THE IMPACT OF PRACTICAL LEARNING ON STUDENTS ACHIEVEMENT IN CHEMISTRY. THE CASE OF ADELE SECONDARY SCHOOL

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THE IMPACT OF PRACTICAL LEARNING ON STUDENTS ACHIEVEMENT IN CHEMISTRY. THE CASE OF ADELE SECONDARY SCHOOL

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Master’s thesis submitted to Wolkite University, school of graduate studies, department of Chemistry in partial fulfillment of the degree of Master of Science in chemistry.

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DECLARATION

I here by declare that this MSc. in chemistry 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 acknowledged.

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We here by certify that we have read and evaluated this entitled "*The Impact of Practical Learning on Students' Achievement in Chemistry in Adele Secondary School*", prepared under Our guidance by Mr.Mulugeta Gossaye Teka we recommend that the thesis shall be submitted as fulfilling the requirements for the award of a Msc. Degree in chemistry.

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ACRONYMS

CG………………………… Control Group

EG…………………………… Experimental Group

SAS ………………………… Students Attitude scale

SAT…………………………… Student Achievement Test

SD……………………………. Standard Deviation

SNNPR ………………… …. Southern Nations, Nationalities and Peoples Region

SPSS…………………………. Statistical Package for Social Science

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ABSTRACT

The purpose of this study was to investigate the impact of practical work in enhancing students' achievements in chemistry in Adele secondary school particularly in grade 10, Sodo Woreda East Gurage zone, Centeral Ethiopia. To achieve this objective i.e. to examine impact of practical learning on students' performance in chemistry, and on the students attitude toward chemistry; this study was employed quasi-experimental design. among a total of six targets secondary school in Sodo Woreda Adele secondary school was selected purposively. 80 students as a sample size out of 600 total populations were selected by using random sampling method. To keep the proportional allocation of students from each section, stratified sampling technique was used. The sampled students were placed in to two groups; experimental group and control group. Both the groups were exposed to the pre-test. The experimental groups were taught using the practical approach for eight week while the control groups were taught using the conventional method. The study used three instruments namely chemistry achievement tests, students' attitude questionnaires and observation checklists were used as a data collection tools. at the beginning of the first week, both groups give the pre-test chemistry achievements and the post-test achievements test at the end of the eight week. The data obtained were analyzed using SPSS version 20. T-test was used to test the statistical significance in the hypothesis generated in the study. The significance of the results was tested at α = .05 significance level. The findings of the students showed that practical approach resulted in higher students' achievements in chemistry and lead to improved students' attitude towards chemistry. The study concluded that, practical instructional approach towards chemistry is an effective teaching method which chemistry teachers should be encouraged to use to enhance students' achievements in the subject. The study recommended adoption of the practical teaching approach in order to enhance students' achievements and improve students' attitude towards the subject.

Key words: Practical, Achievement, Straifed Sampling ,*Statistical Significance*, *Practical Approach*

CHAPTER ONE

1 INTRODUCTION

1.1 Background of the study

Chemistry is the branch of science that deals with the study of the composition and properties of matter, changes in matter, the laws and the principles that govern these changes [1]. It is an important part of what is called science and an active and continually growing science that has vital importance to our world in both the realm of nature and realm of society [2].

According to another reporter [3], chemistry is characterized as the most utilitarian of all the experimental sciences.

A high quality science education in secondary school contributes to developing scientific literacy and would be expected to predispose students to study the sciences at university level. Generating higher levels of participation in science-related studies at university appears to be partly dependent on strengthening science education in secondary schools [4, 5].

Practical learning is an essential part of science education. In science lessons, we are trying to extend students' knowledge of the natural world and develop their understanding of the ideas, theories and models that scientists have found. Practical work is seen as an essential part of teaching and learning science at school level [6, 7].

Students seem to enjoy practical work and it is thus generally regarded as adding to the students' motivation to study science at school level. In most countries, practical approach is either considered a central part of science classes or its status is wished to be lifted to such a position [7]. Practical work may be considered as engaging the learner in observing or manipulating real or virtual objects and materials [8].

Practical learning induces scientific attitudes, develops problem solving skills, collaboration and improves conceptual understanding in students [9]. Practical work puts the students at the Center of science learning where they can participate in, rather be told about science. It focuses on observation, experimentation and manipulation of object/ materials being studied, and other scientific activities are performed by laboratory method as a part of practical work which emphasizes heuristic learning [10].

In Ethiopian , the Government has recently introduce policy of 70:30 percent professional mix in annual enrolment, with 70% of intakes allocated in to science and technology streams and 30% in to the social science and humanity steams. The rationale behind this initiative is the belief that science and technology are the engines of development and that Ethiopia's prospect hinges on the availability of sufficient stock of national expertise in these fields by its higher institutions [11].

The country gave more emphasis to science fields and students are expected to gain adequate practical knowledge parallel to the theoretical knowledge of science disciplines. For this reason, science laboratory activities are the basic input to deliver quality education in computational science. However, there is still gap on reporting the current situation of high school in Ethiopia regarding to the status and effective use of science laboratory to improve students' academic achievement in science subjects such as chemistry, physics and biology.

By the practical approach student can get deep knowledge and skills on science and technology as well as the new innovation of science [9]. Similarly, students will be

able to solve daily life problem by using the scientific method, and also increase the student achievement in chemistry. If practiced in the right manner from the early secondary school level, critical thinking skills can be attained from practical work in chemistry. The practical approach is considered as an effective way of teaching for science education which increases the students' achievement and knowledge in science [12, 13].

As one head of science put it 'it is vital and teaching science without practical work is like swimming without water' [14]. Hence, implementing more practical work in science education improves learners' attitudes as well as their achievement in chemistry. In the majority of Ethiopian secondary and preparatory schools, science laboratories are not available or the available ones are not furnished and fully equipped so as to conduct practical activities. Teachers in developing countries do not perform practical activities in the classroom because of different reasons even if they understand the role of practical work to enhance students' attitudes towards the subject. In Adele secondary school learners interest for chemistry subjects becomes lower and their achievement also, as different scholars saying science teaching is effective when it supported by practical activity. But, as my observation science teachers in Adele secondary school mostly use traditional teaching methods. In addition to that there has been no research conducted at the woreda level. Therefore, the current study investigated the impact of practical approach as an instructional method on students' attitude toward chemistry and the impact of the approach on students' performance in chemistry.

1.2 Statement of the problem

Despite the widespread use of chemistry in the economic and technological advancement of a nation, students' recorded poor performance in chemistry subject. This poor performance of students in science especially in chemistry has continued to be a major concern to all. Different academic year (2012-2015 E.C) documents in Adele secondary school showed that the mean grade value of students in chemistry subject becomes decline.

Table 1: Chemistry subject average result of different academic years (2012 -2015 E.C) in Adele secondary school

Grade level	Academic year	Average score of each academic year	Mean score
10^{th}	2012	48	51
	2013	52.2	
	2014	49.8	
	2015	54	

As the data obtained from the roster a consecutive of four academic year result of Adele secondary school chemistry result becomes declined. More over the poor achievement in chemistry especially observed in grade 10 .The researcher was observing the result of students and also observing their participation in different class by comparing with other subject. So that, it found to be not encouraging. As a result, it makes the academic achievement and attitude of the students in chemistry subject was low. This may be due to the fact that teachers adopt the verbalistic and traditional (conventional) method as a way of teaching the subject and they do not give adequate attention and concern about practical learning in school. Therefore, this study aimed to investigate the impact of practical work on students' achievement in chemistry subject in Adele school.

1.3 Objectives of the study

1.3.1 General objective

The general objective of this study is to investigate the impact of practical learning in chemistry on students' achievements in chemistry in Adele secondary school.

1.3.2 Specific objectives of this study Area

- ✓ To examine impact of practical learning on students' performance in secondary school chemistry.
- ✓ To study the impact of practical learning on the attitude of secondary school students toward chemistry.
- ✓ To Improve the students practical learning in science of chemistry

1.4 Research questions

1. Is there any significant difference between the performance of students taught chemistry using practical activity and those taught using conventional method?

2. Is there any significant difference between the attitudinal change of students exposed to practical activities and those taught using conventional method?

3. what are the improvement of students practical learning science of chemistry?

1.5 Research hypotheses

The following research hypotheses were generated for the study and tested at significance alp

ha level of 0.05.

H01: There is no significant difference between performance of students exposed to practical activities in chemistry and those taught using conventional method.

H02: There is no significant difference in attitudinal change towards chemistry for students taught through practical activities and those taught using conventional method.

1.6 Significance of the study

It was hoped that the finding of this study would be useful to a number of stakeholders in the education sector. Including chemistry teachers, chemistry students, school laboratory technicians, curriculum developers since teachers are the curriculum implementers in the school and future researchers.

The finding of this research would help chemistry teachers on better way of organizing and using the chemistry laboratories. Teachers training institutions may be in a position to change their training approaches and emphasize practical learning with regard to students, the findings would alert them on the importance of the laboratory experience in their better achievements.

school principals on the other hand will be informed on the various requirements needed in the chemistry laboratory and therefore use the finding to sensitize teachers, students and parents on the importance of the laboratory in teaching thus the need to order for chemical and apparatus.

Additionally the research would enable Chemistry curriculum developers to have an insight into the practical activities which are useful in making the learner understand the scientific concepts and principles. Can be used as a source for other researchers to conduct further and detailed study on similar topics.

1.7 Delimitation of the study

The scope of this study is delimited to Adele secondary school fond in Gurage Zone, Sodo Woreda to make the study manageable and even though the problem is observed in all science subjects, the researcher delimited this study in chemistry because the subject is highly practical, highly decline of students achievement in chemistry and also chemistry is the area of specialization of the researcher. For this study two topics (acids-base concepts and electrochemistry) was chosen, taught and examined. This topic was chosen because of its nature. The content of the topic provides an excellent opportunity for exposing the student to various types of experiment during teaching. Thus, the results and findings of the study is delimitated to the study area, the selected school and grade level.

1.8 Limitation of the study

Any research undertaking will not free from problems but the degree of the problems may vary depending on the nature and type of research problems and the study. Thus, the following limited the course of the study: Some students were not willing to participate in the study as control groups where teaching and learning of chemistry was to take place without practical. Lack of chemical and apparatus required for the lesson, internet services (access) were also among the limitations of the study.

1.9 Conceptual framework

The study conceptualized the teaching approaches in chemistry as the independent variables. The students' achievements in chemistry were considered as the main dependent variable. Thesis variables are interrelated as shown in Figure 1.

Independent Variables   Dependent Variables

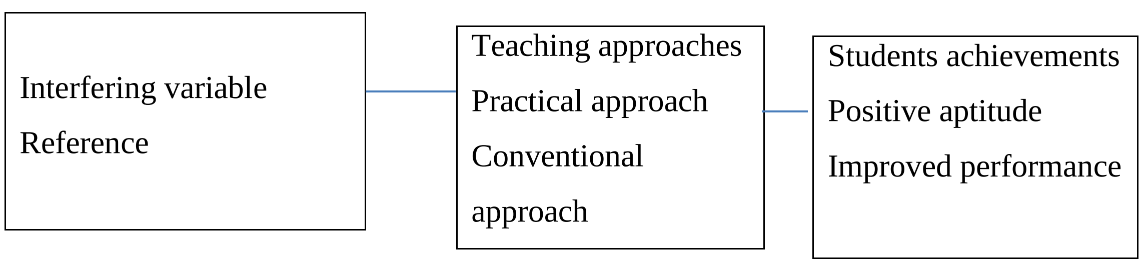

Figure 1: conceptual framework

Figure 1 shows that the independent variables of the study were the two teaching approaches; practical approaches and the conventional approach. The students' achievement in chemistry was conceptualized to be the dependent variable. The students achievements in chemistry was measured using this indicators; positive attitude towards chemistry, improved performance in examination. The independent variable however can be intervened by availability of resources; human, capital, material

1.10 Operational Definitions Terms

Some of the operational terms used in the research study are:-

1.10.1 Practical: Refers to the experiments carried out by the learners themselves or with the help of teacher during the learning.

1.10.2 Attitude Change: - Change in perception towards the subject as a result of using practical work approach in teaching chemistry.

Conventional Method: Method of teaching chemistry by using lecture method with only a few teacher demonstrations.

1.10.3 Performance: Refers to the students' scores obtained in a test.

1.10.4 Laboratory: A room equipped with necessary equipment for carrying out experiments which is used by teachers and students for the study of any science subject.

1.10.5 Achievement: refers to attained in chemistry including mastery of basic skills (observation, recording, reporting), attitudes, knowledge and concepts measured in terms of grades a student scores.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Nature of School Chemistry Practical

Practical learning has been defined as 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 [15]. In science teaching and learning process, the term "practical learning" 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 learning takes place in a laboratory and this often known as laboratory work. According to a framework of score for practical science in schools [16] defining practical learning in science as a "hands-on" learning experience which prompts thinking about the world in which we live. The related report [17, 18] has a list of activities that could be considered to be practical learning. These falls into two main categories: Core activities, Investigations, laboratory procedures and techniques and field work.

Recently, many studies have been conducted on the importance of laboratory work while teaching science. Currently, science educators and teachers agree that laboratory work is indispensable to the understanding of science [19, 20, 21]. The role of laboratory work i science education has been detailed by some researchers [22]. The main purpose of laboratory work in science education is to provide students with conceptual and theoretical knowledge to help them learn scientific concepts, and through scientific methods, to understand the nature of science. Laboratory work also gives the students the opportunity to experience science by using scientific research procedures. In order to achieve meaningful learning, scientific theories and their application methods should be experienced by students. Moreover, laboratory work should encourage the development of analytical and critical thinking skills and encourage interest in science [20].

Teaching and learning of science has over the years tried to mimic what real scientists do. The processes of science, the scientific method, the inquiry process, the content of science and the habits of scientists are all re-contextualized in the science curriculum for schools in many parts of the world [23]. In mimicking the real scientist, the rationale for using chemistry practical's as a form of instruction is sometimes forgotten. Some teachers and students place great emphasis on obtaining the correctness of the answers leaving the mastery of process skills to chance. In such cases, the range of investigations is narrowed and is dominated by the perceived demands of assessed coursework. However, the major barrier to improving the quality and variety of practical activity is the constraints felt by teachers in terms of two interrelated factors: time and the demands of the national assessment frameworks. This may force teachers to use demonstration experiments rather than student experiments and sometimes teachers end up in applying 'drill and practice' to train students to pass examinations.

Traditional laboratory classes normally involve students carrying out teacher-structured laboratory exercises or/and experiments, where each step of a procedure is vigilantly prescribed and students are expected to follow and adhere to the procedures precisely. This kind of laboratory activity is frequently known as a [24], in which little student involvement with the content is required. For such kind of activities, [25] add that students can be successful in their laboratory class even with little understanding of what they are actually doing. Nevertheless, the student may have little option but to accept this passive approach whilst, they deal with new techniques and/or equipment, particularly when the lab preparation involves no more than reading and understanding the laboratory manual. On a similar note, [26] commented that the laboratory is regarded as an information overload place, resulting in students with little brain space to process information and consequently, they blindly and thoughtlessly follow the instructions. In addition, they seldom interpret their observations or/and the results obtained during the experiment. There are two extreme thoughts regarding the importance of Chemistry laboratory experiments/practical [27]. The first one is that in traditional approaches, little opportunity is given to student initiatives or circumstance. In this approach, all the laboratory procedures are carefully listed in the provided manual, and frequently the student is simply asked to fill in a well-planned report template. At the end of a laboratory session, students have no real opportunity of understanding or learning the process of doing Chemistry. The second one is that a student is given an opportunity to engage in deep learning. This would provide a student an opportunity in identifying the main objectives of the work and in planning and executing it, of identifying the conceptual and practical difficulties encountered, recording and discussing the results and observations and of suggesting practical alterations and improvements. The latter, thus, could result in a significant positive impact on a students' ability to learn both the desired practical skills and also the underlying theory.

Chemistry practical should be conducted in such a way that they interact with ideas, as much as the phenomena themselves. It is necessary for teaching to focus upon scientific ways of talking and thinking about phenomena, rather than the phenomena themselves [28]. Teachers can employ a wide variety of teaching strategies to engage students' minds in learning. Reports emphasize that teaching science with the help of chemistry practical's makes chemistry to be more enjoyable and stimulating to students than teaching the same subject matter only through lecture [29]. Students have a lot to benefit from chemistry practical's which may include increasing students' interest and abilities in the subject as well as their achievement in chemistry [30].

2.2 Skills Taught in the Laboratory

The practical skills taught in chemistry are the same as those taught in science education. Science education is the field concerned with sharing science content and process with individuals not traditionally considered part of scientific community. The target individuals may be children, college students or adults within the general public [31].

2.3 Manipulative Skills

Manipulative skills are also known as motor skills. The skills deal with the ability to handle and arrange apparatus and materials for proper experimentation. If students have proper manipulative skills, they will make accurate observations and record the data collected accurately. This will then translate to accurate interpretation. Manipulative skills include handling, arranging, fixing, pouring, and heating, filtering and weighing [32].

2.4 Observing Skills

Observing is the fundamental science process skill .Observing refers to noting the properties of objects and situations using the five senses of seeing, hearing, touching, smelling and tasting. An observation is simply a record of sensory experience made using the five senses. Scientists use observations skills in collecting data. The ability to make good observations is also essential to the development of other science process skills [35]. The simplest observations made using the senses are qualitative such as the colour of a precipitate or the temperature of a solution. Others are quantitative and involve numbers or quantity such as the mass of a solid.

2.5 Measuring Skills

To measure is to express the amount of an object or substance in quantitative terms or comparing an object to a standard [36] .It is the process of making observations that can be stated in numerical terms. Examples of measurement include; length in meters, volume in litres, mass in grams, force in Newton and temperature in degrees Celsius. All measurements should be given in SI units.

2.6 Predicting Skills

Predicting is forecasting a future occurrence based on past observations or on the extension of data. It is the process of stating in advance the expected results of tested hypothesis. A prediction that is accurate tends to support the hypothesis and can be used in planning a test of that hypothesis [37].

2.7 Interpreting Skills

Interpreting refers to considering evidence, evaluating and drawing conclusions by assessing the data. It is answering, the question, “what do your findings tell you?” Put in other words, it is giving explanations, inferences or hypothesis from data that have been placed in data table or graph [38].

2.8 Experimenting Skills

Experimenting is testing a hypothesis through manipulation and control of independent variables and noting the effect on dependent variables. It involves interpreting and presenting results in the form of a report that others can follow to replicate the experiment. Experimenting is an integrated process skill [39].

2.9 Organizing Skills

Organizing is the process of arranging data into a logical order so that the information is easier to analyses and understand. The organizing process includes sequencing, grouping and classifying data by making tables and charts, plotting graphs and labelling diagrams [40].

2.10 Analyzing Skills

The ability to analyses is critical in science. Students use analysis to determine relationship between events, to identify the separate components of a system to diagnose causes and to determine the reliability of data [41].

2.11 Secondary School Chemistry Instructions

Instruction in chemistry is done through practical and theory work. Typically, the term practical mean experiences in school settings where students interact with materials to observe and understand the natural world. The practical are mainly done as student experiments in the laboratory and as teacher demonstrations either in laboratories or in classrooms, while the theory is often done in the classroom. Chemistry practical's as teacher demonstrations or as class experiments where all learners are on similar tasks, working in small groups or a circus of experiments with small groups of learners engaged in different activities, rotating in a carousel. In secondary schools, laboratory activities are designed and conducted to engage students individually, or in small groups (student experiments) and in large-group demonstration settings (teacher demonstrations. Successful learning of chemistry depends partly on correct use of a teaching method whose activities target most learning senses. Since chemistry is a subject that encourages 'hands on 'experiences, more practical oriented modes of instruction should be selected [42, 43].

Practical are a very prominent feature of school science in many countries and a high proportion of lesson time is given to them. Science practical are very much a characteristic of the school science curriculum. They have been part of school science curriculum for over a century, and their place in a chemistry lesson has often gone unquestioned. Like other sciences, chemistry teaching and learning is supported by laboratory experiments (practical sessions) [44]. Chemistry practical classes (experiments) are believed to help students in understanding theories and chemical principles which are difficult or abstract. Moreover, practical offer several opportunities to students such as: handling of chemicals safely and with confidence, acquiring hands-on experience in using instruments and apparatus, developing scientific thinking and enthusiasm to chemistry, developing basic manipulative and problem solving skills, developing investigative skills, identifying chemical hazards and learning to assess and control risks associated with chemicals[45].

However, [29] argues that research has failed to show a simplistic relationship between experiences provided to the students in the laboratory and learning chemistry. There are concerns about the effectiveness of laboratory work in helping the students understand the various aspects of scientific investigation[22,46].Teachers usually want to develop students higher order thinking skills, like critical thinking, through laboratory work; but to what extent they can achieve this is controversial[20]. Therefore, it is important to analyze the purposes

related to laboratory work, as the purposes need to be well understood and defined by teachers and students alike for the chemistry practical to be effective.

Traditionally, chemistry courses at all levels have included instruction in laboratory settings where students follow procedures directing them to mix chemicals, make measurements, analyze data, and draw conclusions. At the elementary, secondary, and early college levels, chemistry practical frequently consists of what is generally described as "cook-book" exercises. The goals and desired outcomes of chemistry practical are the subject of considerable debate. Important aspects of the debate centre around the value versus cost of any laboratory experience and safety versus hazards of chemicals [11].

2.12 Chemistry practical and Performance in School Chemistry

Chemistry practical have been and are being used in chemistry teaching to support theoretical chemistry instruction. The success of any given chemistry practical task depends on the intended learning objectives of that task. Learning objectives of chemistry practical tasks can be divided into two categories, for example, categories A and B. In category A, the practical tasks should be to enable the learners to: (i) identify objects (ii) learn a fact(s) (iii) identify phenomena. In Category B, the practical tasks should be to enable learners to: (i) learn a concept (ii) learn a relationship and (iii) learn a theory/model [8]. The science educators‟ criticisms on chemistry practical are on tasks with objectives in category (B) and not that in category (A).The tasks with objectives in category (A) as being effective as many other forms of instruction. The observable aspects of practical tasks are often remembered many months or even years later if the event is a striking one. For example, seeing a piece of sodium put into water or the 'pop' sound of burning hydrogen gas.

The role of chemistry practical is to help students make links between two „domains‟ of knowledge: the domain of objects and observable properties and events on the one hand, and the domain of ideas on the other [8]. The learning objectives of category (B) above are more strongly involved in chemistry practical than those in category (A). Students are unlikely to grasp a new scientific concept or understand a theory or model (category B objectives) as a result of any single chemistry practical task, however well designed. Students acquire deeper and more extended understanding of an abstract idea or set of ideas in a gradual process, hence the need for frequent and varied practical activities.

Designing practical tasks that animate the students' thinking before they make any observations can make them more effective. One approach which has been found strikingly

successful for this is the Predict Observe Explain (POE) task structure [47]. In this approach, students are first asked to predict what they would expect to happen in a given situation and to write this down, then to carry out the task and make some observations, and finally to explain what they have observed (which may or may not be what they predicted). The POE structure makes the practical task more purposeful and to play a pivotal role in students' learning of chemistry and eventually improve performance in the subject. Otherwise a practical task designed to enable the students to observe an object or phenomenon can easily become rather dull and uninspiring, unless it is striking and a memorable one.

2.13 Relationship between Practical Chemistry and Attitude towards Chemistry

Attitudes are general expression of either positive or negative feelings towards something and this distinguishes it from other terms like value, belief or opinion [48]. Developing favorable attitudes towards science has often been listed as one of the important goal of science teaching. Another reporter [49] suggested that the laboratory, as a unique social setting, has (when activities are organized effectively) great potential in enhancing social interactions that can contribute positively to developing attitudes and cognitive growth.

Attitude associated with science (chemistry) appears to effect student ‘participation in science as a subject and their performance in chemistry [50]. Students enjoyed conducting practical activities but it is argued that this is because they preferred it to other learning activities, just as they would for visit to a science education center. Practical activities and science educational visits can create enjoyment and/or have a positive impact on students’ learning of science as seen through some research [51]. The science education literature emphasize that laboratory work is an important medium for enhancing attitudes, stimulating interest and enjoyment, and motivating students to learn science in general and chemistry in particular[52].

According to [29] reported that students enjoy laboratory work in some courses and that laboratory experiences resulted in positive and improved student attitudes and interest in science. He was also of the view that chemistry students who were asked to rate their perceptions of the relative effectiveness of instructional methods for promoting their interest in and attitude towards learning chemistry. They reported that personal involvement in the chemistry laboratory was the most effective instructional method for promoting their interest in chemistry studies when contrasted with teachers’ demonstrations, filmed experiments, classroom discussions, and teacher’s lectures. In addition, in a study in which they explored the reasons for students’ enrolment in more advanced (post-compulsory) courses in high- school chemistry, they found that one of the key reasons was their experiences with practical exercises in the chemistry laboratory. The researcher [53] finds significant relationships between attitude to a subject and achievement in that subject. Attitude has a greater influence on aspects of learning which are emphasized in the classroom. Student beliefs and attitudes have the potential to either facilitate or inhibit learning.

It is in line with the relationship that exists between practical activities in chemistry and attitude that the researcher exposed students' in the experimental group to practical activities when teaching to determine its impact on their attitudinal change towards chemistry.

2.14 The Status of Practical Activity in Ethiopia

According to [54], the status of chemistry practical activities in secondary and preparatory schools in Ethiopia and the result showed the frequency of practical activities in all schools. Accordingly, out of the total respondents, 70% replied that they were not used practical activities available on their book at all while 8.8% of them responded as they always use practical activities. There was inadequate availability of instructional materials (laboratory equipment) in majority secondary schools. This result indicated that most laboratories in secondary schools are not performing their laboratory activities based on objectives set on the curriculum [55].Finally, practice-based education is not efficient in almost all of the schools under study.

2.15 Challenges faced in the Teaching and Learning of chemistry as a Science Subject

The challenges faced by chemistry as a subject include teachers' training and conceptualization of the subject, students' understanding of the subject, physical resources such as laboratories, chemical, apparatus, teaching aids and text books. Research findings suggest that traditional lecture instruction is ineffective in dealing with students' misconceptions. Traditional lecture instruction does not consider the view of students. This technique is limited in helping a learner develop skills [56] .The practical approach on the other hand engages the student productively and leads to relational understanding. The proposed study contends that if practical work instructional approach is used perhaps improved students' achievements in the subject may occur.

CHAPTER THREE

3. METHODOLOGY OF THE STUDY

3.1 Description of the Study Area

Adele Secondary school is found in Central Ethiopia Regional state of Ethiopia, particularly the parts of East Gurage Zone, Sodo Woreda Buee town which is located approximately 100km south of Addis Ababa, 230km North of Hawassa and 85km from Wolkite.

3.2 Research Design

According to Kothari C,R defines a research design as a plan, structure, and strategy of investigation to obtain answers to research questions or problems. To attain this research, quasi-experimental design was employed for it is efficient to evaluate and determine the effectiveness of teaching method using two groups, one experimental and the other control group [57]. The quasi-experimental design was suitable for this study because the achievement in chemistry of the group of stud3.ents taught with methods integrating chemistry practical (experimental group) was compared to the achievement in chemistry of the group taught without chemistry practical or conventional method (control group). In both groups a pre-test and a post- test was used to determine the achievement of the groups before and after treatment. Student Achievement Tests (SAT) were used to test learners' performance in chemistry. The use or non-use of chemistry practical in teaching was done without affecting the classroom set up so that the learners were not aware of their involvement in the study. A summary of the entire research design and process is displayed in

Figure 2.

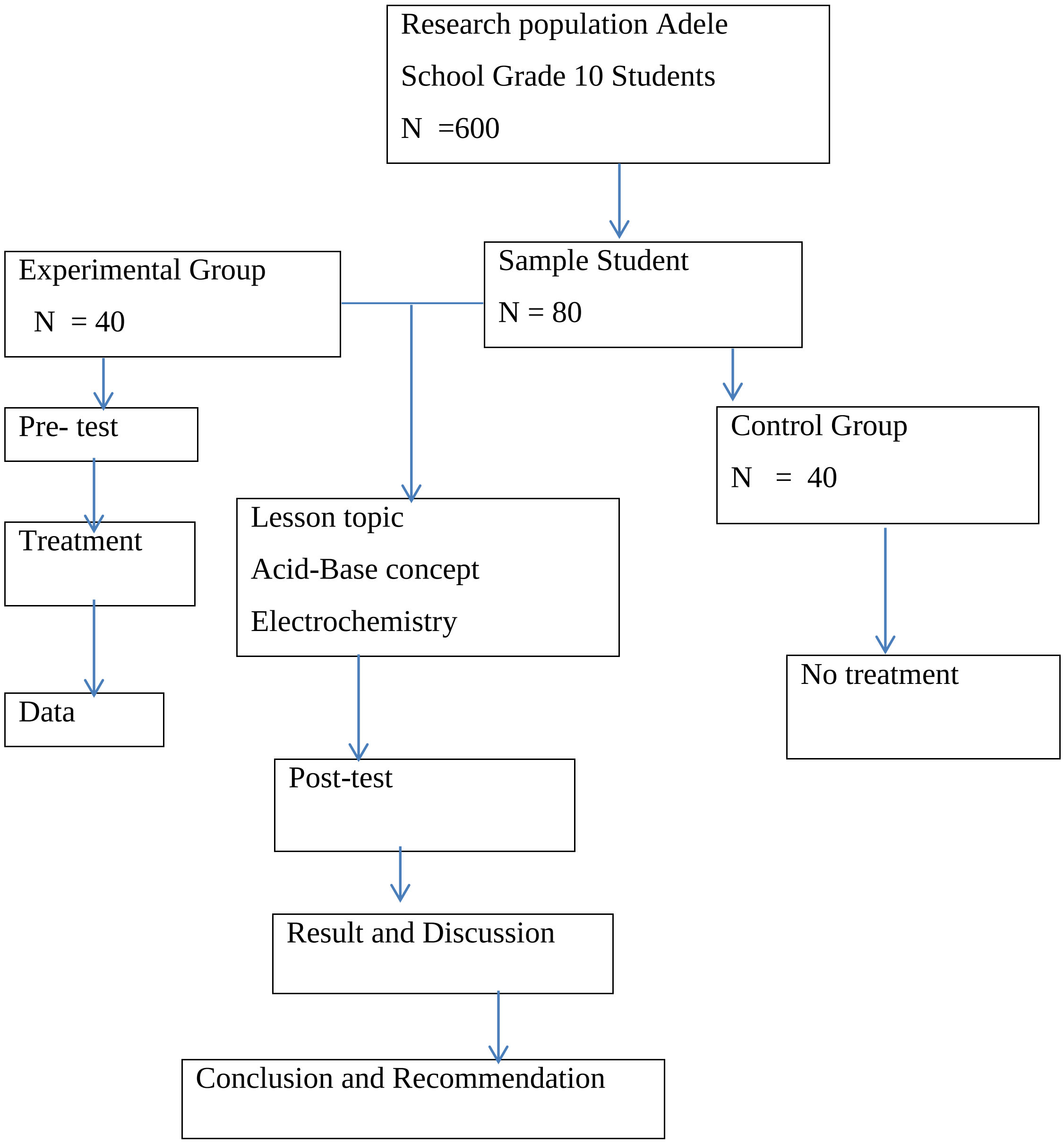

Figure 2 shows how the study was undertaken. Two groups were sampled to form the experimental and control group. The experimental group was given the treatment while the control group was not. The two groups were exposed to the post-test achievements test, the mean for each group was computed and the difference analyzed using the t-test.

3.3 Target Population

Target population or universe of a study is all the members or objects involved in the study [56]. The sample population of the study was grade 10 students in Adele secondary school the respondents of this study. The school and the particular grade level were selected. The reason behind the selection of grade 10 students was mainly by considering the schools'academic achievement across subjects and grade levels report that most grade 10 students achievement decline in chemistry. The researcher's familiarity to those selected school helped a lot in the process of the study.

3.4 Sample size and Sampling Technique

There are 6 secondary schools around Sodo Woreda from which the researcher selected Adele secondary school purposively due to its physical accessibility to the researcher and the researcher worked at this school, which makes the data more valid and reliable.

According to Gay L,R , Mills G,E and Airasian [57] states that 10-20% sample size of the target population is enough for descriptive research ,So 13 % (80) of 600 students were selected using random sampling technique the reason why students were selected randomly from each section was to giving equal opportunity for all students.

To attain the purpose of the research, the researcher used a stratified random sampling technique .Stratified random sampling is a sampling technique that involves the identification of important sup group in a particular population. A total of 80 students, which are 13% from the population, were selected for this study as sample size in this case the sub groups were allocated from the nine section and the sample size required was 80. The detail of the sample is presented in Table 2

The individuals taken into the sample size from ten grade four sections determined by the proportional allocation of sample size total population

$x\ poplation\ of$ = 80 /600

$x\ population\ of\ subgroup$

Were population of subgroup is sections (10^{th}A- 10^{th}I)

Table 2: Sample size determination from each section by proportional allocation

Section	No of students	Proportionality allocation	Obtained sample size
10^{th}A	67	67 × .13	8.71 = 9
10^{th}B	68	68× .13	8.84 = 9
10^{th}C	66	66× .13	8.58 = 9
10^{th}D	67	67× .13	8.71 = 9
10^{th}E	66	66×.13	8.58 = 9
10^{th}F	68	68×.13	8.84 = 9
10^{th}G	67	67×.13	8.71 = 9
10^{th}H	66	66×.13	8.58 = 9
10^{th}I	68	68×13	8.84 = 9

After the selection of sample students on the basis of proportionality, then assigning sample to the experimental and control group was made. In doing so, 40 students were assigned to the experimental group, and 40 students were assigned to control group. The selection of participant students as the experimental and control group were purposively based on their results top, medium and low achieving students.

3.4 Instrument of Data Collection

The data for this study was collected using student achievement test (SAT) though the pre- test and the post test result, observation checklist and questionnaires for students.

3.4.1 Student Achievement Test (SAT)

Student academic achievement in both of the experimental and control group in the study are evaluate using the researcher create chemistry student academic achievement test (SAT).

Two Student academic achievement tests: pre-test and the post-test, were constructed and used by the researcher. A pre-test was administered to the respondents in the first week of the study to assess student pre-treatment chemistry academic abilities. Pre-tests are administered as formative evaluations to assess student pre-treatment chemistry academic levels [58]. The pre-test (Appendix I) consisted of twenty five questions which tested the entry behavior (pre-requisite knowledge) of the students before learning the study topic. The pre-test was planned for one hour and consisted of questions that were of knowledge, comprehension and application levels while a few were of the analysis level in Blooms taxonomy of objectives. After the eight weeks of teaching the topic: electrochemistry and acid- base concepts that is after 2 month (may 4- July 3, 2023) post-test was administered to both the control and the experimental groups. A post-test is administered as summative assessment after every treatment period to measure student academic gain in chemistry [59]. The post-test (Appendix II) consisted twenty five questions and was planned to take place for one hour. It consisted of questions that were of knowledge, comprehension and application levels while a few were of the analysis level in Blooms taxonomy of objectives. Performance of the students was based on the scores attained after marking the achievement tests.

3.4.2 Students Attitude Scale (SAS)

This was administered at the beginning of the study and at the end of the study (Appendix III). The scale was based on a five point Liker type attitude scale. Strongly disagree (1) disagree (2) undecided (3) agree (4) and strongly agree (5).

3.4.3 Observation Checklist

Observation method was used because certain types of information can best obtain through direct examination by the researcher. Observation gives the first-hand account of situation under the studies and combined with other data collecting tools, it allows for a holistic interpretation of the situation which is being studied [60]. Hence, an observation was used in the study. It was semistructured class room observation mainly focused on students' activities, motivation or participation on the teaching learning process.

3.5 Piloting

A pilot study was undertaken for purposes of validation and testing the reliability of the research instrument that was used. Buee secondary school in the center of Sodo Woreda Kebele was purposively chosen for piloting so as to capture the key characteristics of the study. The pilot study helped to identify and rectify the mistakes in set questions. It also helped to determine the suitability and the appropriateness of the language used in both pre-test and post-test. Prior to administration, the contents of the test were validated by two experienced upper secondary school chemistry teachers and senior post graduates in chemistry to determine if there was a match among the stated objectives and the content of the instruments. Finally, the researcher was made modification on some items based on their feedback. The reliability of the assessment test was conducted using a trial testing on 20 grade 10 students in Buee secondary school. The number of items used was twenty five (25) .The Cranach's Alpha correlations, if it was 0.7 and above then the test was considered reliable. The instrument reliability coefficient gotten through the use of Cronbach's Alpha were 0.75 and 0.78 for the Pre-test and post-test tests respectively. The Students Attitude Scale (SAS) has a reliability coefficient of 0.73. It ensures the internal consistency of the instrument used. Therefore, the instrument was considered reliable for use in this present study.

3.6 Procedure for Data Collection

A Permit ion to conduct the study was obtained from the Buee city administration education office and Adele secondary school administration office. Data collection was done by the researcher. The researcher designed and prepared the sample lesson plans and schemes of work to be used by the selected school. The schemes of work used were for the topic: acids-base concepts and electrochemistry. Before the teaching begins the researcher administered the pre-test to the specified groups (experimental and the control groups) so as to determine the entry behavior of the learners. After the test was done, the researcher marked the pre-test and recorded the scores out of 40 marks. The teaching began after the administration of the pre-test and was conducted by the researcher using the prepared schemes of work. The teaching took place for eight weeks. The experimental group was taught using schemes of work containing practical approaches (Appendix V) while the control group was taught using schemes of work without practical approaches(conventional approaches) (Appendix VI). The experimental group instructional technique emphasized practical work when teaching the topics. During the practical activity the respondents were actively involved in setting the equipment and apparatus used in the laboratory.

After eight weeks of teaching, post-test was administered for both the control and the experimental groups. The immediate testing after teaching was to ensure that no new learning experience interfered with the experimental condition and to ensure that learners did not forget what they had learnt. After the post-test was done, the researcher marked the post-test and recorded the scores out of 40 marks. All the students in the two groups were given a student attitude scales, (SAS).the scale was based on a five point Likers type attitude towards chemistry learnt.

3.7 Method of Data Analysis

Both quantitative and qualitative data were generated by the study. Data analysis involves scrutinizing the acquired information and making inferences [61]. The student assessment tests (SAT), both the pre-test and the post-test were marked and marks recorded for each respondent while the data from the student attitude scale questionnaires was sorted, edited and recorded. The data generated from questionnaires and student achievement tests (SAT) was ordered, coded, categorized, classified and labeled as per the themes and objectives of the study. The Statistical Package for the Social Sciences (SPSS) version 20 computer software was used to analyses the data. Statistical tests such as paired samples t-test, independent samples t-test were used for data analysis. These were used to address the research objectives and to test the hypotheses of the study. Paired sample t-tests compare means from the same group at different times while independent samples t-test compares means for two groups. The statistical significance of the results was then examined at a = 0.05 statistical confidence level. T-test used at 0.05 level of significance for the score of student's achievement test and student attitude scale to find the significance difference between the mean score of pre-test and post-test .

3.8 Ethical Considerations

Ethical standards were upheld during the research as the principles of confidentiality; anonymity and informed consent were applied. Prior to carrying out the research, the researcher sought permission from Sodo woreda education office, the school principals and grade 10 chemistry teachers. The researcher explained to the school principals and chemistry teachers, the purpose of the study and the methods to be used to carry out the study. Confidentiality of the respondents' identities and the protection of private information given during the study were adhered to. The identity of all the respondents and all their responses was treated with utmost anonymity. Due to ethical issues, the learners in the control group were later taught using chemistry practical so that they could get the same exposure.

CHAPTER FOUR

4. RESULTS AND DISCUSSION

This chapter presents, interprets and discusses the findings generated from this study and reported using mainly tabular mode. The chapter specifically considers and explains impact of practical learning in chemistry on students, in particular achievements in chemistry and attitude change towards chemistry at Adele secondary school**.**

4.1 Demographic Variables of the Respondents

This section presents the demographic variables of the students involved in the study. The study found it necessary to gather this information as it offered data on the sample characteristics.

4.1.1 Number of Respondents

The number of respondents is given on table 3 and table 4 shows the distribution of respondents' type and group.

The chapter specifically considers and explains impact of practical learning in chemistry on students, in particular achievements in chemistry and attitude change towards chemistry at Adele secondary school.

4.1.2 Demographic Variables of the Respondents

This section presents the demographic variables of the students involved in the study. The study found it necessary to gather this information as it offered data on the sample characteristics.

Table 3: Number of respondents

Respondents	Gender					
	Male	%	Female	%	Total	%
Students	41	41.1	39	38.9	80	100

Finding in **Table 3** indicates that there were 39 (38.9 %) female students out of 80 student respondents.

Table 4: Distribution of respondents' group type

Respondents group type	Frequency	Percent
Experimental	40	50
Control	40	50
Total	80	100

The data presented in Table 4 show that 50%of the respondents formed the experimental group while 50% of the control group.

4.2 Impact of Practical learning in Chemistry on Students' Performance

In order to establish the impact of practical work in chemistry on student's performance the respondents were first subjected to a pre-test to determine their equivalence about ability in chemistry. A chemistry achievements pre-test was used for this purpose (see Appendix I).

4.2.1 Students' performance in the Pre-Test

The result of the students' achievements on the pre-test is shown in table 5

Table 5: Comparison of mean scores of the EG and the CG Pre-tests

Group Statistics					
	Group	N	Mean	Std. Deviation	Std. Error mean
Pre-test	Experimental group	40	18.27	8.470	1.263
	Control group	40	18.22	8.477	1.264

This implying that the two groups of students were at the same level of performance in chemistry before the treatment was done. The equivalence of the groups was confirmed by the t-test using their means. The differences in means were not significant

Pre-test	Group	N	Mean	SD	T	DF	Sig(2-trialed)	Mean difference
	Experimental	40	18.27	8.470	.025	88	.980	.044
	Control	40	18.22	8.477				

Table 6 Independent t-test results on pre–test scores between EG and CG Significant

at p≤ 0.05 level of significance Table 5: shows the statistics for control and experimental group pre-test, the experimental group (M= 18.27, SD= 8.470) and control group (M= 18.22, SD= 8.477) are fairly equivalent in ability in chemistry. The independent t-test result of experimental and control group pre- test was, absolute t (88) = 0.025, p= .980, which is greater than 0.05. Thus the null hypothesis was accepted and alternative hypothesis was rejected. It indicates that there is no significant difference between the mean performance score of experimental and control groups on pre- test. In addition to that the two groups of students were similar in chemistry achievement before the treatment was done.

4.2.2 Pre- Test and Post-test Mean Scores of CG

Table 7: Comparison of pre- test and post-test mean scores of CG

Paired sample static's					
Control group		Mean	N	Std.Devation	Std.error Mean
	Pre-test	18.22	40	8.477	1.264
	Post-test	19.47	40	7.621	1.136

Table 7: shows that the mean scores of the control group before the treatment and after the learning of chemistry lesson through the conventional methods. Accordingly, as it is indicated in the table, the control group students' at initial phase in the pre-test scored 18.22. Then after the eight weeks period of learning through the conventional method their mean score became 19.47. This shows that the mean score of post-test control group fairly improved from the pre-test mean

Paired samples Statics						T	DF	Sig (2-tared)
	Mean	Std. Deviation	Std. error mean	95% confidence Interval of the difference				
				Lower	Upper			
Pre-test and Post-test	-1.244	4.867	.762	-2.707	-218	-1.715	44	.o93

Table 8: T- test results of the CG students' pre-test and post-test results

score . Nevertheless, as the post- test means value of control group informs that the eight week conventional learning failed to reach above the average mean (50%) point. As a result, students' chemistry achievement remained to 19.47 mean values, which remarks students' chemistry result has been found low. In order to determine the level of mean value differences between the pre-test and post-test of control group, t- test was calculated. The result is displayed in the following

Significant at p≤ 0.05 level of significance

Table 8 indicates that the result of the paired sample t-test conducted absolute t (44) = 1.715, p = 0.093, which is greater than 0.05, revealed that there was no significant difference between the pre-test and post test scores of the control group learners' academic performance in chemistry subject. The control group division students' post test results showed a positive trend in improving the academic performance evaluated through successive tests. However, the post-tests mean value of the students' academic achievement was not surpassed the average proficiency (50%) level, limited to 19.47 as the highest post-test mean value.

4.2.3 Pre- test and Post-test Mean Scores of EG

Table 9: Comparison of Pre- test and post-test mean scores of EG

Paired sample statics					
Experimental group		Mean	N	Std. deviation	Std. error mean
Pair 1	Pre-test	18.27	40	8.470	1.263
	Post-test	25.73	40	7.319	1.091

As it is indicated in table 9, the experimental division group students have the mean score vale of 18.27 before they exposed to the treatment. After eight weeks of treatment the experimental group students scored 25.73 in their post-test results. The pre-post mean score comparison had 7.46 mean points, which makes the highest mean score value achievement. For this reason, the experimental group who learnt the lesson of chemistry using the practical assisted instruction method showed grater improvement in academic achievement. Consequently, t-test was conducted so as to see the level of impact of practical assisted instruction method on the achievement scores of experimental group. The result is presented in the following table.

Table 10 : T- test results of the EG students' pre-test and post-test results

Paired sample test	Paired difference					T	DF	Sig (2-taired)
	Mean	Std. deviation	Std. error mean	95% confidence interval of the				
				Lower	Upper			
Pair 1 pre-test-post-test	-7.46	6.066	.904	-9.289	-5.644	-8.644	44	.000

Significant at p≤ 0.05 level of significance. **Table 10** shows that the pre-test and post-test academic scores performance of experimental group at 0.05 levels. The result shows there was a significant difference in the performance scores of pre- test and post-test, absolute t (44) = 8.558, p =.000 which is less than 0.05. Thus, as the result of t-test analysis there was a significant difference in the post-test scores of experimental division group learners academic achievement though the influence of practical assisted instruction method.

4.2.4 Students' performance in the Post-Test

The experimental group was taught for eight weeks using a practical approach while the control group went on with the conventional approach which does not use many practical sessions. At the end, a post test was administered (see Appendix II). The results are as in table 11.

Table 11: Comparison of the post-test scores for EG and CG

Group statics					
Post-test	Group	N	Mean	Std. deviation	Std.error mean
	Experimental group	40	25.73	7.319	1.091
	Control group	40	19.47	7.621	1.136s

Table 12: Independent t-test results on post–test scores between EG and CG

t-test for equality of mean

Post-test	Group	N	Mean	SD	T	DF	SIG(2-taired)	Mean difference
	Experimental	40	25.73	7.319	3.979	88	.000	6.26
	Control	40	19.47	7.621				

Significant at p≤ 0.05 level of significance

Tables11and 12: show that a comparison of the post-test scores for the experimental and control groups in the chemistry performance test. The experimental groups performed higher mean (M=25.73, SD=7.319) than the control groups (M=19.47, SD=7.621).The test scores revealed the presence of a statistically significant difference between the academic performance of the experimental group and control group; the absolute t (88) = 3.979, p =.000 which is less than 0.05. This indicates that students in the experimental group achieve more than those in the control group because significant difference exists between performance of students exposed to practical activities and those who were not exposed, the null hypothesis (H01) which the post test scores between the control and experimental group students' academic achievement in chemistry stated that there is no significant difference is therefore rejected. The alternative hypothesis, H1, there is a significant mean difference in student's performance in chemistry for students' taught chemistry through practical work and those not exposed to practical work was accepted. It indicates that there is significant difference between the mean performance scores of experimental and control groups on post- test.

Therefore exposing practical approaches more enhances students’ performance in chemistry than those taught using lecture (conventional) method. The findings in this study are in line with those of some past studies who were of the view that, when chemistry concepts are taught using practical activities it enhances students’ performance. Such study includes that a similar correlation between practical work and understanding of science subjects which leads to improved achievements in achievements tests [62].

Another reporter [17] suggested that engaging in scientific practical work provides simulation experiences which situate students learning in states of inquiry that require heightened mental and physical engagement. This engagement leads to better understanding and improved achievements. Students encounter problems in chemistry in respective of their ability and mode of instruction and therefore, called for proper theoretical orientation with activities based instruction (practical activities) so as to enhance student’s performance in chemistry. Practical activities can be regarded as a strategy that could be adopted to make the task of teaching more real to students as opposed to abstract or theoretical presentation of facts, principles and concepts of subject matters which enhances students’ performance [63, 64].

4.3 Impact of Practical Work in chemistry on Students’ Attitude towards the subject

The study was also designed to establish the impacts of practical work in chemistry on students’ attitude change towards chemistry. For systematic presentation of the findings in this area, the study presented the result of the students’ pre-test attitude towards chemistry between the experimental and control groups and then followed by post-test attitude towards chemistry and

finally compared the two.

4.4 Pre-Test Students' Attitude towards chemistry scale

Each statement in the scale was rated on a scale of 1 to 5 that is strongly disagree, disagree, undecided, agreed and strongly agreed respectively. There were a total of 15 statements (Appendix III). This implied that a student could get a maximum score of 75(15 x 5 points) or minimum score of 15 points (5 x 1). The total scores for each respondent were computed. The mean score per student was then computed. Finally, the average score was determined. Student's t-test was then performed to determine whether there is significant difference in the mean scores on students' attitude towards chemistry between the experimental and control groups. The results are presented in Table 13.

Table 13: Pre-test students' Attitude towards chemistry

Group statistics					
	Group	N	Mean	Std. Deviation	Std. error mean
Pre-test	Experimental group	40	3.22	.313	.o467
	Control group	40	3.19	.327	.o487

Table 14: Independent t-test result of pre-test scores for EG and CG students' attitude .

t-test for quality of mean								
Pre-test	Group	N	Mean	SD	T	DF	Sig(2-taired)	Mean difference
	Experimental	40	3.22	3.13	.488	88	.630	.032
	Control	40	3.19	3.19				

Significant at $p \leq 0.05$ level of significanceTable 13 and 14 above shows that the experimental group had a fairly higher mean attitude towards chemistry (M = 3.22, SD = .313) than the control group (M =3.19, SD =.327). The difference between the two groups, absolute t (88) =.483, p=.630, which is greater than 0.05. Thus the null hypothesis was accepted and alternative hypothesis was rejected. It indicates that there was no statistically significant mean difference between the experimental and control groups. This is important as it shows that the experimental and control group started off at the same level in terms of attitude towards chemistry.

4.5 Comparison between the Pre-Test and Post-Test CG Students' Attitude.

The results of the comparison between the pre-test and post-test control group students' attitude towards chemistry scale are presented table 15.

Table 15: Mean comparison between the pre-test and post-test CG Students' Attitude toward chemistry and **Table 16**: T-test result of post-test and pre-test scores for CG students' Attitude

Paired sample statistics					
Paired sample statistics		Mean	N	Std. Deviation	Std. error mean
Control group	Post-test	3.267	40	.4431	.661
	Pre-test	3.191	40	.3265	.o487

Paired sample test	Paired difference					T	DF	Sig (2-tailed)
	mean	Std. deviation	Std.error mean	95% confidence interval of the difference				
				Lower	Upper			
Control post test group pre-test	.0756	.5355	.o798	-0853	.2364	.946	44	.349

Results in Table 15 and 16 presented the mean scores of the control group before the treatment (pre-test) and after the learning of chemistry lesson through the conventional methods. Accordingly, as it is indicated in the table, the control group students' at initial phase in the pre-test mean scored 3.191. Then after the eight weeks period of learning through the conventional method their mean score became 3.267. This shows that the mean score of post-test control group improved from the pre-test mean score value by.0756. The difference between the pre-test and post-test of control group, absolute t (39) =.946, p=.349, which is greater than 0.05 level of significance set for the study. This shows that there is no significant difference between the attitude of student in the control group before and after treatment.

4.6 Comparison between the Pre-test and Post-test EG Students' Attitude towards chemistry

The results of the comparison between the pre-test and post-test experimental group students' attitude towards chemistry scale are presented table 17.

Table 17: Mean comparison between the pre-test and post-test EG Students' Attitude towards chemistry

Paired sample statistics					
		Mean	N	Std.deviation	Std.error mean
Experimental group	Post-test	3.800	40	.4158	.0620
	Pre-test	3.224	40	.3131	.0467

Table 18: T-test result of post-test and pre-test scores for EG students' attitude towards chemistry

Paired sample test		Paired difference					T	DF	Sig (2-tailed)
Experimental group		mean	Std.deviation	Std.E, M	95% c,I,d		.7629	44	.000S
	Pre-test,post-test	.576	.507	.0755	.424 LO	.728 UP			

Table 17 and 18 Show that the outcomes of a paired samples t-test for the mean scores for the experimental group. The mean (M = 3.800, SD = .4158) for post-test of experimental group was statistically different from the pre-test mean (M = 3.224, SD =.3131) , t(39)= 7.629 , p value of

.000 was recorded for students in the experimental group before and after treatment which is less than 0.05 level of significance set for the study. This shows that there is significant difference between the attitude of student in the experimental group before and after treatment. This implies that the experimental group taught chemistry through practical work had a better attitude towards the subject than those taught through the conventional method.

4.7 Post-Test Students' Attitude towards chemistry

The results of the post-test students' attitude towards chemistry scale results are presented in the following table. The students Attitude scale that was used during the pre-test was administered at the end of the intervention so as to establish if the students' attitude towards chemistry had changed.

The results are presented in **Table 19**

Group statistics					
	Group	N	Mean	Std. deviation	Std. error mean
Post-test	Experimental group	40	3.800	.416	.0620
	Control group	40	3.267	.443	.0661

Table 20: Independent t-test result of post-test scores for EG and EG students' attitude.

T- test								
Post test	Group	N	Mean	SD	T	DF	Sig (2-tailed)	Mean difference
	Experimental	40	3.800	.416	5.887	88	.000	.533
	Control	40	3.267	.443	0661	88	.000	.533

Significant at p≤ 0.05 level of significance Table 19 and 20 shows that the experimental group had a higher mean attitude towards chemistry (M =3.800, SD =.416) than control group (M = 3.267, SD =.443). The t-test performed shows that there was a significant mean difference between the two group (experimental and control group) in attitude towards chemistry t (88) = 5.887, the p value calculated was .000, which is less than 0.05 level of significant set for this study.

This confirms that practical work approach improves attitude towards the subject (chemistry) than those taught through the conventional method. Additionally student in the experimental group develop positive attitude towards chemistry than those in the control group. The study therefore rejected the second hypothesis H02 that there was no significant difference in attitudinal change towards chemistry for students' taught chemistry through practical work and those taught through conventional method. The study accepted the alternative hypothesis, H2, there is a significant mean difference in attitudinal change towards chemistry for students' taught chemistry through practical work and those taught through conventional method. There is a significant difference in attitude change towards chemistry for students taught chemistry through practical and those taught through conventional methods.

The findings of this study concerning respondent formed attitudes concur with the observations of [65] who found that learner developed improved attitudes towards science as a result of practical courses. Research has shown that there is attitude change towards science on exposure to science, but the direction of change may be related to the quality of that exposure, the learning environment and teaching method. Majority of students who were not taking chemistry for instance were scared of its quantitative nature and the conception that chemistry is too abstract especially when taught theoretically [66].

According to [67] attitudes are acquired through learning and can be changed through persuasion using a variety of techniques. Attitudes once established help to shape experiences the individual has with object, subject or person. Although attitudes can change gradually, people constantly form new attitudes and modify old ones when they are exposed to new information and experiences. The study established a significant difference in attitude change towards chemistry for students taught chemistry through practical and those taught through conventional methods. practical activities give students a more coherent understanding of theory connected to the laboratory activities, is an important medium for enhancing attitudes and that the laboratory as a unique social setting, has (when activities are organized effectively) great potential in enhancing social interactions that can contribute positively to developing attitudes[49,68,69].

4.8 Results from classroom observation (classroom observation checklist)

4.8.1 Observation in experimental class

Table 21 show that laboratory classroom observation checklist teachers made all preparations in advance including grouping and sitting arrangements of students; and making the practical activities, student worksheets, and other supplementary materials ready for use. Teachers started the first experiment by forming small-groups of 7-8 students in which members shared roles (e.g. chairperson, secretary) among each other. Teachers introduced the practical lessons/experiments by clarifying the purpose of the experiments and how to use them. Teachers demonstrated the experiments to their students at the beginning of the experiment and in the course of the experiment when requested by students; and were moving around groups to give further help when students were engaged in the practical activities. During the activities, student-student and

student-teacher interactions were very high .Working in groups, motivation and participation observed in students. Most students demonstrated ability in using the apparatus and producer and eagerly tried to follow the instruction provided in the student worksheets and record their result clearly and accurately. Occasionally, when questions were asked, teachers were observed giving short presentations to the whole class and finally students' tray to draw a conclusion that fit their results. The approach was friendly, and students were smiling, signs of their motivation and happiness of their involvement in the practical activities.

Table 21: Results of classroom observation of the experimental class

NO	Students to be observed	Experimental class lesson observation		
		L_1	L_2	L_3
1	Teacher groups students are experimental works	+	+	+
2	Teacher demonstrate experiment to students	+	+	+
3	Students actively participate in doing practical activities	±	+	+
4	Students can easily manipulate practical activities by reading work sheet	±	±	+
5	Students demonstrate ability in working with apparatus and procedure	±	±	+
6	Students seek help from of the teacher during activities	+	+	+
7	Students show motivation and interest in the experiments thy are doing	±	+	+
8	Students discuss their experimental activity in small group	±	+	+
9	Students demonstrate ability in the working with apparatus and procedure	±	+	+
10	Teacher moves among group asking and answering question	+	+	+
11	Students record their result clearly and accurately	±	+	+

Note: plus (+) means the activity was performed, minus (-) means the activity was not performed and plus/minus (±) the activity was partially performed. L1, L2 and L3 stand for lesson 1, 2and 3 respectively.

4.8.2 Observation in control group

The results in Table 22 show that, while introducing their lessons, teachers tried either to define the concepts directly or ask oral questions about the topic to students. They also tried to relate their lessons with previous lessons, and to clarify lesson objectives. While presenting the main body of the lesson, the main tasks of the teachers were lecturing and writing notes on the black board and the main tasks of students were listening and copying the notes. Teachers were observed circulating around the class to insure 'disciple'. No practical activities were offered to students and their participation and interest was limited to answering orally asked questions in between the lectures and written questions given in the form of class work at the end of the lecture. It was also observed that the low level of interaction with their group and other students in the conventional learning of control group. In general, the climate in the control group classrooms was passive.

Table 22: Results of classroom observation of the control group no

NO	Students to be observed	Control class lesson observe		
		L_1	L_2	L_3
1	Teacher relate the lesson to previous learning (eg checking home work)	+	+	+
2	Teacher organize students for group activities	+	+	+
3	Teacher explain how to use apparatus and procedure	±	±	±
4	Teacher demonstrate experiment to students	-	-	-
5	Students actively participate in doing practical activities	-	-	-
6	Students work cooperatively in the groups	±	±	+
7	Teacher circulate among students /group answering question	+	+	+
8	Students seek help from the teacher during activities	±	±	+
9	Teacher and the students discuss the activities (exercises as a whole class	+	+	+
10	Students show motivation and interest in the lesson of chemistry class	±	±	±
11	Student demonstrate ability in working with apparatus and procedure	-	-	-

Note: plus (+) means the activity was performed, minus (-) means the activity was not performed and plus/minus (±) the activity was partially. L1, L2 and L3 stand for lesson 1, 2and 3 respectively.

4.9 Comparison of the experimental and control group

In general, the results of the experimental and control class showed significant differences in the types of classroom activities, student-student and student-teacher interactions, and teaching styles. In the experimental classes students were active participants; using the opportunity to carry out practical activities, discuss in their groups, motivation and participation observed and to interact with their teachers. On the other hand, in the control class the information flow was one-directional. Thus, the classes were typically teacher- centred. Thus, from the results of the classroom observation , practical activity and students background, it is possible to conclude that apart from the obvious benefit to implement chemistry practical activities, this approach also promoted activele.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Based on the analysis and discussions the conventional method neither promotes nor enhances students' achievement significantly. Instead it was realized that students make better participation and understanding of more effectively and thereby improvement of achievement scores during chemistry class activities as practiced in practical approach. In addition, it was observed that the practical approach led to intense interaction both among the students themselves and between the students and the teacher, there for providing a positive learning that the students exposed to practical learning in chemistry performed better than those taught through conventional method; therefore teachers were exercise different activities by using locally available resources to teach their students, they not waited purchase of standardized chemicals and apparatus. By the result of this study, it can be concluded that there was a significant difference in attitude change towards chemistry for students taught chemistry through practical and those taught through conventional methods. In light of the fact that learning especially chemistry learning is a process that involves investigations, formulation, reasoning and problem solving measuring and relating cause and effect practical approach was found to be more effective in the teaching learning process of the subject.

5.2 Recommendation

Based on the finding, the study recommends the following

- The study has shown that practical approach improves performance and attitudinal change in the subject.
- It is therefore recommended that teachers more attention and consideration should be given to practical teaching in secondary school,
- should be use the practical approach in the teaching of the subject because enhances students' understanding and eventually better students' performance in the subject.
- In addition, the practical approach to the teaching of the subject leads to the development of positive attitude towards the subject.

- Therefore the study recommends even thought, there is not purchase of standardized chemicals and apparatus teachers should to teach their students using by locally available resource.
- The study recommends that the city education office, school administrators and other concerned body should be given strong emphasizes for science laboratories to fulfil the necessary material on regarding to science laboratories as much as possible.
- Finally, since the issue of the impact of practical learning on academic achievement of students in chemistry in the selected school.

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APPENDIXES

APPENDICE: I -STUDENTS ACHEVEMENT TEST (PRE -TEST)

Time: 1hour

This test paper consists of 25 questions. Answer all questions in the spaces provided.

Part: I choose the correct answer from the given alternatives

1. Which of the following bond is formed by transfer of electrons the between atoms? A .covalent bond B .ionic bond C. metallic bond D. all

2. What will be the formula of ionic compounds formed by the reaction of group IIA and VIA elements? A. MX2 B. M2X3 C. MX D. M2X6

3. Is a bond which formed by attractive force between positively charged nuclei of the atom and shared electrons? A. covalent bond B. ionic bond C. metallic bond D. dative bond

4. Which of the following is non polar covalent compound? A. HCl B. Br2 C. H2O D .O2

5. ---- is a short hand representation of a chemical reaction in terms of chemical symbol and formula. A. chemical equation B. symbol C. formula D. compound

6. Which of the following represents an exothermic chemical reaction?

Reactant + heat product

reactant product +heat

Reactant product D. none

7. The most common reaction that alkenes undergo is: A. elimination B. substitution C. addition D. decomposition

8. Benzene is an unsaturated hydrocarbon; it mainly undergoes: A. addition B. elimination C. polymerization D. substitution

9. Which one of the following substance is not used in dry cleaning?

A. CCl_4 B . $Cl_2C == CCl_2$ C . C_6H_6 D. CH_3COOH

10. A neutral aqueous solution: A. has a 7.0 M H_3O^+ concentration B. contains neither hydronium ion nor hydroxide ion C. has an equal number of hydronium ions and hydroxide ions D. has an unequal number of hydronium ions and hydroxide ions 11. A solution is a: A. Heterogeneous mixture C. suspension B. Homogeneous mixture D. Colloid

12. Alcohols that yield ketones on oxidation are classified as: A. Primary alcohols B. secondary alcohols C. Dihydric alcohols D. trihydric alcohols

13. Which one of these statements about magnesium oxide is true: A. it reacts with hydrochloric acid to form a salt B. it reacts with sodium hydroxide to form a salt C. it reacts with water to form an acid D. it reacts with basic oxide to form a base

14. Strong electrolytes differ from weak electrolytes in that strong electrolytes: A. are poorer conductors than weak electrolytes B. ionize to a smaller extent than weak electrolytes C. produce greater numbers of ions in aqueous solution as compared to weak electrolytes D. do not conduct electricity in aqueous solutions 15. Which of the following is a wet voltaic cell: A. Leclanche cell B. cells used in electronic wrist watches C. cells used in mobile telephones D. lead-storage cell

16. In an electrochemical cell, electrons travel in which direction? A. From the anode to the cathode through the external circuit B. From the anode to the cathode through the porous cup C. From the cathode to the anode through the external circuit D. From the cathode to the anode through the porous cup

Part: II answer the following question accordingly

17. Two solutions A and B have pH values of 2 and 6 respectively. How many times greater is the hydrogen ion concentration in solution A than that of Solutions B?

18. Draw the energy diagram for endothermic reaction.

19. Two reagent bottles, labelled A and B, are filled with solutions prepared by dissolving 49g H_2SO_4 in 250 mL solution and 122.5 g of the acid per litre solution, respectively. a) What is the

molarity of solution A and B, respectively? b) When you compare the two solutions which one is i). more concentrated? ii). more dilute? (Molar mass of: H_2SO_4 = 98 g/mol)

20. In a Daniel cell, copper and zinc are used as electrodes. Which metal serves as an anode and which one as a cathode? Is the anode the positive or the negative terminal in this cell?

21. Why do we refer to the redox reactions in electrolytic and voltaic cells as nonspontaneous and spontaneous, respectively?

22. Explain the differences between primary and secondary cells.

23. How many moles of H_2SO_4 are present in 0.500 L of a 0.150 M H_2SO_4 solution? 24. What is the purpose of a salt bridge in a voltaic cell?

25. Write the equation for the reaction of sulphuric acid and water, and identify the

acid, the base, the conjugate acid and the conjugate base.

APPENDICE: II -STUDENTS ACHEVEMENT TEST (POS)Time: 1hour

This test paper consists of 25 questions. Answer all questions in the spaces provid

Part: I choose the correct answer from the given alternatives

Which one of the following solutions shows no current flow in an electrolytic cell? A. water solution of table salt B. molten sodium chloride C. hydrochloric acid solution D. sugar solution

Which of the following occurs during electrolysis of the molten binary salt of a metal:

the metal in the salt will deposit on the cathode B. reduction will take place at the anode

oxidation will take place at the cathode

no current will flow through the molten salt

Increasing the concentration of ions in an electrolyte solution: A. increases the extent of conduction of electricity through it B. decreases the extent of conduction of electricity through it

C. has no effect on the conduction of electricity D. changes the direction of electron flow A. do not conduct electricity in aqueous solutions

Four different solutions of equal volume (1 L) were prepared by dissolving one mole of each of the following substances. The conduction of electricity is least in the solution containing: A. HCl C. HNO3 B. CH3COOH D. KCl

During the electrolysis of fused sodium chloride, the anode half reaction involves: A. oxidation of sodium atoms to ions B. reduction of chlorine atoms to give chloride ions C. reduction of sodium ions to form free metal D. oxidation of chloride ions to elemental chlorine

Which substance does not conduct electricity? A. solid CaCl2 C. dilute aqueous solution of HCl

B. aqueous NaCl solution D. molten PbBr2

7. It has been observed that gaseous hydrogen chloride is a very poor conductor of electricity but a solution of hydrogen chloride gas in water is good conductor of electricity. This is due to the fact that A. Water is good conductor of electricity B. Hydrogen chloride gas in water solution ionizes C. A gas is non-conductor but a liquid conducts electricity D. None of the above

8. Potassium hydroxide solution is added from a burette to dilute hydrochloric acid solution in a beaker. Which of the following changes will not occur in the beaker: A. The pH of the solution in the beaker increases. B. The [H+] of the solution in the beaker decreases. C. The pOH of the solution in the beaker increases. D. The [OH-] of the solution in the beaker increases.

9. Strong electrolytes differ from weak electrolytes in that strong electrolytes: A. are poorer conductors than weak electrolytes B. ionize to a smaller extent than weak electrolytes C. produce greater numbers of ions in aqueous solution as compared to weak electrolytes D. do not conduct electricity in aqueous solutions

Part: II answer the following question accordingly

10. Why do solutions of strong electrolytes conduct electricity better than solutions of weak electrolytes of the same concentration?

11. Given a voltaic cell consisting of a gold electrode in a gold nitrate solution in one half– cell and a zinc electrode in a zinc nitrate solution in another half – cell, and connected by a salt bridge. The electrode reactions when a wire is connected to both electrodes are: Au + 3e → Au

Zn → Zn + 2e

Identify the metal that serves as anode and cathode.

Which electrode is negative and which one is positive?

Write the balanced chemical equation for the cell reaction.

What is the direction of electron flow in the external circuit?

12. A reagent bottle (labelled as A) is filled with HCl solution and the other (labelled as B) is filled with water. Both liquids in the bottles are colourless. What method do you recommend to identify the acid and water?

13. The compounds BF3, AlCl3, and PCl5 are acids, according to the Lewis concept, but not according to Arrhenius and Bronsted – Lowry. Why?

14. Aqueous solution of HCl is a good conductor of electricity. What is the reason for its electrical conductivity?

15. Classify the following substance as strong conductor, weak conductor and non- conductor by completing the table below?

Conductivity apparatus	Strong conductors	Weak conductors	Non conductors
Table salt solution			
Distilled water			
Hydrochloric acid			
Sodium hydroxide			
Sugar solution			
Lemon juice			

16. In question number 22 above, which Solutions of substances make the bulb to glow with a: i. Bright light? ii. Dim light? iii. No light?

17. Consider the electrolysis of NaCl a. Identify ions which migrate towards the anode. b. Identify ions which migrate towards the cathode. c. Write down the half-reactions at the anode and cathode and cell reactions. d. Write the substances produced at the electrodes.

18. What colours have you observed when each indicator was added to each of the solutions? Use the following Table below.

Indicators	Colour of indicator in				
	Lemon juice	Dilute HCl	Ash solution	Dilute H_2So_4	Tomato juice
Litmus paper					
Phenolphthalein					
Universal indicator					

19. Which of the following views are true for the electrolysis of fused electrolytes? For those which you think are wrong, explain why? i. The number of electrons lost at the anode by negative ions is the same as the number of electrons gained at the cathode by the positive ions. ii. The number of positive ions reduced at the cathode is always the same as the number of ions oxidized at the anode. iii. Electricity flows through the molten electrolyte from the cathode to the anode.

20. Why do the anions move to the anode, and cations to the cathode, during electrolysis?

21. Why are ionic compounds like NaCl, KCl, CaCl2, and PbBr2, etc. non-conductors in the solid state but conductors in aqueous solutions?

22. A chemistry teacher in a chemistry laboratory asked two students, A and B, to perform an experiment. The teacher told student A to refine impure silver and told student B to produce a gold-plated medal from a medal made of copper. How can these students accomplish the tasks given to them?

23. Explain the difference between: i. metallic and electrolytic conductivity ii. Electrolyte and non-electrolyte. iii. Inert and active electrodes iv. Galvanic cell and electrolytic cell

24. A classmate states, “All compounds containing H atoms are acids, and all compounds containing OH groups are bases.” Do you agree? Give examples and explanations.

25. What is the different between electrolytes and non-electrolyte?

No	Statements	1	2	3	4	5
1	Chemistry is very worth while and necessary subject					
2	Chemistry practical classes help me know the importance of chemistry to every day life					
3	When theories are related to practical activities ,it makes me see chemistry as real not abstruct.					
4	I remember chemistry concepts better by doing it in the laboratory rather than just reading it in book.					
5	Chemistry practical classes are time consuming .					
6	Chemistry is one of my most dreaded subject.					
7	I understand chemistry concepts more by doing it practically rather than just hearing about it					
8	I see chemistry as an abstract subject.					
9	Carrying out chemistry practical is not interesting.					
10	I get to explore more and also learn new skills from chemistry practical.					
11	Carrying out chemistry experiment make, me believe that content of chemistry courses is not applicable to daily life.					
12	I am confortable answering question in chemistry class.					
13	I am happier in chemistry class than in any other class.					
14	I can see what happens during practical chemistry classes which makes me understand chemistry better rather than when some one tells me about it.					
15	Helped you understand more about electrical conductivity of solution of different compound , electrolysis and indicators.					

APPENDIX III- STUDENTS' QUESTIONERS

The researcher would like to express her appreciation in advance for taking your time to fill this questionnaire. The purpose of this questionnaire is to collect relevant information about the "The practice and impact of laboratory activities in teaching and learning in chemistry at Adele secondary school of Sodo Woreda, So that the information that you provide will be used only for the purpose of the study. Therefore, you are kindly requested to respond honestly and thoughtfully.

Thank you for your cooperation!!

Note: you don't need to write your name other identification.

Part -I Characteristics of respondent

Name of school----------------------------

2. Sex: A. Male   B. female

3. Age: A.14-17   B.18-21   C.22-25   D. >25

Part II- Research questions related to students' Attitude towards Chemistry Practical Questionnaire (ATCQ) Instructions: These are statements about your attitude toward chemistry. There are no correct or incorrect responses. Read each item carefully. Please think about how you feel about each item. Place a tick at the most closely corresponds to how each statement best describes your feelings. Answer every question. Tick (√) where appropriate

Key: Strongly Agree (SA) =5 Agree (A) =4 Undecided (UD) =3 Disagree (DA) =2 sstrongly disagree (SD) =1

APPENDIX IV- CHEMISTRY TEACHING LEARNING OBSERVATION CHECKLIST

The main purpose of this observation checklist is to asses and evaluates students' activities in teaching learning.

School name ___________________ group_________________

Date ___________________

Time ________________________

No of student _____________

No	No Check list to be observed Experimental class lessons observed L_1 L_2 L_3	L_1	L_2	L_3
1	Teachers groups students for experimental group			
2	Teacher demonstrates experiments to students			
3	Students actively participate in doing practical activities			
4	Students can easily manipulate practical activities by reading worksheet			
5	Students seek help from the teacher during activities			
6	Students show interest in the experiments they are doing			
7	8 Students discuss their experimental activities in the small groups			
8	Students record their result clearly and accurately			
9	Groups present observations to the whole class			
10	Teacher moves among groups asking and answering questions			
11	Students to relate the practical activities with they learn theoretically in the class			
12	Draw a conclusion that fits their results and explain it using their scientific knowledge			

APPENDEX V FORM 1 CHEMISTRY SCHEMS OF WORK (EXPERIMENTAL GROUP

week	Lesson	Topic	Lesson objective	Learning activities	Necessary chemical/material
1	1 and 2	Acids and bases concept	At the end of lesson ,the learner should be able to Define acid base by the Arrhenius concepts Explain limitation of the Arrhenius concept of acid and base	**Class discussion** On; Arrhenius acid and base concepts. Give example for each Show the drawbacks of Arrhenius	Chalk Duster Black board Chart
		Bronsted Lowery concept of acid and base	At the end of the lesson , the learner should be able to Explain Bronsted lowery acid and base concept using suitable example	**Class discussion on;** Bronsted Lowery acid and base concept Give example for each similar b/n acid and base	Chalk Duster Black board Chart
2	3	Lewis concept of acid and base	At the end of the lesson , the learner should be able to ; Explain Lewis concept of acid and base using suitable example	**Class discussion on** Present Lewis acid and base concept and different from Bronsted Lowery acid and base	Chalk Duster Black board Chart
3	4	Properties of acid and base	At the end the lesson , the learner should be able to; Describe physical properties of acid and base	Demonstration/experiment on List physical properties of acid and base	Lemon juice Ash solution Piece of soap Orange juice Litmus paper
	5	Neutralization reaction	At the end of the lesson ,learner should be able to; Explain the reaction b/n acid and base	**Demonstration /experiment on;** Investigate the reaction b/n acids and bases	1M HCl ,1M NaOH ,red and blue litmus papers , beakers ,dropers, stirring rod

4	6 and 7	P^H and P^H scale	At the end of the lesson , the learner should be able to ; Define P^H ,P^{OH} and P^H scale	**Class discussion on**; Explain about P^H ,P^{OH} and P^H scale	Chalk Duster Black board P^H scale chart.
5	8	Electrical conductivity	At the end of the lesson , the learner should be able to; Define electrical conductivity Explain electrical conductor and non conductor	**Demonstration / experiment on;** Electrical conductivity test	Distilled water ,NaCl ,sugar solution ,lemon juice , 1M H_2SO_4 , 1M CH_3COOH(DC), or dry cells ,light bulb , insulated electrical wire, two graphite electrode , beaker

APPENDEX VI-FORM II CHEMISTRY SCHEMES OF WORK (CONTROL GROUP)

week	Lesson	Topic	Lesson objective	Learning activities	Necessary chemical/material
1	1 and 2	Acids and bases concept	At the end of lesson ,the learner should be able to Define acid base by the Arrhenius concepts Explain limitation of the Arrhenius concept of acid and base	**Class discussion** On; Arrhenius acid and base concepts. Give example for each Show the drawbacks of Arrhenius	Chalk Duster Black board Chart
		Bronsted Lowery concept of acid and base	At the end of the lesson , the learner should be able to Explain Bronsted lowery acid and base concept using suitable example	**Class discussion on;** Bronsted Lowery acid and base concept Give example for each similar b/n acid and base	Chalk Duster Black board Chart
2	3	Lewis concept of acid and base	At the end of the lesson , the learner should be able to ; Explain Lewis concept of acid and base using	**Class discussion on** Present Lewis acid and base concept and different from Bronsted Lowery acid and base	Chalk Duster Black board Chart

			suitable example		
3	4	Properties of acid and base	At the end the lesson , the learner should be able to; Describe physical properties of acid and base	Demonstration/experiment on List physical properties of acid and base	Lemon juice Ash solution Piece of soap Orange juice Litmus paper
	5	Neutralization reaction	At the end of the lesson ,learner should be able to; Explain the reaction b/n acid and base	**Demonstration /experiment on;** Investigate the reaction b/n acids and bases	1M HCl ,1M NaOH ,red and blue litmus papers , beakers ,dropers, stirring rod
4	6 and 7	P^H and P^H scale	At the end of the lesson , the learner should be able to ; Define P^H ,P^{OH} and P^H scale	**Class discussion on**; Explain about P^H ,P^{OH} and P^H scale	Chalk Duster Black board P^H scale chart.
5	8	Electrical conductivity	At the end of the lesson , the learner should be able to; Define electrical conductivity Explain electrical conductor and non conductor	**Demonstration / experiment on;** Electrical conductivity test	Distilled water ,NaCl ,sugar solution ,lemon juice , 1M H_2SO_4 ,1M CH_3COOH(DC), or dry cells ,light bulb , insulated electrical wire, two graphite electrode , beaker

APPENDIX VII – STUDENTS WORKSHEET MANUAL (FOR EXPERIMENTAL)

Experiment 1: Effect of Acids and base on Indicators Objective: To detect acidity of a solution using indicators. Materials required: Lemon juice, ash solution, piece of soap, orange juice, litmus, test tubes, test tube rack, reagent bottles, dilute H2SO4 and universal indicator Procedure: Take four clean test tubes and place some lemon juice in the first, piece of soap solution in the second, ash solution in the third, orange juice in the fourth and dilute H2SO4 in the fifth. Dip a strip of blue litmus paper into each of the five test tubes and observe. Follow the same procedure and repeat the experiment until each acid has been tested by indicator. Record your observation. Observations and analysis: What colours have you observed when each indicator was added to each of the four acid solutions? Use the following Table to record your observation:

Indicators	Color of indicators				
Litmus paper	Lemon juice	Piece of soap	Ash solution	Orange juice	Dilute H_2SO_4
phenolphthalein					
Universal indicators					

Experiment 2: PH of Solutions of Common Substances

Objective: To determine the pH of different substances

Materials required: Lemon juice, vinegar, tonic water, tomato juice, beakers, and universal indicator solution or pH indicator paper

Procedure: Take four beakers and place lemon juice in the first, vinegar solution in the second, tonic water in the third and filtered tomato juice solution in the fourth. Then pour a few drops of universal indicator solution or dip a piece of pH indicator paper into each of the solutions. Compare the colour developed with standard colour chart to decide the pH of each solution. Observations and analysis: a. What is your conclusion based on your observations? b. Are the substances used in this experiment acidic or neutral? Why? c. Record your observations using the following Table:

Substance	Colour developed P^H			P^H
Lemon juice				
Vinegar solution				
Tomato juice solution				

Write a laboratory report on your observations and present to the class.

Experiment 3: Neutralization Reaction

Objective: Investigate the reaction between acids and bases

Materials required: 1 M HCl, 1 M NaOH, red and blue litmus papers, four 150 mL beakers, two droppers, stirring rod, and two watch glasses.

Procedure: 1. 1. Make 1 M NaOH solution by dissolving 4.0 g NaOH in enough water to make 100 mL solution. 2. Make a 1 M HCl solution by dissolving 8.3 mL of concentrated HCl in enough distilled water until the volume of the solution is 100 ml. 3. To a 150 mL beaker add 10 mL HCl solution and 9.5 mL NaOH solution and stir thoroughly and test with blue and red litmus paper. Continue adding NaOH solution dropwise using a dropper, stirring after each addition and checking with red and blue litmus until the blue remains blue and the red stays red. Put 2 mL of the neutral solution in a watch glass and allow the water to evaporate until the next day. Observations and analysis:

Is there any colour change, when you dip blue and red litmus papers into the solution of the acid and the base?

Why is it necessary to add NaOH solution dropwise (one drop at a time) in procedure 4?

During this experiment, under what conditions does the blue litmus remain blue and the red remain red?

What are the products formed in procedures 4? Write balanced chemical equations for the reactions?

Experiment 4: Electrical conductivity

Objective: To classify substances as electrical conductors and insulators non-conductor.

Apparatus: Copper wire, light bulb, power supply (DC) or dry cells, scotch tape, distilled water, NaCl ,1M H2SO4 , 1M CH3COOH , table sugar, lemon juice.

Procedure:

Arrange the conductivity apparatus

Pour some distilled water in the beaker, dip the electrodes into the water and turn the switch on.

Repeat the experiment with separate solutions of table salt, lemon juice. Sulfuric acid, sodium hydroxide, acetic acid and sugar solutions

Observations and Analysis:

Does the bulb glow when the switch is turned on?

Solutions of which substances make the bulb glow and not glow, when you turn on the switch?

Solutions of which substances make the bulb to glow with a:

Bright light?

Dim light?

Classify the substances used in this experiment as strong conductors, weak conductors and non-conductors by completing the table below:

Strong conductors	Weak conductors	Non conductors

e. Which substances in the experiment are used as:

strong electrolytes

weak electrolytes




APPENDIX IX: T-Test Output Result

Output result of independent t-test results on pre–test scores between EG and CG

Independent sample Test										
		Levene's test for equality of variance		T test for equality of mean						
		F	Sig.	T	Df	Sig.(2-tailed)	Mean difference	Std.error difference	95% confidence interval of the difference	
									Lower	Upper
Pre-test	Equal variance assumed	-003	-958	-025	88	-980	-044	1.786	-3.506	3.595
	Equal variance not assumed			-025	88	-980	-044	1.786	-3.506	3.595

Output result of independent t-test results on post–test scores between EG and CG

Independents sample test								
	Levene's test for equality of variance		T test for equality of means					
	F	Sig.	T	Df	Sig. (2-tailed)	Mean difference	Std. error difference	95% confidence interval of the difference

									Lower	Upper
Post-test	Equal variance assumed	.014	.906	3.979	88	.000	6.26	1.575	3.137	9.397
	Equal variance not assumed			3.979	87.8	.000	6.26	1.575	3.136	9.397

Independent t-test result of pre-test scores for EG and CG students' attitude towards chemistry

Independent sample of test										
	Levene's test for equality of variance			T- test for equality of mean						
		F	Sig.	T	Df	Sig.(2-tailed)	Mean difference	Std. error difference	95% confidence interval of the difference	
									Lower	Upper
Pre-test	Equal variance assumed	.43	.51	.483	88	630	032	067	-101	.167
	Equal variance not assumed			.483	88	630	032	067	-101	.167

Independent t-test result of post-test scores for EG and CG students' attitude towards chemistry

Independent sample of test										
		Levene's test for equality of variance		t- test for equality of mean						
		F	Sig.	T	Df	Sig.(2-tailed)	Mean difference	Std.error difference	95% confidence interval of the difference	
									Lower	Upper
Post-test	Equal variance assumed	.003	.957	5887	88	.000	533	091	.353	.713
	Equal variance not assumed			5887	88	.000	533	091	.353	.713