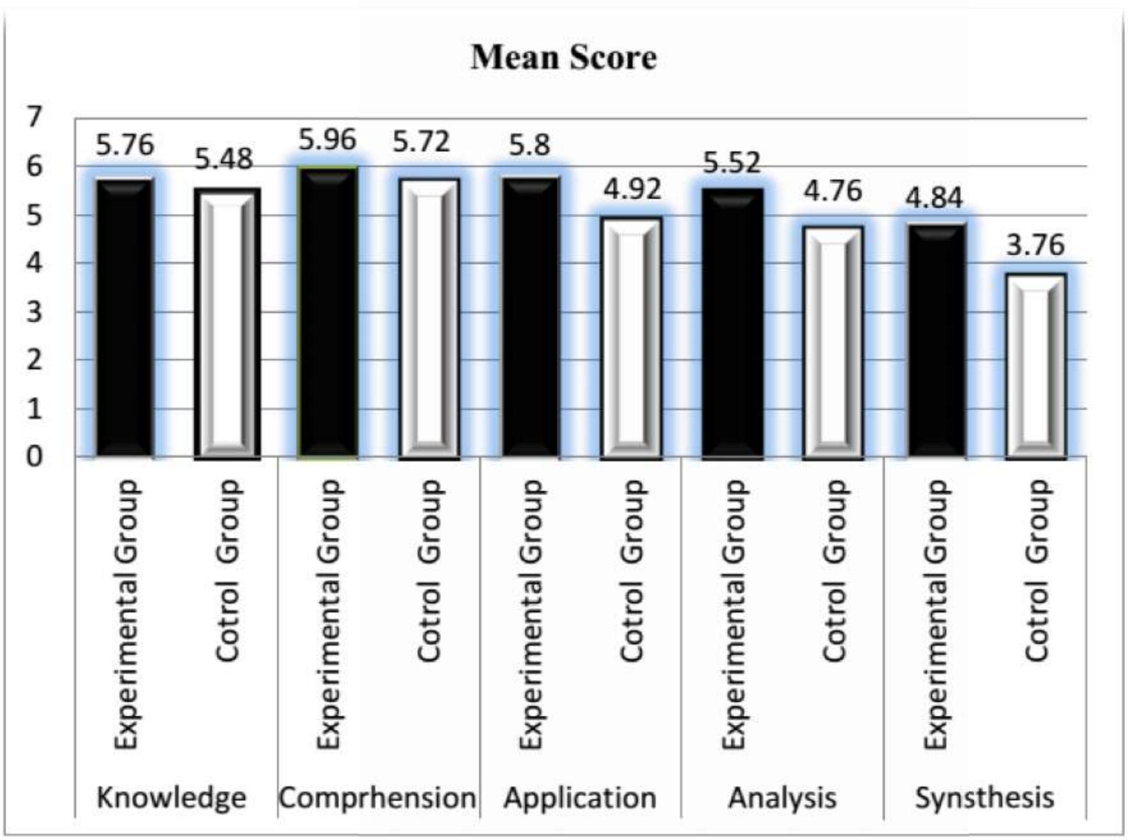

Figure 2: Summarizes the results of control and experimental group for post-test.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

Implementation of practical works in all levels of education in general and in preparatory schools is necessary. The main purpose of this research work is to investigate the impact of physics practical work on student's academic achievement in physics education (the case of ghimbi preparatory school of west wollega oromia regional state), to understand the integration of theory and practical activities in physics teaching and to forward alternative solutions that might help in solving the problem under study.

According to the new education policy of the 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 infrastructure (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, the theory of lecture part 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 carried out to know the impact of insufficient practical activities on the student's achievement in government preparatory school. The researcher aim was to answer the basic research hypothesis formulated earlier in this study.

Thus, to accomplish the study appropriate research methods and sampling echniques and instruments have been developed and employed. Pre-test and post-test have been conducted to obtain qualitative data which are used to elaborate and emphasize the quantitative analysis after categorizing and developing into main themes. And the collected data and response were tabulated and analyzed and interpretation has made using statistical methods such mean standard deviation and t-test.

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

1. In the selected preparatory schools, the finding of this study indicated that practical work in teaching physics is the best method to make understand the subject and students possess knowledge, skills of physics to arrive on new findings.

2. Students have an interest to learn physics during active based learning rather than teachers dominance method.

3.The finding of this study indicated that items were the main constraints and limiting conditions of practical/laboratory teaching physics works on preparatory school student's achievement.

- 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.
- No laboratory facilities, tools, equipment's and trained lab technicians.
- Financial problem or the allotment of budget for physics laboratory class and no lab rooms at all.
- Poor monitoring or controlling technique, evaluation and supervision of laboratory activities which is done by department heads, school principals and other concerning bodies like educational supervisors.

5.2 CONCLUSIONS

Based on the major findings of this study, the following major conclusions were drawn.

1. From the results shown above it was concluded that there was a positive impact of practical-based teaching in developing cognitive skills in the students of physics at secondary/preparatory level.

2. Practical Based learning method of teaching is more effective for the development of higher order thinking skills in the students. These results are supported by the findings of Hung, Jonassen and Martin et al.(1998,Dean(1999),Lieux (2001,Thornton (2001),Schmidt and vanderMolen (2001) and Schmidt et al.(2006).

3.The research work confirmed that the availability and usage of laboratory activities towards increasing of student's achievement in preparatory schools of west wollega zone is zero.

4.Although the mean scores of Experimental Group, in the domain of knowledge and comprehension, is greater than control group, there is no significant difference found between the mean scores of both the groups which means that PBL is more effective for higher order thinking skills (application, synthesis and analysis) than lower order thinking skills (knowledge, comprehension). Gallagher and Stepien, (1996), Lieux,(2001)and Zumbachetal. (2004) reached on the same conclusion regarding the effectiveness of practical based learning.

5. The study clearly identified the core problems of empirical teaching in government preparatory schools as listed out below. The major constraints of practical activities are absence of laboratory facilities, no well-trained lab technicians and teachers, lack of proper attention given to practical activities by the concerned bodies.

5.3 RECOMMENDATIONS

Following recommendations are made on the basis of the results obtained from the analysis of the data:

1. The role of Practical- Based Learning (PBL) is well acknowledged in the literature to develop higher order thinking skills. As this study is consistent with past findings, it is therefore, recommended that PBL should be adopted at secondary level to teach Physics in Ethiopia.
2. It is mandatory to use the laboratory experiments in teaching science in general and physics in particular, because of this method is very effective in teaching.
3. The curriculum designers should give emphasis to the practical works of physics subjects in relation to the assessment techniques, the time division for carrying out laboratory works, the class size, training systems of teachers and lab technicians.
4. The study should be replicated in all science disciplines.
5. The study should be replicated to compare the PBL with other methods of teaching to find out the relative effectiveness of the different methods with PBL.

6. The study should be replicated in all grades from elementary to university level.
7. Introducing special weekly classes for laboratory works in teaching schedule for the physics topics, because they greatly enhance the student achievement in such topics.
8. The introduction of practical examination in the students' assessment procedures of physics results and the students that carry out practical activities should be credited and it has to be added to the total physics scores of the student.
9. School managements, teachers, the community and the government at large must give consideration and attention to the capacity building of the preparatory schools in terms of finance and giving training, workshops and seminars for teachers. 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.

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APPENDIXCES

APPENDIX- 1

Instructional guide

The 12^{th} grade curriculum takes a competency-base active learning approach, under pinned by three broad outcomes: knowledge, attitudes and skill.

Unit selected– electromagnetism

This unit of study has specific learning competencies and these are listed below. This guide will provide a useful checklist for both students and teachers.

Learning competencies for this unit

By the end of this unit students to will be able:

- ✓ Describe a magnetic field
- ✓ Perform and describe an experiment to demonstrate the existence of magnetic field around a current-carrying wire.
- ✓ Sketch the resulting magnetic field lines pattern of a solenoid.
- ✓ Derive the relation B= mv/qr from the fact that the centripetal force is provided by magnetic force.
- ✓ Drive the expression F= BILsinΘ from F= qvBsinΘ
- ✓ Explain the magnetic force between two parallel current carrying wires.

Teaching methods

The subject content can be delivered in different ways in order to achieve the specific objectives. The types of teaching method used will affect the skills and attitudes that the students develop. The teacher will want to use the effective method for teaching a particular topic. In physics, it is recommended that the teacher use more than one teaching method in a single lesson-the discussion method might be suitable for the lesson. The different types of teaching methods will be used in this chapter are:

- ❖ Lecture, Discussion, Problem solving, Demonstration, Cooperative learning, Brain storming

Lecture

- The content is delivered to the students by teacher
- It is useful for large number of students
- It makes students passive because it is on-way communication

Discussion

- Sharing of ideas between students and teachers
- It allows every student to participate actively.
- Some students may be dominating the discussion

Problem solving

- Students are presented with an exercise where they must find an answer to problem
- It can waste time if it is not properly planned and guided

Demonstration

- Teacher carries out practical work if materials/equipments are inadequate or the procedure is too complex or unsafe for students.
- Students develop skills such as identification, observation, recording, making prediction, synthesis and drawing conclusions.

Cooperative learning

- Cooperative learning is an approach to group work
- The group will be formed based on ability. In each group may be 5 students, the group consists of one high achiever students, two middle achiever students and two lower achiever students.

Brain storming

- Brain storming is in which students are encouraged to generate as may ideas on the topic as possible without judgment or critique, when they are made and summarizing the key point of a lesson.

Assessment and evaluation

We should carryout continuous assessment. This means that in the course of ordinary class teaching and setting and making assignments, we need to keep a record of how well the class does. Continuous assessment helps teacher to ensure succeed in school. In the class there may be a wide range of abilities or needs, and by using continuous assessment, teachers can adapt their approach to all of them. The teacher should continually observe the students to see what they know and can do. In continuous assessment and regular testing/exam setting, teacher should assess all aspects of knowledge and understanding.

Lesson plan for controlled group

Topic : electromagnetism

Duration: 1hour

Class: grade 12

Lesson one

Subtopic: the concept of magnetic field

Lesson objectives

At the end of this lesson the students should be able to:

- Describe magnetic field
- Perform and describe an experiment to demonstrate the existence of magnetic around current-carrying wire.
- Apply the right hand rule to show how the magnetic field lines go.

Prior knowledge

An electric field a region where an electric charge will experience a force due to other charge is present. The existence of electric field around a charge can be determined by placing atiny positive charge.

Teaching/ learning material/

- Horse shoe, magnet Bar, magnet Compass, Clamp stand, Paper, Electric wire,Source of potential difference

Stage (time)	Teaching and learning activities	reso urce	rationale
Introduction(10minutes)	**Review of prior knowledge** • Define electric field • Explain how the existence of electric field can be determined by positive test charge **Lesson opening** Show the objectives of the lesson		Students know what to expect
Development(30min)	Describe magnetic field as a region where the magnetic force may be exerted Demonstrate the existence of magnetic field around current-carrying wire and show how the compass deflects Apply right hand rule to show magnetic field lines	Bar mag net Co mpa	-to identify the region where the magnetic force

		ss Current carrying wire	exerted - to observe the existence of magnetic field
Summary and conclusion(10mi)	Talk about the main point that we have learnt in this lesson.		To recall the lesson
Evaluation(10mi)	Students have opportunity to ask question Ask students to recall information		To recall the lesson

APPENDIX -2

Academic Achievement of Pre-test And Post-Test For Students

Question for pre test

***DIRECTION* ;- choose the correct answer from the given alternatives**

1.The distance between two point charges is doubled. What will happen to the force of interaction between the charges?

A. The force will be doubled B. the force will be reduced by half.

C. the force will be reduced by a factor of 0.25 D. the force will not be affected.

2. which of the following is not property of a conductor in electrostatic equilibrium?

A. the electric field is zero everywhere inside the conductor B. the electric field just outside the conductor is tangent to its surfaces. C. the electric field just outside the conductor is perpendicular to its surface.

3. an ion accelerates through a potential difference of 115V and experiences an increase in kinetic energy of 7.37×10^{-17}J. what is the charge on the ion?

A.6.41×10^{-19}C B. 2.32×10^{-12}C C. 4.51×10^{-15}C D. 2×10^{-21}C

4. What is magnitude of the electric force between two protons separated by 2×10^{-15} m?

A. 67.5N B. 115.0N C. 57.5N D. 83.4N

5. what is the SI unit of electric field?

A. Am^{-1} B. Vm^{-1} C. Cm Nm^{-1}

6. van de Graff's generator can start working

A. when it is given some initial charge B. without giving an initial charge

C. with or without giving an initial charge D. none of the above

7. electric charge

A. resides on the outer surface of an insulated conductor

B. resides on the inner surface of an insulated conductor

C. resides on the outer as well as inner surface of an insulated conductor

D. none of the above

8. Four charges of magnitude +q are placed at the four corners of a square. How much charge must be placed at its center so that the whole system is in equilibrium?

A. $-(0.5 + \sqrt{2})q$ B. $-(2+\sqrt{2})q$ C. $-\sqrt{2}q$ D. none

9. three equal charges +q are placed on the circumference of a circle such that they form an equilateral triangle. The intensity of electric field at the center of the circle is

A. $\frac{1}{4\pi\pi\in}\frac{3q}{r2}$ B. $\frac{1}{4\pi\pi\in}\frac{3q}{4}$ c. $\frac{1}{4\pi\pi\in}\frac{q}{r2}$ D. zero

10. What happens while a plastic rod is being charged?

A. electrons are removed or added

B. electrons are given an additional negative charge.

C. protons are removed or added

D. protons are given an additional positive charge

11. as a positively-charged rod is brought closer and closer to a positively charged electroscope, the gold leaf

A. diverge B. converges C. is neutralized D. is unaffected

12. we know the unit for the constant of proportionality used in coulomb's law is

A. Nm^2 B. NmC^2 C. N D. none of these

13. the E-field at a distance r from the infinite line of charge of λ linear charge density is given by

A. $E=\frac{\lambda}{4\pi\varepsilon r}$ B. $E=\frac{\lambda}{2\pi\varepsilon r2}$ C. $E=\frac{\lambda}{4\pi\varepsilon r2}$ D. $E=\frac{\lambda}{2\pi\varepsilon r}$

14. an electric field inside the conductor _______________

A. maximum B. minimum C. Zero D . Perpendicular

15. in what form is the energy stored is a capacitor?

A. magnetic B. electrostatic C, both magnetic and electrostatic D, none of these

16. if a dielectric is placed between the plates of a capacitor

A. its capacitance B. its capacitance increases C, its capacitance is unaffected D. none of these

17.,Let C1=C2=C, C3=C4=C5=2C are connected in parallel with the potential difference b/n A and B is V. what is the equivalent capacitance of the circuit?

A. 3/2 C B. 2C C. 3C D. 1/4C

18.a square flat loop of wire is placed in a uniform magnetic field that is in the y direction. The magnetic flux through the loop is a maximum if the plane of the loop is in the

A. xy plane B, xz plane C, yz plane D. inclined 45^o w.r.t the xy plane

19.a parallel plate capacitor has a capacitor has a capacitance of 10μF. if the distance b/n the plates is doubled, keeping all other quantities constant, what is the capacitance of the capacitor?

A. 0.2μF B. 5μF C.10μF D.20μF

20. Consider the following procedural steps

I. ground an electroscope

II. Remove the ground from the electroscope

III. Bring a charged rod near, but not touching, the electroscope

IV. Remove the charged rod

Which steps are correct sequences to charge an electroscope by induction?

A. III,I, IV and II B. III,II,IV and IV C. III, I, II, and IV C. I, III, IV, and II

QUASTIONS FOR POST-TEST

1. Which of the following charging method is a phenomenon of charging the same sign?

A. induction B.conduction C. friction D.convection

2. N identical spherical drops charged to the same potential V are combined to form a big drop. The potential of the new drop will be

A. V B. V/N C. NV D. Zero

3. Capacitor is used

A. to produce charge

B. to change the direct ion of current

C. to collect the charge

D. as a good conductor of electricity

4. A battery of potential difference 8v is connected to 10kΩ resistor. How many electrons pass across the resistor in 100sec? ($1e=1.6x10^{-19}C$)

A. $5x10^{19}$ B. $1.6x10^{-14}$ C. $5x10^{17}$ D. $1.6x10^{-17}$

5.A long solenoid has 1000turns uniformly distributed over a length of 0.4. what current is required in the windings to produce a magnetic field of magnitude π x 10-4T at the centre of the solenoid? A. 0.1A B. 0.01A C. 1A D. 10A

6. A current carrying wire is put in a uniform magnetic field. All of the following modification will change the magnitude of the magnetic force except

A. increasing the magnetic field strength B. reversing the direction of flow of the current

C. doubling the current through the wire D. increasing the length of the wire

7. what is the SI unit of electric field?

A. Am^{-1} B. Vm^{-1} C. Cm Nm^{-1}

8. van de Graff's generator can start working

A. when it is given some initial charge B. without giving an initial charge

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9.charge distribution on metallic surface

A. resides on the outer surface of an insulated conductor

B. resides on the inner surface of an insulated conductor

C. resides on the outer as well as inner surface of an insulated conductor

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10. Four charges of magnitude +q are placed at the four corners of a square. How much charge must be placed at its center so that the whole system is in equilibrium?

A. $-(0.5 + \sqrt{2})q$ B. $-(2+\sqrt{2})q$ C. $-\sqrt{2}q$ D. none

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A. $\frac{1}{4\pi\pi\in}\frac{3q}{r2}$ B. $\frac{1}{4\pi\pi\in}\frac{3q}{4}$ c. $\frac{1}{4\pi\pi\in}\frac{q}{r2}$ D. zero

13.What happens while a plastic rod is being charged?

A. electrons are removed or added

B. electrons are given an additional negative charge.

C. protons are removed or added

D. protons are given an additional positive charge

14.as a positively-charged rod is brought closer and closer to a positively charged electroscope, the gold leaf

A. diverge B. converges C. is neutralized D. is unaffected

15. An electron that enters perpendicular to a magnetic field B with speed V moves in a circular path of radius R if the magnetic field is doubled, the radius of circular path will be

A. 2R B. R C. square root of 2 D. ½ R

in what form is the energy stored is a capacitor?

A. magnetic B. electrostatic C, both magnetic and electrostatic D, none of these

16. if a dielectric is placed between the plates of a capacitor

A. its capacitance B. its capacitance increases C, its capacitance is unaffected D. none of these

17.,Let C1=C2=C, C3=C4=C5=2C are connected in parallel with the potential difference b/n A and B is V. what is the equivalent capacitance of the circuit?

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19.a square flat loop of wire is placed in a uniform magnetic field that is in the y direction. The magnetic flux through the loop is a maximum if the plane of the loop is in the

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