ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

ASSESSMENT OF CHEMISTRY LABORATORY PRACTICAL COURSE: THE CASE OF KOTEBE COLLEGE OF TEACHER EDUCATION

BY

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LIST OF ACRONYMS

AAHE: American Association for Higher Education

CA: Continuous Assessment

CICED: Centre for International Cooperation in Education

ETP: Education and Training Policy

FCA: Formative Continuous Assessment

HDP: Higher Diploma Program

ICDR: Institute of Curriculum Development and Research

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KCTE: Kotebe College of Teacher Education

LPA: Laboratory Practical Assessment

MOE: Ministry of Education

NPE: National Policy of Education

NOE: National Organization for Examination

NRC: National Research Council

PW: Practical Work

SA: Summative Assessment

SPD: Science professional Development

TESO: Teacher Education System Overhaul

TGE: Transitional Government of Ethiopia

USAID: United States Agency for International Development

ABSTRACT

The general objective of this study was to investigate and describe the awareness, attitudes and practice of assessment of laboratory courses in chemistry subject at KCTE. For this end, descriptive survey design was employed. Available sampling methods were used for students, laboratory assistances and laboratory manuals. Systematic random sampling was used for instructors, laboratory session observation and sample question papers. The data collected using available and systematic random sampling methods was presented numerically in a descriptive and narrative form. This was followed by the researcher's analysis and interpretation. The finding of this research suggests that the awareness and attitudes of instructors, laboratory assistances and students regarding assessment of laboratory practical courses was low. And also, the practice of assessment of laboratory courses in chemistry subject was in danger. To site some, majority of the students (90.2%) and surprisingly, (100%) of students did not prefer to be assessed with different assessment techniques and preferred to be assessed after laboratory session respectively. Majority of instructors and laboratory assistances (80.5%) did not give feed back for their students. Further more, instructors did not conduct laboratory practical assessment. This was due to lack of instructional materials, work load and number of students per laboratory session as reported by both the instructors and the laboratory assistance. Therefore, the assessment system of chemistry laboratory practical courses is in crisis. The demands of the 1994 ETP in relation to science curricula will not be met. Thus, science as practical subject or as a means of solving problems needs a drastic change. Therefore, its assessment need concrete effort of those who involved in the education sector. Finally, it also recommended that concerned bodies of the college should prepare on job training on assessment of laboratory practical course and avoid the hindrance factors for implementation of LPA.

CHAPTER ONE

Introduction

1.1. Background of the Study

According to the latest 'constructivist' learning theories, Learning is essentially: constructive, cumulative, self-regulated, goal-oriented, situated, collaborative, and individually different (De Corte, 1996). The learner is an active partner in the process of learning, teaching and assessment. She/he selects, perceives, interprets, and integrates new information to form a coherent and meaningful. This is with her/his prior knowledge and former experiences (Dochy Segers, and Buehl, 1999). According the learning theory, the changes grasped in the process of teaching-learning and assessment go together with innovations in instruction and evaluation: new instructional methods are introduced in educational practice, the latest technologies and media are used, and alternative modes of assessment are implemented (Birenbaum, 1996).In today's educational environment, assessment has become a critical component of educational policy makers, education administrators, parents and employers often view assessment scores to hold schools accountable for teacher performance.

Reece and Wolker (2003) defined assessment as the process of obtaining information about how much the student knows. Besides this, Airasian (1991), as cited in ICDR (1999) stated that assessment is a process of collecting, interpreting and synthesizing information. This helps teachers to understand their pupils, plan and monitor instruction. As well as, to establish a conducive classroom atmosphere. Therefore, teachers based on the information they get from the class room assessment can modify their pedagogical strategies. This helps to include the construction of remediation and the creation of enrichment activities for pupil. Assessment can also be used to provide information about the quality of programs, schools and stakeholders that are providing education and training (Okeke, 2004). Thus, teachers share assessment results with educators, stakeholders and community members on how their children are doing in school. Regular reports from the teacher based on the assessment allow the parents to know about their children's progress with this knowledge at hand. More over, parents can assist and support children with their studies during the school year before, opportunities for grade level achievement have passed. Anisiobi (2000) stated that continuous assessment is a method of finding out what the learners have gained from learning activities in terms of knowledge, thinking and reasoning, character development and industry. Continuous assessment is needed because it is an assessment approach which involves the use of variety of assessment. It is an approach that assesses various components of learning not only thinking process but including behaviors, personality traits and manual dexterity. (Anisiobi, 2002). As continuous assessment takes place over a period of time, such an approach would be more comprehensive representing the learner. However, examinations alone can not measure all what the student has learned because their effectiveness is limited to assess the entire complex learning outcomes(Mulu,2005).

To overcome this, it will be much more helpful if the assessment is employed on a continuous basis using different strategies. Apparently, continuous assessment is getting momentum. It is believed to be more valid, reliable and motivating than the traditional one-off examinations (Mulu, 2005). These days advanced nations such as America, Spain, England, Australia and others are applying continuous assessment partially or wholly in their educational system (Heaten, 1990).Assessment as an integral part of education has existed since formal and informal education was introduced to help human development(Birhanu,1999). Assessment in the formal education sector has been one of the important elements of school curriculum and it has been changing with the curriculum changes .However, despite the fast curricular changes taking place in Ethiopian school system the nature of student assessment has not undergone many changes. For example, the science curriculum before the 1960s curricular change was content centered and practical activities were done using standard scientific apparatus usually in a science laboratory to help students understand scientific concepts, laws and principles (Birhanu).During these times, the assessment method was dominantly written tests (paper and pencil) tests such as short answer questions, essay and written practical reports. These types of test items are called free response questions. The written practical reports included the aims, procedure, the required materials and the result of the experiment learnt in a class room.

The global science curricular change in the 1960's had also been reflected in our school science curricula (Birhanu,1999). In late 1960's, the American system of education and the objective type questions currently called fixed response questions were introduced to our school system. As the result, the free response questions were de-emphasized and the objective type question such as multiple choice questions, true or false, etc., were favored. The objective type question has continued to operate at both school assessment and national assessment levels until today. Even though the objective type questions were not fully appreciated to assess some vital basic practical activities in science (Berhanu, 1999). Therefore, it can be argued that the assessment of students achievements and performance have never been fully realized in our schools. And the employment of objective type (fixed response) questions has encouraged content centered teaching and recalling facts, laws., etc. rather than the science process that includes problems solving skills(Berhanu,1999).This approach has hampered the realization of innovative curricular changes that have occurred in our schools in the last many years.

The new education and training policy of Ethiopia (TGE, 1994) implies a shift in educational paradigm and declines problem solving as a guide-line for framing curriculum development. It has identified five general objectives (TGE, 1994 7-8) but two of them which are listed below were considered as more relevant to the topic under investigation. These are: firstly, to develop the physical and mental potential as well as problem solving capacity of the individual by expanding education and in particular by providing basic education for all. The other one is to cultivate the cognitive, creative, productive and appreciative potential of citizens by appropriately relating education to environmental and societal needs. As the general objectives portray and it is further explained in the policy, the intent was to develop curriculum materials that would improve the problem solving capacity of the students.

The policy document acknowledges and emphasizes also the importance of science education. The education sector strategy (TGE 1994b:15) states that the teaching and learning of science should enable students to understand scientific concepts and there by interdependability develop rational thinking and problem solving in their daily life; develop scientific skills to achieve scientific judgments (MOE, 2002). For this, it reasoned out that giving special due concern to natural science subjects will enable students to understand nature, enrich their scientific outlook and employ scientific knowledge to solve environmental and social problems (TGE,1994). This is evident at least in the "70/30" plan in which it was envisaged that as of 2008/09 academic year, about 70% entrants to higher education institution are in natural science and technology stream while 30% are in social science or humanities stream(Amdissa, 2008:53).

Moreover, in line with the New Education and Training Policy, the practical task of implementing the new curriculum at college level requires continuous assessment as part of the curriculum in general and the instructional process in particular (TGE ,1994). However, some researches had already been conducted in the area of science teaching (Temechegn, 2001; Yasin, 2004 ; Sileshi, 2004; Akalewold, 2001; Olani, 2008; Aklilu,2010) there are still gaps in the area of assessing practical courses in teaching sciences, practically in chemistry subject. In connection to this, educational assessment practice at KCTE like many others has faced problems in its implementation. With regard to this, Daniel (2004) in his research work indicated that the effectiveness of Assessment practices in Ethiopian HEIs is appeared to be questionable. Similarly, Girma (2001) in his part stated the educational assessment practices in Ethiopian HEIs found to be ineffective. Besides, HERQA (2006) showed that the current assessment practices in HEIs need improvement.

This inspired the researcher to look into the case of Kotebe College Teachers Education to investigate and describe status, awareness and attitudes of assessment of practical courses in chemistry subject and also to suggest means for improving the assessment and there by improve the student learning to set standards chemistry objectives stated in the curriculum guides.

1.2 Statement of the Problem

Educationists today have the opinion that teaching is a complex and difficult task (Mekasha, 1999). One of the things that make teachers task more complex and difficult is probably the routine process of assessing their pupils (Mekash, 1999). By applying assessment, teachers should be able to get feedback from their pupils and, from the feed back they should be able to understand the extent to which their pupils have developed desired behaviors or objectives. The feedback should tell them also about the extent to which the lesson is covered and classroom performance has improved within a given period of time. Obtaining such information lead teachers to the decision and planning of what should be done next in the teaching -learning process .This implies that by using assessment as a tool, teachers can understand the behavior, abilities, interests, attitudes and needs of their pupils and be in a position to design better teaching and learning activities. However, this can be true, if teachers have the necessary knowledge, skill and capability to implement sound and practical assessment techniques in the teaching-learning process and use properly the results of the assessment for continually devising new methods of instruction. In relation to what this, the researcher has a general impression that the performance assessment system currently being used in Ethiopian College in general particularly and KCTE in particular is not up-to-date. First of all, new approach to assessment is still alien to college instructor's .Secondly assessment seems to be misconceptualized as well as misused by college instructors, simply seek information out of it. And also, most instructors do not help their pupils learn better.

However, the education and training policy (ETP) (TGE, 1994) has entrusted science education to incorporate technological elements, student practical experience and societal issues into its curricula (ETP) (TGE, 1994). To asses the attainment of science educational goals the current system of assessment needs to be reappraised. The techniques are necessary to assess student's problem solving skills, acquisition of higher cognitive abilities and skill as well as desirable attitudes. The 1994 ETP has already put emphasis to educational measurement and evaluation issues in Higher Institution. According to the policy, continuous assessment in academic and practical subjects, including aptitude test will be conducted to ascertain the formation of all round profile of students at all levels.

Having this framework, the need to improve the nature of science assessment in general and chemistry in particular in the higher institutions. From my experience, assessment of laboratory practical courses in higher institutions is understood by giving final written exam and laboratory reports to measure the outcomes of learning. It is conducted during the practical course of instruction in the form of final written exam and laboratory report in which grades are assigned to students. Therefore, to make benefit out of assessment of practical courses the role of instructor is indispensable. Instructors' understanding of the concept and applying it in the laboratory situation determines the extent to which teaching learning process is improved through practical assessment. The laboratory reports and final written exam, thus allowing a very small share to practical assessment of student's performance. As result, the present practices of the assessment process of students performance in practical courses in the college needs to be studied, analyzed and re-appraised. Hence, proper modes of assessment could be designed and employed that would enhance better learning of pupils. Accordingly, this study attempts to investigate the status and some of the problem in assessing student's performance in practical courses of chemistry.

1.3. Objective of the study

1.3.1 General objective

The general objective of this study was:-

- To investigate and describe the awareness, attitudes and practice of assessment of laboratory practical courses in chemistry subjects at KCTE

1.3.2 Specific objectives:-

The specific objectives of this study were:-

- describe the current implementation of assessment of laboratory practical courses in general and practical assessment in particular.
- find out the level of awareness of instructors, laboratory assistances and students towards assessment of chemistry laboratory practical courses in KCTE.
- find out the attitudes of instructors, laboratory assistances and students towards assessment of chemistry laboratory practical courses.
- identify the major factor that affect the implementation of practical assessment and its possible solution.

1.4 Basic research questions

In order to address the above objectives of the study, the research will try to answer the following basic questions.

1. What is the current status of the implementation of laboratory practical courses in general and practical assessment in particular?
2. What are the levels of awareness of instructors, students and laboratory assistances on chemistry laboratory practical courses assessment?
3. What are the attitudes of instructors, laboratory assistances and students toward assessment of laboratory practical courses?
4. What are the major factors that affect the implementation of practical assessment and its possible solutions?

1.5 Significance of the study

This study was designed to investigate and describe awareness and attitudes of instructors, laboratory assistances and students. And also, to determine current status of the implementation assessment of laboratory practical courses assessment in KCTE, thus; the study will have the following Significance, i.e., the finding of the study would help MOE, KCTE, higher institutions and other concerned bodies to indicate the current status of implementation of assessment of laboratory practical courses in relation to new education and training policy. Hence, they can device sound means for the factors that impede the proper implementation. Besides this, the curriculum designers in MOE and other institutions will get some benefits out of this study. Because it helps them to get some information on the nature of assessment of laboratory practical courses. So that by using it as a clue on the strength and weakness in existing condition and there by take corrective measure. Also, it gives some sight about attitude and interest of instructors and laboratory assistances towards chemistry of laboratory practical courses assessment at KCTE. Moreover, it may be used as steeping stone for those who are interested in this area to conduct further investigation.

1.6 Delimitation of the study

This study is carried out at KCTE by considering a sample of students and instructors and laboratory assistances in diploma program. Also, the study focused on the assessment of chemistry laboratory courses. Nevertheless, the research would have been more reliable if degree program students and all other concerned bodies of different higher institutions were included; as well as, if the assessment of all laboratory practical courses of science subjects had been considered.

1.7 Limitation of the study

The main problems that faced in conducting this research work: - Lack of sufficient time, budget inefficiencies and lack of appropriate literature. As result, the research was unable to come up with more reliable and valid findings.

1.8 Operational Definition of terms

Assessment - refers all informal and formal activities that teacher makes to get information about pupil's attainment and performances.

Laboratory practical Assessment: - defined as a task which requires some manipulation of apparatus or action on materials and which involves direct experience of examinee with the materials or events at hand

Practical work - refers to the doing of experiment, practical exercises and observation exercises with scientific apparatus in and science laboratory.

Attitude: - a term that shows felling, opinion believes of instructors, laboratory assistances and students regarding assessment

Awareness: - a term that shows knowledge and understanding of instructors, laboratory assistances and students in relation to assessment

1.9 Organization of the study

The study was organized in to five chapters The First chapter deals with background of the study, statement of the problems, objective of the study, significant of the study, scope and delimitation of the study, limitation of the study, organizational of the study and operational definition of terms. The second chapter presents the review of related literature and chapter three deals with research methodology and design. Chapter four focuses on presentation, analysis and interpretation data. The last chapter deals with summary, conclusion and recommendation.

CHAPTER TWO

Review of Related Literature

2.1. Meaning and concept of Practical work

Practical work has long been a distinctive and central role in science curriculum, and science educators have suggested the many benefits accrue from engaging students in laboratory activity (woolnough, 1991). A term practical work for the United Kingdom (UK) and literature of its previously affiliated countries corresponds to the term laboratory work used in U.S literature (Lazarowiz and Tamir, 1994). Lunetta (1998) also indicated that laboratory experiments as terminology in the U.S.A corresponds to the terminology practical activities used in UK literature. These terms have embraced an array of activities but normally they refer to experiments in school setting in which student's interact with materials to observe and understand the natural world.

Yager (1991) stated that practical work as typical laboratory work where students encounter ideas and principles at first hand. To some extent it merely means "hands on" science. Similarly, Hegarty stated that student laboratory work is a form of PW taking place in a purposely assigned environment where students engage in the planned learning experiences and interact with the materials to observe and understand phenomena (Hegarty, 1990).

Woolnough (1991) also added that, though it is difficult to define the term PW in science, it is defined as the doing of experiment, or practical exercises with scientific apparatus, usually, in a science laboratory. Practical exercise, with scientific apparatus, usually in a science laboratory. PW has long been an area of contention. It was observed that educators still faced the problem of defining activities as an essential of the science curriculum, due to the complexity of factors related to practical work and the use of assessment procedures that have often been inadequate (woolnough, 1991)

Husen and Postlethwite (1994) stated that, with in a science course the term" practical work" may be taken to include any activity involving students in real situations using genuine materials and properly working equipment. In many of the Biological science and physical science, practical work takes place in a laboratory and this is often known as laboratory work. In line with this, Kerr (1963) describes demonstrations, co-operated demonstration by groups as well as experiments and observational exercises carried out by pupils in laboratory or else where. As to Hodson practical work need not always comprise activities at the laboratory bench. It is any learning methods that require being active ratherthan passive accords with the belief that students learn best by direct experience (Hodson, 1990). Akalewold, (2001), argues that practical work (PW) as activities especially designed in the students text books where students are required to interact in someway from through observation (in demonstration) to employ some problem solving skills in doing science. In more general sense, Kerr (1963) stated that practical works can be done in either ways of demonstrations, that verify facts and principles, experiments, problem solving or discover experiments, investigation projects and the activity set to develop skills in techniques. Therefore for this research as it is defined by educators above, the learn PW is assumed that students engage in group or individually and in laboratory classroom; observations, laboratory experiments.

2.2. The nature of practical work in science education.

PW is said to be a sine qua non of school science by a number of researchers in the field (Woolnough and Allsop, 1985, Tamir, 1991). They suggest that...... In practical activities students teach themselves and each other and learn essentially through their own efforts under the careful preparation and guidelines of teachers.

According to Tamir (1991) a study of the literature enables taxonomy of aims and objectives for practical work to be established. This can be structured under five main headings; understanding concepts (declarative knowledge); acquiring habits and capacities; gaining skills (Procedures knowledge) including planning and design, performance, organization, analysis and interpretation of data and application to new situations; appreciating the nature of science and developing attitudes. However, these can be achieved only if students are provided with the opportunity to be involved in the necessary experiences.

A number of researchers (Harron, 1971; Tamir 1991), compared a typical (school laboratory) laboratory lesson with that of a typical investigation carried out by a scientists in term of who does what and he concludes that what students are actually doing in a typical laboratory is like technical and not like scientists. Tamir, suggested that, openness can occur of different stages of an investigation in the problem to be solved; in the planning, and operation of the investigation and in the possible solutions to the problems. Based on this he produces a four way classification of investigations, depending on weather each stage is open that is left to the students to decide or closed (Tamir, 1991)

Table 2.1 Level of inquiry in the science laboratory

Level of inquiry	Problem	Procedures	Conclusions
Level 0	Given	Given	Given
Level 1	Given	Given	Open
Level 2	Given	Open	Open
Level 3	Open	Open	Open

Source: Tamir (1991) practical work in school science on analysis of current practice. In woolnough (ed) practical science

In level Zero (0) problems, procedure and conclusions are all given and hence there is no experience of scientific inquiry. At this level one may find exercise involving practice in the same techniques and/or confirmation where the answer is already provided to the students. They may provide opportunities for students to learn accuracy in the process of trying to replicate a known answer. In level 1 both problems and procedures are given and they have to collect data and draw the conclusion. In level 2 only the problem given and the students have to design the procedure, collect data and draw conclusions. Akalewold (2003) called these level investigative practicals. In level 3 the highest level of inquiry the students have to do every thing by themselves, beginning with problem formulation and enduring with drawing conclusion (Tamir,1991)

Similarly, Simons and Jones in Akalewoled, (2005) in order to analysis the laboratory tasks suggested in the text books, assigned a stage by reading the script or outline of the activities and noted the level of openness on the basis of the freedom the activities give to students to engage in the central process of scientific inquiry.

The Scheme provides three stage in doing the activity (a) defining the problem (b) choosing the method, and (c) arriving at solution. In analyzing the activities, the first two stages (defining the problem and choosing the method of investigation) range from closely 'defined' to 'not defined' and the third stage (arriving at solution) is positioned from the activity that has only one solution to those having several alternative solutions.

As we have seen so far, the main criticism of practical work has been its undue emphasis on the lower levels, "0" and "1". The above description indicates that when the practical work was properly designed and employed at secondary level many of the expected outcomes were realized.

2.3. Type of practical work in science

Akalewold (2003) stated that in designing a course for practical work the major part of the design next to decisions of aim and objective is to make a right balance of concept development, skill development, and motivational aspect. Many attempts have been made to classify practical work in order to define their respective roles and purposes. Woolnough and Allsop (1985), identify three distinct types of practical work; experiences which are intended to give pupils a 'feel' for phenomena; exercise which are designed to develop practical skills and techniques; and investigation which give pupils the opportunity to tackle a more open-ended task as a problem-solving scientist (Millar, 1991:44). Woolnough (1991) also classified the practical into four major types: exercises, experiences, demonstrations and investigations. Each of these types of practical has its own place in science teaching. Field works are likely to include aspects of all these functions (Akalewold, 2003). Similarly, Parkinson indicates that practical work generally falls into one of the following four categories: (1) Learning basic practical skills (2) illustrating a theory or concept (3) Providing theory and (4) investigative work.

According to Got and Duggan (1995), five types of practical work developed by Gott et al (1988). These are (1) skills to acquire a practical skill (2) observation; frame work in relating real objectives and events to scientific idea (3) Enquiry to discover a concept law or principles (4) illustration, to verity a particular concepts, law or principles (5) investigation, to provide opportunities for pupils to use concepts, cognitive and skills to solve a problem. In the same way woolnough, (1994) recognizes four types of PW in science which do not all have to be investigations. It can also include exercises which develop specific practical skills; experiences which introduce students to particular phenomenon, demonstrations which allows the teachers to develop a scientific argument or to create a dramatic impression, and there will be scientific investigations either of the hypothesis testing type or of the problem solving types.

Table 2.2 Types of Practical work

Exercises	To develop practical skills
Experiences	To gain experience of a phenomena
Demonstrations	To develop a scientific argument or cause an impression
Investigations	Hypothesis testing to reinforce theoretical understanding problem, solving to learn the ways of working as a problem solving scientist.

Source:-Woolnough (1994:107) effective science teaching developing science and technology education series

Each of these types of PW has its place in science teaching each will be effective if its aim is appropriately targeted and students are active both mentally and physically through out. Educators also indicated that the boundaries are not claimed to be water tight; practical activities can clearly include more than one aspect particularly skills and observation are implicit to some degree in the other types (Gott and Duggan, 1995).

From these explanations, it is possible to identify that practical work is classified differently by different educators in different time.For this study Gott and Duggan (1995) classification were considered.

2.4. Rationales for Inclusion of practical work in science Education

A number of writers in the field offered many reasons as a rationale for student's PW. For example, Matiru et al, (1995) summarized the current roles of PW to be four major statements (1) teaching technical skills relevant to the subject (2) understanding principles and the process of scientific enquiry (3) developing systematic problems solving skills (4) nurturing the development of professional studies practical and commitment. Tamir, (1991) analyzed the works of Lawson, Schwab, Ausbel, Bruner, Gagne , and others in to five major reasons offered as a rational for the students laboratory experience in school in to (1) science involves highly complex and abstract subject matter (2) Students participation in actual investigations, employing and developing procedural knowledge often referred as skills, is an essential component of learning science as inquiry (3) practical experience whether manipulative or intellectual are qualitatively different from non-practical experiences and are essentially for the development of skills and strategies with a wide range of generalizable effects, (4) the laboratory has been found to offer unique opportunities, conducive to the identification, diagnosis and remediation of students' conception (5) students usually enjoy activities and PW and when they are offered and given a chance to experience meaningful and non-trivial experience that become motivated and interested in science.

Tamir, (1991) states that the new conception of the role of the school laboratory was one of the major changes advocated by the curriculum reform movement in the UK,USA and also where, i.e., it was not to be a more illustrative confirmative adjunct to the learning of science but instead was to become the centre of the instructional process. Arzi (1998) in his work entitled, enhancing science education through laboratory environments: indicate that, more than walls, Benches, and Widgets assume that . . . laboratory work in both a means and an end in science education and that some of school science teaching should be carried out in a flexibly designed laboratory. Similarly, woolnough (1991) point outs that pupils learning to do science as scientists do are the most appropriate models for school science. Thus it is generally accepted that PW teaching will be at the heart of science education. Layton (1990) underline that:- Science education without some laboratory experience is unthinkable but, equally students' laboratory practices are not general panacea, the universal means to a multiplicity of ends.

Kerr (1963) claimed that laboratory work led to many different desirable outcomes in cognitive, psychomotor, and affective domains-such outcomes included better understanding, familiarity with techniques and operates and manipulative skills respectively. Similarly, Tamir in woolnough (1991) emphasized that, laboratory is expected to provide for the development of motor and intellectual skills as well as problem- solving abilities and an effective outcome since the major learning mode is direct experience. Driver, (1986) indicates that the content of science course has been up dated and their structure change to reflect recent developments in the conceptual structure of the discipline. Paradoxically, this has been coupled with a shift in pedagogy towards a greater amount of PW; PW which in most cases is introduced to be illustrative or provide confirmatory evidence for the presented theories. We tend to think that this 'Practical' approach makes the subject more relevant and easier for pupils to understand (Ibid).

The laboratory sets science apart from most school subject. It gives science teaching a special character, providing many teachers and their students liveliness and fun that are hard to obtain in other ways that character is almost sufficient alone to justify the capital and recurrent cost of laboratories (White, 1988).

According to Shulman and Tamir (1973) and Friedler and Tamir (1990), a rationale for student laboratory work includes these features: science involves highly complex and abstract subjective matter. Even high school students may fail to grasp science concepts without the concrete props and opportunities for manipulation offered in the laboratory. The laboratory also offers unique opportunities to identify student misconceptions (Driver and Bell, 1986: Friedler, 1984). Students' participation in actual investigations that develop their inquiry and intellectual skills in an essential component of the inquiry curriculum. It gives students an opportunity to appreciate the spirit of science (Ausbel, 1968) and promotes understanding the nature of science – for instance, the multiplicity of scientific methods, and the interrelationship between science, technology and society (Shulman and Tamir, 1973).Laboratory work promotes the development of cognitive abilities such as problems solving, analysis, generalizing (Ausbel, 1968), critical thinking applying, synthesizing, evaluating, decision making and creativity (Shulman and Tamir, 1973).Students usually enjoy PW in the laboratory and when offered a chance to experience meaningful, non trivial but not too difficult experiences, they become motivated and interested, not only in their laboratory assignment but also in studying science.

2.5. The aim of practical work in science education

According to Brown et.al., (1986) science is not just natural history, and education in science involves more than simply extending range of pupils sense experiences. It is about introducing students to the conventional scientific interpretation of events and helping them to re-organize their idea accordingly, they stated as:

> *(Science instructors) believed that pupils should have first hand practical experience in laboratory in order to acquire skills in handling apparatus, to measure constants and to illustrate concepts and principles unfortunately,PW often did not go farther than this and few opportunities where provided for pupils to conduct challenging experimental investigation (Brown et. Al. 1986: 278)*

Similarly, Kerr (1963) indicate that there are certain functions of science teaching which can be best fulfilled through PW. For the purpose of the schools inquiry, the following ten statements referring in particular to PW on science teaching method: (1) to encourage accurate observation and careful recording; (2) to promote simple commonsense, scientific methods of thought; (3) to develop manipulative skills; (4) to give training in problem solving; (5) to fit the requirements of practical examination regulation; (6) to elucidate the theoretical work so as to aid comprehension; (7) to verify facts and principles already taught; (8) to be an integral part of the process of finding facts by investigation and arriving at principle; (9) to arouse and maintain interest in the subject; (10) to make biological and physical phenomena more real through actual experience." Besides, Kerr (1963) notes that out of the above ten aims of PW the first four refers the possible effects of PW, the last two are possible effects on one's general attitude to science and the rest four refer to the actual teaching process.

Pakinson (1994) said about the aim of PW in science education, they are a whole host of reasons for carrying out PW in science lesson. Some of which one listed below. PW: Motivates pupils to do science and helps to keep them interested; to teaches skills to pupils (e.g., the ability to make accurate observation, manipulation skills; to helps to promote logical thinking accepts the theory (i.e., the idea of seeing is believing); to provide an opportunity for pupils to develop communications skills and to learn through group discussion; to provide an opportunity for pupils to work together as part of a team.

It could also be said that the more PW pupils do the greater skill will be and the higher will be their level or grade in any assessment scheme. In general Parkinsan clearly states that, the pupils will be presented with a variety of types of practical work, but they should all fulfill three major aims (1) they should motivate the pupils to do science (2) pupils should learn something from the experience and (3) they should be safe.

2.6 The status of assessment

The use of laboratory situation to assess aspects of student's work that may not appropriately be assessed by regular paper –based tests. A wide variety of testing objectives are possible and Brown,Bull and Pendlebury(1997) offer a long list of potential objectives which may need to be included in assessment. As a result of deciding what exactly it is that needs to be assessed, the teacher must decide whether any simple paper-and –pencil test method is adequate or whether the laboratory needs to the venue for assessment. Typically, students are required to perform some experimental procedure, note the results and evaluate their findings in the form of laboratory practical assessment.

Assessment and instruction are two inseparable entitles and some educators say assessment and instruction are two faces of a coin. In other words, assessment should be integral part of the teaching learning process. Instructors are expected to use different assessment tools and the assessment should be continuous.

In science laboratory practical courses, students are expected to develop the three categories of educational objectives, namely cognitive, affective and psychomotor. The instructional objectives should be clearly stated in the course out line or in laboratory manuals. And also, it has to show the three categories of educational objectives. In principle assessment should be based on the instructional objective. So in order to show whether students develop a necessary knowledge, skill and value using different assessment techniques is the only mechanism. Instructors in science laboratory courses are expected to use different assessment tools like laboratory reports, quiz, final written exam and practical exam as stated in the curriculum Guide. But all KCTE instructors' of chemistry used only laboratory reports and final written exam which accounts 40% and 60% respectively to determine student grade in laboratory practical courses.

The general method of assessment to be followed in higher institutions is indicated in the Education and Training Policy (EATP). The policy says, "Continuous assessment in academic and practical subject, including aptitude tests will be conducted to ascertain the formation of all round profile of students at all levels" (EATP 1994:18). Regarding assessment methods for laboratory practical courses the following methods are indicated in the curriculum guide: Laboratory reports (40%); quiz (20%); practical examination (20%) and finally written exam (40%). However, Hofstein and Lanetta (2004) said that:

It was observed that educators still faced the problem of defining activities as an essential of the science curriculum due to the complexity of factors related to practical work and the use of assessment procedures that have often been inadequate (woolnough, 1991)

Well-designed, inquiry-type laboratory activities can provide learning opportunities that help students to develop high-level learning skills. They also provide important opportunities to help students learn to investigate (e.g., ask questions), to construct scientific assertions, and to justify those assertions in a classroom community of peer investigators in contact with a more expert scientific community. There is no doubt that such activities are time-consuming. And also, the education system must provide time and opportunities for teachers to interact with their students and also time for students to perform and reflect on such and similar complex inquiry and investigative tasks. Such experiences should be integrated with other chemistry classroom learning experiences in order to enable the students to make connections between what is learned in the classroom and what is learned and investigated in the laboratory. This is largely based on the growing sense that learning is contextualized and that learners construct knowledge by solving genuine and meaningful problems (Brown, Collins, & Duguit, 1989). One of the most crucial problems regarding the implementation of inquiry-type laboratory experiments is the issue of assessing students' achievement and progress in such a unique learning environment. In general numerous science teachers are not using authentic and practical assessment on a regular basis. The *National Science Education Standards* (NRC, 1996) indicate that all the students' learning experiences should be assessed. As teachers, whose goal is to assess comprehensively what takes place in school science in general, or in the laboratory more specifically, we should use appropriate assessment tools and methodologies to identify what students are learning both in terms of concepts as well as procedures. The effect of such experiences on students' interest and motivation should also be assessed.

2.6.1 Assessment techniques in science

The objectives of sciences can be categorized into three general areas. These areas correspond to Bloom's taxonomy of educational objectives called the cognitive, psychomotor, and affective domains. The objectives of sciences are as follows:

1. Science content:-to measures the student's knowledge and understanding of scientific concepts, principles, etc.
2. Science process:-to measure the student's practical skills and abilities
3. Scientific attitude:-to measure the student's attitude to science and acquisition of scientific attitude.

What are the contemporary methods of assessing the above objectives? Mayer (1988), Black (1990) and Giddings and Fraser (1988) have clearly identified the assessment techniques which are applicable for assessing the three areas of science objectives.

2.6.1.1 Assessing the science content

To assess the science contents Mayer identified written examination, oral examination (interview), practical examination and pupil/student self assessment as the appropriated methods. The Written examination is used to assess the acquisition of scientific knowledge, understanding, application, analysis, synthesis and evaluation. It can appear as fixed response questions such as multiple choice, true or false, matching and free response questions such as sentence completion, short answer question, structured question and essay question. Some educators argue that the written examination particularly the fixed response questions encourage recalling of learnt facts. On the other hand, if one wishes to measure understanding, application and the higher cognitive abilities such as analysis and evaluation the free response questions as well as multiple choices. It is important to note that, the short answer question include labeling diagrams, completing sentences, completing graphs, table, giving definition, short description and doing calculation. Each of the above methods has its own strengths and weaknesses. For example, a multiple choice question and true or false question do not give direct evidence of students understanding. They have to be accompanied by short answer question to justify why they choose the item. On the other hand, the advantage of multiple choice questions is to measure large factual information in a relatively short time and easy to mark them.

2.6.1.2 Assessing the science process

In science literature, the science process or science as method is viewed as an independent entity in science curriculum not as a subservient to scientific concepts and their understanding. Murphy and Gott (1984) argued that the adoption of this view of science inevitably focused attention on the activities associated with solving problems scientifically. They grouped the science activities into six categories outlined below. 1. Use of graphical and symbolic representation, 2. Use of apparatus and measuring instruments, 3. Observation, 4. Interpretation and application, 5. Planning of investigation and 6. Performance of investigation. To assess the above practical activities in science, Giddings and Fraser and Black identified four broad categories of assessment techniques. These are written laboratory report, written test items, laboratory practical work and observational assessment.

The written laboratory report is commonly used to assess the student's skill of planning, designing a procedure and drawing conclusion of an investigative work. The problem is that the student's skill of manipulating instruments, observing and recording data and performing an investigation are missed.

The written test items for practical activities include reading measuring instrument, planning, designing, applying learnt knowledge and interpreting data, etc. For example, students can be asked to read a temperature from a scale printed on a test paper.

The practical activities that cannot be assessed with a written test can be assessed practically using "bit by bit" or holistic approach. 'The bit by bit approach employs either a prearranged stationary laboratory set up and require students to take accurate measurements, make and record qualitative observation and make interpretation or give an equipment and require certain types of response in terms of measurement taking and analysis of the result. Giddings and Fraser (1988) have acknowledged that the prearranged stationary approach is reliable and practical where large numbers of students are involved. Observational assessment on several occasions throughout the year is necessary or covers adequately the variety of tasks and techniques which comprise the total practical work. Use of checklist in observational assessment is essential.

2.6.1.3 Assessing scientific attitude and students interest to science

To assess the students' attitude to science and the development of scientific attitude, the attitudinal instructional objectives have to be clearly outlined. Scientific attitudes include curiosity and open mindedness while students' interest to science includes enjoyment of science learning, attitude towards the social benefits and problems which accompany scientific progress.

To assess the students' attitudes a relevant measuring questionnaire can be prepared for the different science related attitudes (Gadding and Fraser, 1988). Observation of students; Performance in a classroom can be also used to assess the students' attitude.

Experiences of other countries, for example, the UK, show that attitudinal assessment has not been part of the assessment. However, educators argue that as long as the scientific attitude is part of the curriculum, it has to be assessed and the assessment result has to be used for developing proper attitude and not for promotion purpose.

2.6.2 The chemistry laboratory: A unique mode of learning, instruction and assessment

Kelly and Lister (1965), based on comprehensive research findings, suggested that the science laboratory is a unique mode of teaching and learning and that the abilities of students in the laboratory are only slightly correlated with their abilities in other non-practical learning experiences. Support for this was provided at a later stage by Tamir (1972) and more recently by Yeany, Larossa, and Hale (1989). A study on modes of learning and teaching in the context of chemistry was conducted by Ben-Zvi, Hofstein, Samuel, & Kempa (1977). The main goal of this study was to identify relationships between modes of learning in the chemistry laboratory and other modes of learning that prevail in high school chemistry. The study was undertaken in the context of a laboratory centered program: *Chemistry for High School* (1972), developed at the Weizmann Institute of Science. This program was developed and implemented in the Israeli education system to replace the adopted version of the CHEMSudy program. To this end, a battery of tests were developed to cover at least the first three phases of performance in the chemistry laboratory (Kempa & Ward, 1976; Kempa, 1986; Giddings & Hofstein, 1990; Giddings, Hofstein, & Lunetta, 1991): *planning and design* (formulating questions, predicting results, formulating hypotheses, to be tested designing experimental procedures); *performance* (in conducting an experiment, manipulating materials and equipment, making decisions about investigative techniques, observing and reporting findings); *analysis and interpretation* (processing data, explaining relationships, developing generalizations, examining the accuracy of data, outlining limitations, formulating new questions based on the investigation conducted); and *application* (making predictions about new situations, formulating hypotheses on the basis of investigative results, applying laboratory techniques to new experimental situations). These phases refer both to psychomotor skills (manipulation and observation) and to cognitive abilities, i.e. investigation and processing of a problem and its solution by practical means. The battery of tests included two practical tests using a scheme and criteria originally developed by Eglen and Kempa (1974), an observational test (Kempa & Ward, 1976), two paper and pencil achievement tests, and an attitude and interest questionnaire. This battery of tests was administered to a sample of 233, 10 th grade students (in 12 classes from 5 schools) in Israel. Correlation of the results followed by factor analytic investigation revealed the following: Cognitive achievement in chemistry measured by written paper and pencil tests and achievement in the chemistry laboratory constitute independent modes: - Factor analytic investigation of the various variables showed that the practical domain can be subdivided into three distinct modes: -problem-solving abilities; skills in performing routine laboratory tasks and the ability to observe. Overall achievement in chemistry is therefore a combination of all these various modes that have to be taken into consideration when assessing students' ability in chemistry. Although this study was conducted in the mid-seventies, it is still in alignment with more recent reforms in science, claiming that if we truly value the development of knowledge, skills, and attitudes that are unique to practical work in science laboratories, appropriate assessment of these outcomes must be developed and implemented continuously by teachers in their own laboratory-classrooms. The National Science Education Standards (National Research Council, 1996), for example, indicate that the entire student's learning experiences should be assessed and that the assessment should be authentic. Attention to such standards, however, has promoted testing that has generally not incorporated the assessment of performance and inquiry, although there have been a few noteworthy efforts to do so. Researchers, teachers, and testing jurisdictions, whose goal is to assess comprehensively the learning that takes place in school science generally, or in school laboratories more specifically, should use appropriate assessment tools and methodologies to identify what the students are learning (conceptual as well as procedural).

2.6.3 Assessing student's performance, progress and achievement using different modes of presentations in chemistry laboratory

Bryce and Robertson (1985), in their review of the literature regarding assessment in the laboratory, wrote that in many countries teachers spent considerable amounts of time in supervising laboratory work, but the bulk of science assessment is traditionally non-practical in nature. More recently, Yung (2001) on the basis of a study conducted in Hong Kong in the context of biology learning. Presented data that demonstrate the complexity of assessment in school science laboratories. According to Yung, teachers should be aware of the potential of assessing their students regarding the improvement of teaching and learning. However, he claims that even as we enter the 21 st century, teachers continue to assess their students using paper and pencil tests, thus neglecting many of the most important components of students' performance in the science laboratory in general, and the inquiry laboratories in particular. In the previous section we presented the four phases that comprise practical work in the chemistry laboratory. Kempa (1986) suggested that these phases of experimental work provide a valid framework for the development and assessment of practical skills. In order to assess these phases, valid, reliable, and usable measures must be developed and implemented. A review of the literature (Ganiel & Hofstein, 1982; Bryce & Robertson, 1985; Giddings &

Hofstein, 1990; Giddings, Hofstein, & Lunetta, 1991; Tamir, Doran, & Chye, 1992; Lazarowitz & Tamir, 1994; Lunetta, 1998; Hofstein, Kipnis, & Shore, 2004) has shown that in general, several distinct categories of assessment are available to assess some or all these phases: written evidence (either traditional laboratory reports or paper and pencil tests); one or more practical examinations; continuous assessment by the science teacher or researcher; and the combined methods in which at least two of the assessment methods are employed.

2.6.3.1 Non- practical assessment

2.6.3.1.1 Written evidence

Traditionally, science teachers have been assessing their students' performance in the laboratory on the basis of their written reports, during or after the laboratory exercise. Unfortunately, this method of assessment provides only limited information regarding the Students' behavior and performance during the practical exercise. The second form of written evidence is a paper and pencil test, designed to assess students' knowledge and understanding of the use of experimental techniques and the principles underlying laboratory work and procedures. Such a method was employed by Ben-Zvi, Hofstcin, Samuel and Kempa (1976). The test was divided into two sections, dealing with (1) principles and techniques, and (2) methodology. In this case, too, the method is limited to the more theoretical components of the laboratory work and therefore does not provide evidence for the more performance-type activities.

Paper – and –pencil tests can be used to assess student's procedural knowledge or to complement practical tests of technical skills. (For an early example of such tests, see persing (1929) and for a more recent one, see Lunetta, Hofstein and Giddings (1981)). However; what is or can be measured by such tests is uncertain. Use of written tests to replace practical tests is a dubious procedure. Kruglak (1955) showed only low to moderate correlations between laboratory performance tests of very specific skills and paper-and-pencil items which were intended to be exact analogues. Correlations for more complex aspects of laboratory performance were even lower.

2.6.3.2 The purpose of assessment

As we know, the laboratory can play an important role at all levels of science education. The laboratory does not only provide unique learning experiences but also requires special assessment procedures. Teaching in the laboratory requires special skills is time consuming and quite expensive. Unless we can show clearly that learning in the laboratory carries important benefits, it is doubtful whether education systems and higher institutions will be willing to allocate time and means to it. The relationship between assessment and curriculum goes in two directions: on the one hand, curriculum determines the kind of assessment that takes place in higher institutions; on the other hand, the result of assessment are used of a basic for decisions regarding a variety of higher institutions related curriculum, such of a distribution of students in to study groups, promotion to a higher level, selection of instructional materials and instructional strategies.

2.6.3.2.1 Advantages of practical assessment over Non-practical assessment.

Practical assessments have fairly high face validity because the activities which are similar to those carried out by scientists in their normal work (Dunn, 1986). NLPA have low face validity because they are not married in scientific works. Another aspects of validity is the extent to which the assessment procedure measures the desired out comes and on this criterion, a student's skill is best assessed by LPA of students results using skill.Assessement on the basis of the results NLPA would have the lowest rate. LPA of skill may be extremely valid, reliable and capable of discriminating between students. LPA is a unique made of assessment. Hence, there is no real and complete substitute for it. This means that LPA can and should be used to assess all the outcomes expected of learning in the laboratory although different kinds of LPA assess different kinds of skills. LPA involve doing something rather than writing about something, this is an area which should not be neglected.

2.6.3.3 Practical Assessment

2.6.3.3.1 Practical examination(s)

This type of examination is the most valid approach for assessing the *performance* phase, in which the student is involved in the conducting of and decision making within the experimental and observational phases. Examples of practical examinations used in research studies were found mainly in studies conducted and published throughout the 1970s (e.g., Yager, Engen, & Snider, 1969; Tamir, 1972, 1974; Eglen & Kempa, 1974; Kempa & Ward, 1975). Ben-Zvi, Hofstein, Samuel, and Kempa (1976) used three practical tests in a study in which the educational effectiveness of a filmed experiment was investigated in the context of high-school chemistry learning. Two groups of students were involved in the study: a group of students who watched the experiments performed in 8mm film-loops and a control group in which the participating students performed the same experiments as hands-on activities. The first practical test required students to perform experimental work according to well-defined instructions; its main purpose was to examine manipulative skills. This was done by using a checklist embracing four subcategories of manipulative skills (experimental techniques, procedures, manual dexterity, and orderliness) suggested previously by Eglen and Kempa (1974). The second practical test was developed with the goal in mind of assessing students' skills in the context of a problem-solving situation involving not only the activities to be performed but also the planning of an experimental procedure in an area not previously encountered by the students, for example, a quantitative investigation of the effect of heat on a carbonate. The same checklist was used as in the first practical test. The third practical mode of assessment was an *observational test.* This test consisted of six test-tube-type experiments covering the following perceptional areas: color change, change of temperature, evolution of gases, and the precipitation of solids. The results of the study indicated that, except for the manipulative skills area, filmed experiments presenting experimental situations are an effective substitute for students' individual laboratory work in that they do not adversely affect cognitive or laboratory-based problem-solving achievement. However, in the area of routine manipulative skills, direct experience with laboratory work obviously leads to a higher performance level; but the relative advantage gained by the experiment-group students over the film-group students is small and strongly supports the potential of filmed experiments as a means of teaching manipulative skills simply. Common sense suggests that technical skill should be tested in a practical setting. Experience shows that despite the apparently obvious connection between student learning in the science laboratory and the testing of students' performance, the use of laboratory practical testes has a patchy history worldwide- although some countries (e.g. the United Kingdom) have a long tradition of practical examinations at both secondary and tertiary levels. Even in the UK, the use of practical examinations has varied depending on the value currently placed on testing of technical skills or observational skills, and the extent to which it has proved feasible or desirable to test higher level enquiry skills. It is a point of criticism that sometimes the testing of technical skills, procedural knowledge and enquiry skills are confounded so that poor performance on the former two results in low marks on the latter. In addition, there have been doubts about the validity, reliability and discriminating ability of practical tests. They are expensive; require extensive organization and supervision and constant renewal with attendant administrative difficulties. The practices of assigning low proportions of marks to results of practical tests or of moderating students' marks on the basis of their performance in written tests are extremely dubious in view of studies which have demonstrated consistent low correlations between laboratory practical examinations and (knowledge-oriented) written tests (Abousief and Lee, 1965; Robinson, 1969; Tamir, 1972; Comber and Keeves, 1973; Kempa and Ward, 1975). Tamir (1972) introduced the term 'the practical mode' to signify this difference in performance.

On this basis, the importance of practical examinations for assessment of practical skills seems well established (Kempa, 1986). The relationship within the practical skills to be assessment is a matter of priorities within a curriculum. The following will serve as an example. It is the schedule adopted for the assessment of chemistry laboratory work at sixth form level in the United Kingdom (University of London, 1977): Manipulative skills (25-30%); Skills in observation and the accurate recording of such (25-30%); Ability to interpret observations (20-25%); Ability to devise and plan experiments (10-15%) and Attitudes (10-20%)

Practical tests (and also written reports and interviews) have fairly high face validity because the activities which are similar to those carried out by scientists in their normal work (Dunn, 1986). Paper- and – pencil tests have low face validity because they are not mirrored in scientific work. One would not wish to push this comparison too far- there is little or no possible counterpart for secondary or tertiary students. Another aspect of validity is the extent to which the assessment procedure measures the desired outcome, and on this criterion, a student's technical skill is best assessed by direct observation of the student using the skill. Assessment on the basis of results would have lower validity and again paper- and – pencil tests would have rate lowest. In summary, direct practical tests although superficial in their relationships to the work of practicing scientists, are the best tests available.

In practice, compromises are required and use of a range of testing methods may be advisable (kempa, 1986). For example, direct observation of technical sills may be extremely valid, reliable, and capable of discriminating between students. However, it is extremely time- consuming and on some occasions may be replaced by measurement of outcomes with tolerable deficiencies. Use of criterion referenced testing is the only acceptable method of providing student feedback on performance of technical skills (Dunn, 1986). Teachers must decide what constitutes acceptable mastery of a skill. Care must be taken not to include in assessment for grading, mastery level skills where most students will top out on the test. Skills on which mastery is required are best separated in a compulsory prerequisite examination on a pass/fail basis.

The main obstacle in using the *'practical examination'* approach is that its implementation is limited to those experiments that can be readily administered to students in a limited time, which obviously restricts both the scope and validity of the assessment. In addition, it can also have undesirable effects on the choice of experiments conducted throughout the year. In other words, in general, teachers limit their choice of experiment to those highly related to the type of experiment utilized in a practical test. There has been a change towards continuous internal assessment of practical abilities conducted and monitored by teachers in their school system in attempting to overcome these limitations and obstacles.

2.6.3.3.2 Continuous assessment

In attempting to overcome the drawbacks of practical examinations, teachers have shifted towards implementing the assessment of students' achievement and progress in the science laboratory by using continuous assessment. The philosophy behind this method is that students are not only evaluated at the end of the learning process, but instead this is A continuous and dynamic process (JMB, 1979). In this form of assessment the science teacher unobtrusively observes each student during the normal laboratory session and rates him or her regarding specific preconceived criteria and marking schemes (JMB, 1979; Ganiel & Hofstein, 1982; Giddings & Hofstein, 1990; Hofstein, Kipnis, & Shore, 2004). This system was largely formalized in the United Kingdom (JMB, 1979) as an alternative to one- time practical examinations that were administered by the government. Continuous assessment of practical work on several occasions throughout the year(s) is necessary to adequately cover the variety of tasks and skills that comprise a total program of science-based practical work.

The continuous assessment method was implemented in Israel in a study in which Students perform inquiry-type experiments (Hofstein, Kipnis, & Shore, 2004). For this study, about 100 inquiry-type experiments were developed and implemented in 11 th and 12 th grade chemistry classes in Israel (for more details about the developmental procedure, assessment of students' achievement and progress, and the professional development of the chemistry teachers see Hofstein et al., 2004). Almost all the experiments were integrated into the framework of the key concepts taught in high-school chemistry, namely acids-bases, stoichiometry, oxidation-reduction, bonding, energy, chemical equilibrium, and the rates of reactions. These experiments have been implemented in the school chemistry laboratory in Israel for the last five years. As previous mentioned, under these conditions, we controlled such variables as the professional development of teachers, the continuous assessment of students' progress in terms of achievement in the laboratory, and the allocation of time and facilities (materials and equipment) for conducting inquiry-type experiments.

2.6.3.3.3 Direct observation

The most direct method for assessment of students' technical skills is for suitable trained judges to observe them in action. This method has reasonable face validity in that it is most similar to the situation for which the student is being trained although it is far from clear what standards should apply (those of practicing scientists or those of secondary or tertiary teachers?). Direct observation meets the criterion of validity where the assessment procedure measures the desired outcome. All other methods of assessment involve some steps of inference.

There are two major criticisms: one is pragmatic and may be the single most important reason for discontinuation of direct observation programmers or for their patchy use. This is the necessarily highly individualized and time-consuming nature of the method. The second criticism is more fundamental and concerns the distinction between performance and underlying competence (Wood and Power, 1987). Here there is always the danger of false negatives-students who perform poorly are judged to lack underlying competence where as they may have a fair grasp of procedural knowledge and technical skills but not be able to apply them to the particular examination question. Direct observation should be accompanied by suitable elaborative procedures' (Wood and Power, 1987) where by students would be interviewed or otherwise given the opportunity to explain why they did X or what they would do if conditions changed to Y. This may sound even more dauntingly time-consuming than direct observation is already but would probably be necessary only sometimes if performance criteria (described below) were made available to students at the time of learning a technique (as well as to staff at the time of an examination).

Different methods for direct assessment have been reviewed and illustrated (Dunn, 1986; Kempa, 1986). The research study reported by Englen and Kempa (1974) used three different methods of assessment by direct observation, subjective rating, checklists and intermediate mode checklists.

Subjective rating is threatened by idiosyncrasy and vagueness but checklists have a long and honorable history (Hendricks, 1950; Kempa, 1986, Chapter 5) and see Tamir's chapter 5.2, on national evaluation processes in Israel). Intermediate mode checklists have a shorter history but have been successfully modified for use with assembly of equipment (Giddings and Hofstein, 1980).

Research findings for the three different methods of assessment (Englen and Kempa, 1974) were as follows:

(1) Subjective rating resulted in low mean grades by comparison with other methods and this was attributed to use of negative or penalizing performance characteristics.

(2). Use of the checklist assessment method resulted in lower grade variances than either of the other methods but had advantages of validity. However, it was impractical for use in normal classes since it involved long spans of individualized attention to very few students.

(3) The intermediate mode was found to have most of the advantages of the checklist (similar mean grades and variances) without its disadvantages of being too detailed and too consuming of time and energy for normal purposes. The basic mechanism appeared to be as for subjective rating but with use of both positive and negative performance features presumably due to specification of performance criteria.

2.7.3.3.4 The nature of practical mode

Olson (1973) observes that human learning is always mediated or specified through some form of human activity. Both knowledge ('knowing that') and skills ('knowing how') are acquired by using one or more of the following modes: direct experience; 'modeling or observation' and 'symbolically coded' (i.e. information transmitted through the media of speech, print, pictures and films). Any educational experience involves both knowledge and skill. Because different experiences generate different kinds of skills, it is important to recognize that the means of instruction exert a decisive effect on the acquisition of skills. Therefore, the crucial, yet largely overlooked, issue for instruction becomes one of deciding which skills should be cultivated. In our schools aspire to facilitative the acquisition of both knowledge and skills, they are reasonably successful in serving the goals pertaining to the acquisition of knowledge, but they serve poorly the educational goals pertaining to the development of skills. Yet it is these skills that are primarily responsible for the generalizable effects of experience.

Table 2.3 The relationship of knowledge and skills to goals, modes, and media and assessment outcomes

Educational component	*knowledge*	*Skills*
Educational goals		
Cultural heritage	High	Low
Motor skills	Low	High
Intellectual skills	Medium	High
Affective outcomes	Medium	High
Modes of learning (forms of experience):		
Direct experience	Medium	Medium
Modeling and observations	Medium	Medium
Symbolically coded	High	Low
Instructional media:		
Performance acts with direct feedback	Medium	Low
Mass media (speech, print, TV, films, Pictures)	High	Low
Present-day schooling	High	Low
Assessment of outcomes:		
Paper and pencil achievement tests	High	Low
Real-life situations	Medium	High
Techniques-oriented practical tests	Low	High
Enquiry- oriented practical tests	High	High

Source:- Attempts to summarize Olson's (1973) arguments by presenting the relative contributions to knowledge and skills of four major components of education: goals, modes of learning, instructional media and the assessment of outcomes.

How does the laboratory relate to the different educational components? As far as educational goals are concerned the laboratory is certainly expected to provide for the development of motor and intellectual skills as well as problem- solving abilities and affective outcomes. The major learning mode is direct experience, based on instructional media characterized by performance acts with direct feedback. While typical paper and pencil tests are, as suggested by Olson, 'high' in knowledge.

And 'low' in skills, practical tests of any kind are judged by us to be 'high' in skills. However, there is a fundamental difference between the two types of practical tests-while techniques oriented tests are 'low' in knowledge, enquiry oriented tests are 'high' in both knowledge, and skills. It has been argued elsewhere that the school laboratory occupies a unique position since it offers a balanced mix of modes of learning and provides ample opportunities for the development of skills. This uniqueness has been designated the practical mode (Tamir, 1972a).
The distinctiveness of the practical mode is restricted neither to the involvement of the learner in manipulation, nor to the activation of psychomotor skills. We argue that even intellectual skills such as planning an investigation, formulating hypotheses and interpreting data are different when carried out as part of an investigation going on in the laboratory.

2.7 Awareness of assessment

Teachers rarely have opportunities to engage in assessment design even though classroom assessment is fundamental to effective teaching. Teachers who strive to teach for student understanding need to be able to assess student understanding. There are few opportunities, however, for teachers to develop their conceptions of assessment or to learn how to assess student understanding in ways that inform instruction and support student learning. In working with teachers from across all grade levels, it is clear that there is demand for additional support in classroom assessment and a willingness to admit limited expertise in several key facets of assessment. In fact, in contrast to teachers in other disciplines, there seems to be greater doubt expressed by mathematics teachers about the design of the quizzes and tests they use and the usefulness of those tasks for eliciting student responses that might exemplify student understanding of mathematics. Contrast the typical classroom assessments in mathematics with scientific inquiry promoted in student-initiated experiments in science labs, genre-based writing in language arts, and extended conversations in a foreign language class. The comparison is easy to appreciate even without empirical evidence. Teachers' limited conceptions of and confidence in assessment often restrict implementation of mathematics curricula designed to achieve more ambitious goals for student learning such as non-routine problem solving, modeling, generalization, proof and justification. At present, therefore, there is an urgent need to provide mathematics teachers opportunities to develop their expertise in classroom assessment.

Hofstein and Lunetta (2004) said that:

> *Clearly, serious discrepancies exist between what is recommended for teaching in the Laboratory-classroom and what is actually occurring in many classrooms. Researchers need to examine and understand why large numbers of "good teachers" have not been using authentic and practical assessment on a regular basis. Such understanding should then shape research on classroom practice, the development of assessment techniques, teacher professional development, and further research studies. No doubt, the issues are complex, but explanations may lie in differences in the perceptions of teachers and researchers. For example, teachers may perceive they do not have the time or skill the required to implement such assessment methodologies successfully. Reluctance may also originate in the beliefs teachers hold about what students should be learning in laboratory experiences, how students learn, what they need to do to achieve important learning outcomes, and what they need to perform successfully on external examinations. Building on relevant scholarship, future research in science education should produce information that informs the development of strategies, protocols, and resources for teaching and for the professional development of teachers. Questions to be addressed include how to assess students' learning efficiently and effectively when they are engaging in inquiry and practical work, how to engage students with different skills and knowledge in practical experiences that result in meaningful learning, and how to promote a more effective laboratory learning environment.*

Bryce and Robertson (1985), in their review of the literature regarding assessment in the laboratory, wrote that in many countries teachers spent considerable amounts of time in supervising laboratory work, but the bulk of science assessment is traditionally non-practical in nature. More recently, Yung (2001) on the basis of a study conducted in Hong Kong in the context of biology learning. Presented data that demonstrate the complexity of assessment in school science laboratories. According to Yung, teachers should be aware of the potential of assessing their students regarding the improvement of teaching and learning. However, he claims that even as we enter the 21 st century, teachers continue to assess their students using paper and pencil tests, thus neglecting many of the most important components of students' performance in the science laboratory in general, and the inquiry laboratories in particular.

2.8 Attitude of assessments

An attitude as stated by Manogue (1999) is a mixture of beliefs, thoughts and feelings that predispose a person to respond, in positive or negative way, to other people, objects or institution. He further described that attitudes can not be measured directly, so one infers a person's attitude from his/ her actions and uses to predict future actions.

Goodwin and Klaaismer (1975) and Manogue (1999) assert that attitudes can and do change through: Personal experience (direct contact), Reflection on personal experience, Group interaction, Professional identity, Chance conditioning, Media influence (persuasion) and Cult influence (closed communities). They further added that changes in attitude can be brought about by changing Knowledge, understanding, skills and context. They assumed that these changes can be brought about through lectures, small group work, practical and projects.

It can be deduced that positive or negative attitudes that instructors may have due to reasons of their own may have the power of influencing their work positively or negatively. Moreover since attitude can be changed through any one of the above mentioned ways, the attitudes of instructors can be changed positively towards the task they have in their hands. However, researchers and educators share the idea that instructor's low interest or negative attitude towards assessment has been one of the variables that contributes to ineffective implementation. In view of this, some researchers such as Nitko (1996) and Gronlund and Linn (2000) are of the opinion that a new assessment progress can succeed only if instructors accept it. If instructors do not accept the basic philosophy of a program, one can hardly expect that it will be properly implemented. It seems clear here that instructors do their job successfully, if they themselves accept the basic inputs of the program. In line with the above view, Teshome (2001) has asserted that instructors must understand the assessment process, feel secure about it, and accept it as their own for its effective implementation. But, insufficient training, lack of adequate materials, lack of moral support, and lack of orientation and assistance from concerned body make it difficult for instructors to appreciate and apply continuous assessment.

For example, in Sirlanca the main problems encountered was instructors' resistance to implement Continuous Assessment and the causes were instructors' lack of preparation and parent's mistrust of instructors' judgment (Thorndike, 1997)

Taking the student attitude towards assessment, Shirley.M.et al (2003) agree that, pupils who do well on tests like tests and pupils who do not perform well in tests do not like tests .From the above statement one can guess that pupils, who do well on tests may have a negative attitude towards continuous assessment and to the contrary, pupils who are not comfortable with tests may have positive attitude towards continuous assessment

2.9 Factors affecting practical assessment

In order to maximize the efficiency of summative (and formative) assessment, the following factors must be considered:

Authenticity (Brook hart, 1999); Variety (Kellough et al, 1999); Volume (Kellough, 1999); Validity (Brook hart, 1999); and reliability (Kellough, 1999)

2.9.1 Authenticity

Assessment that is aligned with the classroom objectives and that reflects a real-world application is called authentic assessment. In providing examples of authentic assessment, Kellough et al (1999: 30-31) wrote that:

> In English language arts ... although it may seem fairly easy to develop a criterion-referenced test, administer it, and grade it, tests often measure language skills rather than language use. It is extremely difficult to measure students' communicative competence with a test .... An authentic assessment of punctuation then would be an assessment of a performance item that involves students in writing and punctuating their own writing. For the authentic assessment of the students understanding of that which the student has been learning, you would see a performance based assessment procedure, that is, a procedure that requires students to produce rather than to select a response.

2.9.2 Variety

Another method of insuring quality assessment is to use a variety of assessment techniques. Traditionally, True/False and selected response test items have been popular method of assessing students. However, these are limited in scope and typically test each student's capacity for rote memorization.

However, assessment should include all three domains of learning; cognitive, affective and psychomotor; in addition, assessments of the cognitive domain should reflect, at least partially its higher levels, such as synthesis and evaluation. Hence instructors should see use a variety of assessment technique, such as portfolios, cooperative research projects, papers and performance tests. Variety, in addition to permitting an instructor assess each of the domain of learning, is also a method for minimizing assessment bias against risk-groups. For example, "Decoding the language of a paper and pencil test can hinder language minority students from demonstrating what they know. Instructors will want to use a variety of assessment methods to provide more complete pictures of assessment methods to provide a more complete picture of students' progress and cease of need (NREL, 2000).

2.9.3. Volume

Unfortunately, instructors often require more summative assessments than are necessary. According to William (1992: 11-20):

> The quantity of assessment, which contributes toward the final result, need only be the minimum amount of necessary to ensure a valid result ... students resent over-assessment that often occurs across their course because each subject instructor believes his/her workload is reasonable. Large amounts of assessment also take their toll on staff, especially in terms of setting and marking. It is not surprising that examiners may be tempted to set assessment with more regard for ease of marking than for educational benefit.

2.9.4. Validity

According to Crooks (1988), the validity of assessment refers to the extent to which the assessment measures performance on the aspects of the course which are important. Hence, a valid assessment is one, which measure what is intended to measure.

For example, it would be not be valid to assess typing skills through a written test alone. A more valid way of assessing typing skills would be through a combination of tests that help determine what the typist knows, such as through a written in test of typing Knowledge, and what the typist is able to do, such as through a performance assessment of actual typing.

2.9.5 Reliability

Reliability relates to the consistency of an assessment. A reliable assessment is one, which consistently achieves the same results with the same cohort of students. Various factors affect reliability including ambiguous questions, too many options within a question paper, vague making instructions and poorly trained markers. Thus, explicitness in terms of learning outcome and assessment criteria are vitally important in attempting to achieve reliability. It should be explicit to the students when the task is set, and where there are multiple markers it should be discussed, and preferably used on the same sample cases prior to be using for real.

The problems that hinder science teachers to have a practical assessment system arises from curriculum, teachers themselves, School administration, nature of science itself and educational institutions. Further more, the main obstacle in using the *'practical examination'* approach is that its implementation is limited to those experiments that can be readily administered to students in a limited time, which obviously restricts both the scope and validity of the assessment. In addition, it can also have undesirable effects on the choice of experiments conducted throughout the year. In other words, in general, teachers limit their choice of experiment to those highly related to the type of experiment utilized in a practical test. There has been a change towards continuous internal assessment of practical abilities conducted and monitored by teachers in their school system in attempting to overcome these limitations and obstacles.

There are a number of factors that of affect laboratory practical assessment. And, some of them are the following ones: - large number of students per laboratory session; shortage of instructional materials; Absence of continuous on job training on LPA, lack of time and work load.

CHAPTER THREE

Research Design and Methodology

For the successful completion of this study, a case study was applied. The general objective of this study was to investigate and describe practice, awareness and attitudes of assessment implementation of chemistry laboratory practical courses at KCTE.

3.1. Rational of Selecting the Research Setting

I have an experience of five years as laboratory assistance and four years as instructor with in chemistry department of KCTE. As the result, I have a chance to see how the assessment of laboratory practical courses are conducted. In addition to this, I have taken the Higher Diploma Program that would make the assessment more qualified and professional. For these reasons, I am interested and decided to conduct research entitled as "Practices, awareness and attitude of assessment of chemistry Laboratory practical courses". The case of KCTE. Besides this, I am working as instructor in the college which makes data accessing and collecting efforts from using questionnaire, interview, FGD, laboratory session observation and content analysis much easier.

3. 2. Research Design

The main purpose of this study is to investigate and describe the practice, awareness and attitudes of assessment implementation of chemistry laboratory practical courses at KCTE.

For this, the researcher has assessed the extent of the implementation of assessment by teacher educators in laboratory practical courses at KCTE. Besides, the researcher tried to point out hindering factors in implementing laboratory practical assessment and its possible solutions.

For this purpose the study employed a Case study. A case study is a detailed examination of one setting, or a single subject, a single depository of documents, or one particular event (Merriam, 1988, Yin 1989; Stake, 1994). Cases studies vary in their complexity; both novices and experienced researches do them, but characteristically they are easier to accomplish than multi site or multi subjects studies (Scott, 1965).Start with a case study. Have a successful experience and then move on, if you choose, to the more complex. Therefore, this kind of study is selected based on the core supposition that it could assist the researcher to determine the status, awareness, attitude and factors affecting present level of assessment of laboratory practical courses in chemistry subject.

3.3. Sources of Data

The sources of data were: - chemistry instructors, laboratory assistance, students and laboratory session observation as primary sources, laboratory manuals and Final written exam question papers as secondary sources.

3.4. Population and Sampling Techniques

According to the data obtained from the administration of the college, there were 10 chemistry instructors, and 41 diploma students and 3 laboratory assistances in the academic year of 2010/2011 in chemistry department at KCTE. Out of these 41(100%) students, all instructors and laboratory assistances were included in this study. It was using available sampling that students (40), laboratory assistances (3) and laboratory manuals (6) were selected. Each five instructors for FGD and interview; final written exam question papers(3),that is, one is practical general chemistry for first year ; the second is practical organic, for second year and the last is analytical chemistry II for third year and 8 instructors for laboratory session observation were randomly selected.

3.5. Data Collection Instruments

This research employed various data collection tools, i.e., questionnaire, interview, focused group discussion, observation check list, and content analysis. Therefore, various tools were used for the purpose of triangulation and supplementing information gained from the other instruments.

3.5.1. Questionnaire

Gall (1996:7) stated that this form of data collection is used extensively to collect information that is not directly observable. It inquires about the feelings, motivations, attitudes, accomplishment, and experiences of individuals. In this regard, questionnaires were used to obtain information about current practice of assessment, the awareness level of students and also about their attitudes towards assessment of practical courses in chemistry subject. The data gathering instrument for questionnaires were in English for students. While the FGD with instructors and the interview with both instructors and laboratory assistances were conducted in Amharic to encourage participation and free flow of ideas. The items in three questionnaires were closed ended type. Some of the items of the questions were positively worded and the others were negatively worded to avoid possible bias. Moreover, to satisfy the need for confidentiality, respondents were not asked to put their names on the questionnaire instead they were requested to indicate their sex, age and years of study. (For detailed information see appendix A).

3.5.2. Interviews

As Silverman (cited in Henn 2006:164) argued that in-depth interviews enable the interviewer to maximize her or his understanding of the respondent's point of views. In this research two sets of interview were prepared for instructors and laboratory assistances. Eleven interview questions for instructors and 10 interview questions for laboratory assistances were constructed. The interview questions were both structured and semi structured. The main focus of the interview was to obtain information about current practice of assessment, the awareness of instructors and laboratory assistances and regarding their attitudes towards assessment of practical courses and factors affecting implementation of practical assessment and its possible solution. (For detail information, see appendix C and D).The interview was used to triangulate and cross check the data gathered through the other data collecting tools.

3.5.3 Focused Group Discussion

In recent year qualitative researchers have become interested in the use of focus group discussion to collect data (Gall 1996:10). Gall argue that interactions among participants will stimulate them to state feelings, perceptions, and beliefs that they would not expressed when interviewed individually. The purpose of FGD was to obtain information about the current practice of assessment, the awareness and attitudes level of instructors towards assessment and also factors affecting the implementation of laboratory practical assessment and its possible solutions. Because of this, the researcher conducted intensive discussion with five instructors who were assumed to have adequate information about the issue. The discussions were held in Amharic for ease communication and clarify of idea. The FGD consists of 11 questions. (For detail information, see appendix E)

3.5.4 Content Analysis

Content analysis is defined as a "systematic quantitative analysis of learning material such as textbooks, worksheets, etc., according to categories which represent educational objectives" (Tamir and Pilar Garcia 1992).It can be applied to study the content of any book. Tamir and Pilar-Garcia (1992) also emphasized the benefit of this method for checking the lofty claims of curriculum developers. Content analysis is used as a descriptive research when current documents or text issues are the focus; the analysis is concerned with the explanation of status of some phenomena at a particular time (Best and Kahan, 2008; creswe11, 2009). The actual learning depends on the nature of the tasks assigned and opportunities offered to students to learn (Lazarowlz and Tamir 1994). Text books often determine the nature of the assigned task. Therefore, in order to investigate the status of assessment each Instructional objective on both laboratory manuals and some sample exams would be analyzed. (For detail information see appendix F to N).

3.5.5. Observation check list

According to Best and Kahn (2003) observation can be employed to collect data regarding the number of occurrences of what on a specific period of time, or the duration of very specific behavior or events.In addition, Yin (2003:93) also stated that observation is useful in providing additional information about the topic being studied. In the same Vein,Vin(2003:86) further explained that, observation is insightful in to interpersonal behavior and motives. With this idea in mind, the focus of laboratory session observation was to determine the status of assessment methods by instructors and factors affecting laboratory practical assessment on their laboratory practical courses teaching. (For detail in formation see appendix B). To this end, an observation check list was adopted from Getachew, (2008). The observation took place in the diploma program students. The observation conducted in 16 laboratory session, each of the 8 instructors was observed two times. Each observation took two hours.

3.6. Pilot Testing

A pilot test was administered by interviewing 3 instructors and 20 students who were made to fill questionnaire. The result of the pilot needed some improvement in terms of ambiguity of words and repetition of items. After pilot study, the instruments were given to my adviser and the researcher tried to make necessary correction based on the feedback obtained. Accordingly, amendments were made with the help of the advisor.

3.7. Procedures of data collection

The preparation, distribution, continuous follow-up and the collection of questionnaires were made by the researcher himself. Furthermore, to maximize the quality of responses of the respondents and the rate of return, convenient time gap was arranged. Moreover, the researcher had made the objective of the study clear to all respondents at the beginning of the administration of the questionnaire, in order to avoid confusion and facilitate the administration easily. A close follow up was made immediately to correct possible problems that arose during the filling of the questionnaire.

Observation check list was prepared and filled during laboratory session observation of instructors. And then, the results were analyzed using percentage and frequency. The interviews were prepared for both the instructors and the laboratory assistances. But FGD was prepared only for the instructors. To make the communication more effective, all and FGD were made using Amharic. Then, both instruments were administered and the results were recorded in tape recorder and field notes. Finally the results were analyzed qualitatively. Besides this, laboratory manuals were collected and conducted inventory. Then the objectives were listed out and categorized in cognitive, affective and psychomotor domain. Finally, the results were analyzed quantitatively. Similarly, laboratory exam samples were collected and categorized in the there domain of educational objectives. Then, the results were analyzed quantitatively using percentage and frequency.

3.8 Data analysis

Accordingly, the data gathered through the questionnaire, laboratory session observation and content analysis were tabulated and analyzed using descriptive static's, namely percentage and frequency. In addition, the qualitative data from interview, observation check list and FGD were narrated and analyzed

CHAPTER FOUR

Data presentation and analysis

The general purpose of the study was to investigate and describe the practice, awareness and attitudes about assessment of chemistry laboratory practical courses. In this chapter, data collected through various tools were analyzed. The data were organized thematically.

4.1 Background Characteristics of Respondents

Based on the response obtain from students, laboratory assistants and instructors, their characteristics were examined interms of sex, age, years of experience and qualification.

Table 4.1.1 Background characteristics of represents by sex, age, years of experience and qualification

<table>
<tr><th rowspan="2">No</th><th rowspan="2">Item</th><th colspan="17">Types of Respondents</th></tr>
<tr><th colspan="8">Students</th><th colspan="4">Laboratory assistances</th><th colspan="5">Instructors</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Sex</td><td colspan="4">F</td><td colspan="2">M</td><td colspan="2">Total</td><td>F</td><td colspan="2">M</td><td>Total</td><td>F</td><td colspan="2">M</td><td colspan="2">Total</td></tr>
<tr><td colspan="2">f</td><td colspan="2">%</td><td>f</td><td>%</td><td>F</td><td>%</td><td rowspan="2">-</td><td colspan="2" rowspan="2">3</td><td rowspan="2">3</td><td rowspan="2">1</td><td colspan="2" rowspan="2">9</td><td colspan="2" rowspan="2">10</td></tr>
<tr><td colspan="2">19</td><td colspan="2">46.3</td><td>22</td><td>53.7</td><td>41</td><td>100</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Age</td><td colspan="2">18- 21</td><td colspan="2">22- 25</td><td colspan="2">26- 29</td><td colspan="2">Total</td><td>20-25</td><td>26-31</td><td>Above 32</td><td>Total</td><td>25-30</td><td>31-36</td><td>37-42</td><td>Above 43</td><td>Total</td></tr>
<tr><td>f</td><td>%</td><td>f</td><td>%</td><td>f</td><td>%</td><td>f</td><td>%</td><td rowspan="2">2</td><td rowspan="2">1</td><td rowspan="2">-</td><td rowspan="2">3</td><td rowspan="2">2</td><td rowspan="2">2</td><td rowspan="2">3</td><td rowspan="2">3</td><td rowspan="2">10</td></tr>
<tr><td>30</td><td>73</td><td>11</td><td>27</td><td>-</td><td>-</td><td>41</td><td>100</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Years of experience</td><td colspan="8" rowspan="2">-</td><td>1-5</td><td>6-10</td><td>Above 10</td><td>Total</td><td>1-5</td><td>6-10</td><td>11-15</td><td>Above 15</td><td>Total</td></tr>
<tr><td>3</td><td>-</td><td>-</td><td>3</td><td>2</td><td>4</td><td>1</td><td>3</td><td>10</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Qualification</td><td colspan="8" rowspan="2">-</td><td>Diploma</td><td>BA/Bcs</td><td colspan="2">Total</td><td>BA/Bsc</td><td>MA/Msc</td><td>PhD</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>3</td><td colspan="2">3</td><td>1</td><td>8</td><td>1</td><td colspan="2">10</td></tr>
</table>

As indicated in table 4.1 above, 22 (53.7%) and 19 (46.3%) of students are males and females respectively. This shows almost the numbers of female students are equally involved with male students in the study. Regarding the age of the student respondents, 30 (73%) were between the age of category 18-21; the rest 11 (27%) fall in the age group of 23-25.

As indicated in table 4.1 above, majority of the instructors were males and only one individual is female. Regarding the age of instructor respondents, each two individuals were between the age category of 25-30 and 31-36 respectively and the rest each three individual fall in the age group of 37-42 and above the age of 43 respectively. The third item in table 4.1 shows the instructor's work experience. With regard to this, two instructors have an experience less than five years, while the other three instructors have more than 16 years teaching experience. Here, many researchers have indicated that experience helps the professional development of teachers. In relation to this, Heffeman and Todd (1960) as cited in Temesgen (2006:37), argued that the professional growth of teachers will take place through increasing years of service in the schools and working with students and colleagues. It enables them to practice different teaching skills and to integrate new knowledge and skills with current practices. The fourth item in table 4.1 presents the qualification of instructor respondents. Accordingly, eight individuals have master's degree and one instructor has PhD and the remaining one instructor is Bsc holder. Qualified instructors are crucial to ensure the quality of education. Therefore, for the importance of quality teachers, Ayalew(1991:1) has stated that what ever curriculum changes are introduced and reforms are made, all will be of little or no avail without qualified teachers.

As indicated in table 4.1 above, all laboratory assistances were males. Regarding the age of laboratory assistances, two individuals were between the age category of 20-25 and the rest one individual falls in the age group of 26-31. The third item in table 4.1 shows laboratory assistance's work experience. With regard to this, all of them have an experience less than five years. Even though the requirement level of laboratory assistance according to Ministry of Education's is diploma, all are Bsc holders.

4.2 Status assessment on LPC

Regarding the necessity of inclusion of assessment in lesson plan, Paris et al (1991) stated that assessment and instruction are inseparable and one supports the other. Moreover, he added that teachers are expected to incorporate assessment in to their larger Learning frame work of their plan. So the following table shows assessment practice of laboratory practical courses in chemistry subject as reported by students.

Table 4.2 Assessment practices of LPC, as responded by students

No	Item	Yes		No		Total	
		f	%	f	%	f	%
1	Do instructors provide objectives for laboratory courses?	31	75.6	10	24.4	41	100
2	If your answer is yes for number 2, are objectives clearly stated?	31	100	-	-	41	100
3	Are assessment methods clearly stated in the laboratory manuals?	7	17	34	83	31	100
4	Do you get appropriate feedback from your instructors?	8	19.5	33	80.5	41	100
5	Do you write laboratory report by yourself?	10	24.4	31	75.6	41	100
6	Do you think that instructors have interest to correct laboratory report?	28	63	13	37	41	100
7	Are assessment method used by instructors based on objectives	33	80.5	8	19.5	41	100
8	Do you think that instructors used uniform criteria to correct laboratory reports	36	87.8	5	12.2	41	100

As shown above, 34(83%) of the students responded that teachers would assess their students without making clear assessment types and techniques. As I have checked from laboratory session observation and content analysis, all Instructors (100%) unlike other theory courses there is no the trend of giving course out line to the students. Although (60) objectives are indicated in all laboratory manuals, (28%) of them are not clearly stated. In addition to this, they do not consider the categories of educational objectives, particularly affective and psychomotor domain as expected (for detail information, see table 4.2). And also, the assessment techniques are not mentioned. The above idea also confirmed during FGD with instructors and interview with laboratory assistances. Here, it is possible to say that the majority of the instructors have contribution for a negative impact on assessment implementation. Regarding giving feedback the student respondents said that 33(80.5%) instructors did not give feedback after correcting laboratory reports and final written exam. Where as 8 (19.5%) of them explained that their instructors give feedback to their students. In relation to above idea, one of the interviewees of instructors fictitiously named Gudeta said that:-

> *Instructions did not give feedback to their students after correcting laboratory reports and final exam. For this, He resend out number of students per laboratory session, lack of times and work load.*

Further more, in relation to above idea, one of the interviewees of laboratory assistance fictitiously named Eyasu said that:-

> *Instructors did not give feed back to their students after correcting laboratory reports. No one controlled such activity even though giving feedback fully a responsibilities and duties of instructors.*

Besides this, majority 36(87.8%) of the student respondents indicated that there is no uniform criteria to correct student's laboratory reports. This shows the status and level of awareness of instructors in assessment implementation was low. In fact, the instructors are expected to assess their students frequently in order to check how much their students have grasped the idea under consideration, as well as to take remedial actions. And also, to improve the techniques they used are some of the benefits of assessment.

As shown on the above table 4.2, 75% of the respondents said that they didn't write laboratory reports by their own; 15(48.4%), 7(22.6%) and 9(29%) said that they copied from previous works, someone doing for them and copied from their classmate during writing their laboratory reports respectively. This idea also supported by instructors and laboratory assistances during FGD and interview respectively. However, both the respondents of instructors and laboratory assistances expressed as they have no controlling mechanism and means of cross -checking whether the students have done the laboratory reports by themselves or not. For this, they gave various reasons such as shortage of time, work loaded, number of students and other factors. Here, it is possible to say that the reliability and validity of assessment technique of laboratory reports which accounts 40% is under question mark.

4.2.1 Assessment practices of LPC from laboratory session observation

During observation of laboratory sessions the instructors used the usual form of assessment tools such as laboratory reports and final written exams. The tools to measure practical skills were not observed. Stressing the importance of using different assessment tools Baker and Stities (1991) asserted that CA is an assessment approach that involves the use of a variety of assessment instruments, for assessing various components of learning, not only the thinking process but also including behaviors, personality trait and manual dexterity.

Even though peer assessment is one of the techniques of assessment which helps students to learn from one another and correct their mistakes, there was no instance in which such activities were observed. Thus, this finding indicate that instrument for assessing the cognitive domain was highly used by instructors, and the instruments for assessing the affective and psychomotor domains were less used or neglected in the college under study.

In addition of this, from laboratory session observation few laboratory reports were found corrected and given feedback. This is in contrast to Cholera et al (2003) package of continuous assessment cited in Desalegn Chalchisa (2004) that after students are assessed, they should receive immediate feedback from their instructors so that they know what areas they need to work on for the next time they are assessed. In TESO (2003) guidelines it is also stressed that giving feedback is an essential part of assessment for students to learn from what they do, they must be told that they have done well and in what ways they could improve their work. Further more the available instructional materials were adequately used by instructors. However, in some course of study there are enough instructional materials for instructors demonstrate for their students. And the students are made to practice in large groups. These could in turn affect practical ability of individual students being not done privately.

Considering instructors use of portfolios, no one of the observed instructors were using it. However, portfolios as stated by Phil Race (1996) can tell much more about students than most other forms of assessment. Because, they are personal collection of materials, and can contain evidences reflecting a wide range of skills and attribute that can fully reflect a student's personal development.

Table 4.3 Assessment practice of LPC from content analysis of laboratory manuals

Course title for laboratory manuals	Types of objectives							
	Cognitive		Affective		Psychomotor		Total	
	f	%	f	%	f	%	f	%
Practical general Chemistry I	7	58	-	-	5	42	12	100
Practical general Chemistry II	7	50	-	-	7	50	14	100
Practical Inorganic chemistry	14	82	-	-	3	18	17	100
Practical Analytical Chemistry I	-	-	-	-	-	-	-	-
Practical Analytical Chemistry II	-	-	-	-	9	100	9	100
Practical organic chemistry	2	22	-	-	7	78	9	100

During analysis of instructional objectives which are found in four laboratory manuals, one professional and qualified instructor and the researcher have done individually. Then comparison made between two results of analysis. Thus, 85% of the results were agreed. So as it can be seen from the table 4.3, there are 61 objectives, among these 31 (48.2%)

were cognitive and 31 (51.8 %) were psychomotor objectives. But no affective objectives even though it is difficult to measure. From among six laboratory practical courses, two of them have more cognitive objectives and one has 100% psychomotor objective and one laboratory practical course, namely practical chemistry I has no objectives at all (for detail information, see Appendix F). Generally, when we see the laboratory manuals of different courses, the following problem observed:-witting two objectives in one statement, using words, i.e., study 15 (24.6%), determine10 (16.4) as an action verb which is not an acceptable way of writing specific objectives, for laboratory courses and using extraordinary long statement write specific objectives. (For detail information see appendix F up to k)

In order to write specific objectives, one has to use action verbs particularly for laboratory practical courses words like measure, prepare, construct, build, manipulate, operate, assemble, etc. And also, the statement should be clear, specific, measurable and observable.

Table 4.4 Assessment methods from content analysis of laboratory manuals.

	Assessment method		
	Indicated	Not indicated	Total
Course title for laboratory manual	%	%	%
Practical General chemistry I	-	100	100
Practical General chemistry II	-	100	100
Practical Inorganic chemistry	-	100	100
Practical Analytical chemistry I	-	100	100
Practical Analytical chemistry II	-	100	100
Practical organic chemistry	-	100	100

As can be seen above table 4.4, surprisingly, in all laboratory manuals (100%), Assessment methods are not indicated. But instructors should indicate the assessment methods for each laboratory courses either in course outline or laboratory manuals.

Table 4.5 Assessment practice of LPC from content analysis of sample exam papers

Course title	Types of objectives							
	Cognitive		Affective		Psychomotor		Total	
	f	%	f	%	f	%	f	%
Practical general Chemistry I	30	80	-	-	8	20	38	100
Practical Analytical Chemistry II	15	100	-	-	-	-	15	100
Practical organic chemistry	20	83	-	-	4	17	24	100

During analysis of sample exam papers, one professional and qualified instructors and the researcher have done individually. Then comparison made between the results of two analyses. Thus, more than 80% of the results were agreed. So as shown in table 4.5, more than 80% of the exam questions measure cognitive level of the students. Of course, we can not say that during the laboratory activity the students have developed affective domain. But the data we can see that the sample questions have no measure affective domain. Besides this, the exam of one course totally has no psychomotor domain at all. In fact, laboratory courses are expected to develop cognitive, affective and psychomotor skills. Nevertheless, sample exams mostly measure cognitive domain .So the exam questions should be balanced in measuring all types of domains effectively. As a whole the majority assessment for the sample exam items are not based on objectives stated in the laboratory manuals. (For detail information see Appendix F up to k)

4.3 Status of LPA

The use of laboratory situation to assess aspects of student's work that may not appropriately be assessed by regular paper –based tests. A wide variety of testing objectives are possible and Brown,Bull and Pendlebury(1997) offer a long list of potential objectives which may need to be included in assessment. As a result of deciding what exactly it is that needs to be assessed, the teacher must decide whether any simple paper-and –pencil test method is adequate or whether the laboratory needs to the venue for assessment. Typically, students are required to perform some experimental procedure, note the results and evaluate their findings in the form of laboratory practical assessment.

Table 4.6 Summary of status of LPA, as reported by student respondents

No.	Item	Used always		Used several times		Some times		Too often		Did not use		Total	
		f	%	f	%	f	%	f	%	f	%	f	%
1	Individual Assessment	-	-	-	-	-	-	-	-	41	100	41	100
2	Group Assessment	-	-	-	-	-	-	-	-	41	100	41	100
3	Laboratory reports	41	100	-	-	-	-	-	-	-	-	41	100
4	Observation	-	-	-	-	-	-	-	-	41	100	41	100
5	Oral question	-	-	-	-	4	9.8	-	-	37	90.2	41	100
6	Mid written exam	-	-	-	-	-	-	-	-	41	100	41	100
7	Portfolio	-	-	-	-	-	-	-	-	41	100	41	100
8	Laboratory practical exam	-	-	-	-	6	14.6	-	-	35	85.4	41	100
9	Presentations	-	-	-	-	3	7.3	-	-	38	92.7	41	100
10	Pre-laboratory quiz	-	-	-	-	2	5	-	-	39	95	41	100
11	Demonstration	-	-	-	-	10	24.4	-	-	31	75.6	41	100
12	Peer assessment	-	-	-	-	-	-	-	-	41	100	41	100
13	Post-laboratory quiz	-	-	-	-	-	-	-	-	41	100	41	100
14	Final written exam	41	100	-	-	-	-	-	-	-	-	41	100
15	Self assessment	-	-	-	-	-	-	-	-	41	100	41	100

As table 4.6 shows, all of the student respondents 41(100%) expressed that the most commonly used assessment techniques were laboratory report and final written exams.

However, the valid and reliable assessment techniques for laboratory practical courses namely practical examination were not used as expected. Thus, as in this finding indicated the affective and psychomotor domains were less used. From their FGD and interview, the instructors and the laboratory assistances respectively said that LPA is not given for the students. Further more, they stated that there is no guide line principle in the department as well as in the college. Even though the curriculum guide says that 20% has to be evaluated through laboratory practical examination. In relation to above idea one of the interviewees of laboratory assistances fictitiously named Desta said that:-

> *Instructors did not conduct LPA but they can conduct with available chemicals and apparatus. Most instructors sticked to old tradition assessment tools such as, laboratory reports and final written exam which have been existing since many years ago. This old tradition should be changed and instructors should implement appropriate assessment method for laboratory courses as stated in the curriculum (Feb3, 2011).*

4.4 Awareness of assessment of LPC.

According to Yung, teachers should be aware of the potential of assessing their students regarding the improvement of teaching and learning. However, he claims that even as we enter the 21st century, teachers continue to assess their students using paper and pencil tests, thus neglecting many of the most important components of students' performance in the science laboratory in general, and the inquiry laboratories in particular.

General speaking, the awareness about assessment of instructors, laboratory assistances and students is very important in the teaching learning process. With this regard, the following table shows student's awareness on assessment of laboratory practical courses.

Table 4.7 Level of awareness on assessment of LPC, as reported by students

No	Item	Agree		Undecided		Disagree		Total		Mean
		F	%	F	%	F	%	F	%	
1	I consider laboratory practical assessment as giving a series task of laboratory report and final written exam to measure pupil laboratory practical performance	35	85	-	-	6	15	41	100	1.58
2	Laboratory practical assessment enables students to identify their weakness and strength	11	27	-	-	30	73	41	100	2.07
3	The current Assessment method for laboratory courses can not be reliable and valid	38	92.7	-	-	3	73	41	100	1.29
4	Objectives and assessment method should not be included in the laboratory manual	32	78	-	-	9	22	41	100	1.88
5	Instructors should not use uniform criteria with in the department to correct laboratory reports.	29	70.7	4	9.8	8	19.5	41	100	1.96
6	Assessment of laboratory courses should not be continuous.	33	80.5	-	-	8	19.5	41	100	1.78

The mean scores from the data analysis were interpreted as 0.05 -4.49 (very low), 1.5-2.49 (low), 2.5-3.49 (medium), 3.5 -4.49 (high) and above 4.5 (very high). Based on this interpretation and as can be seen from above table 4.7, the mean value is 1.58, 2.07, 1.29, 1.88,1.96 and 1.78 for item number 1,2,3,4,5 and 6 respectively. So we can say that the awareness of students regarding assessment of laboratory courses is low. Moreover, From the above data 35 (85%) of students responded that laboratory practical assessment is giving series tasks of laboratory reports and final written exam. But 6 (15%) of student respondents disagreed to the above idea. From FGD and interview, we can understand that the instructors and the laboratory assistances respectively also have the same view. This shows that all of them, i.e., the instructors, laboratory assistances and students level of awareness of laboratory practical assessment was low.

In stressing the importance of using different assessment tools Bakers and Sitties (1991) asserted that CA is an assessment approach that involves the use of variety of assessment instruments for assessing various component of learning. However, as it can be seen from the above table, 33 (80.5%) of the students have the idea of assessment not to be continuous. At the same time as reported by the students majority of the instructors i.e., 38 (92.7%) are not using various assessment techniques. The above idea also confirmed by the instructors and the laboratory assistances during FGD and interview respectively. This shows majority of the three group of respondents have also low awareness about the concept of assessment. Moreover, the three groups of respondents have no idea about the term validity and reliability related to assessment. Here, 32(78%) of the student respondents said that objectives and assessments should not be included in the laboratory manuals. Among the student respondents 29(70.7%) of them said that uniform criteria is not necessary to correct laboratory reports. On the other hand, all instructors and laboratory assistances expressed during FGD and interview respectively, the absence of uniform criteria to correct laboratory reports even for the same course. Besides this, the instructors do not know the relation between objectives and assessment. Furthermore, the student respondents said that 30 (73%) laboratory practical assessment do not identify their weakness and strength. Therefore, it is possible to say that all the three groups of respondents have low awareness on assessment of laboratory practical courses in chemistry subject.

4.5 Attitudes on assessment of LPC

An attitude as stated by Manogue (1999) is a mixture of beliefs, thoughts and feelings that predispose a person to respond, in positive or negative way, to other people, objects or institution. In view of this, researchers and educators share the idea that instructor's low interest or negative attitude towards assessment has been one of the variables that contributes to ineffective implementation.

Taking the student attitude towards assessment, Shirley, et al (2003) agree that, pupils who do well on tests they like tests and pupils who do not perform well in tests do not like tests.

Table 4.8 Level of Attitudes on Assessment of LPC as reported by students.

No	Item	Agree		Undecided		Disagree		Total		Mean
		F	%	F	%	F	%	F	%	
1	I prefer laboratory report and final written exam than laboratory practical assessment	38	92.7	-	-	3	7.3	41	100	1.29
2	I prefer to be assessed with different assessment techniques.	4	9.8	-	-	37	90.2	41	100	1.39
3	I believe laboratory practical assessment assess my practical performance and ability better than laboratory reports and final written exam	6	14.6	-	-	35	85.4	41	100	1.83
4	I believe that instructors should not give feed back for students about their assessment results	34	83	-	-	7	17	41	100	1.68

As shown from above table 4.8, the mean value is 1.29, 1.39, 1.83 and 1.68 for item number 1, 2, 3, and 4 respectively. So it is possible to say that the attitudes of assessment of assessment of students regarding practical courses if low. Furthermore, as it can be seen from the same table, majority of student respondents, i.e., 38(92.7%) prefer to be assessed laboratory reports and final written exams where as 3(7.3%) of them preferred LPA.

As they expressed in their response, most of them, i.e., 37(90.2%) do not like to be assessed with different assessment techniques. But 4 (9.8%) of the student respondents like to be assessed with different assessment techniques. On the other hand, majority of the instructors and the laboratory assistances during FGD and interview respectively said that they dislike CA by reasoning shortage of time, work load, number of students and other factors. This shows all the three groups of respondents have low attitudes regarding assessment. Package of CA as cited in Desalegn Chalchisa (2004) that after students are assessed, they should have to receive immediate feedback from their instructors. So that they know what areas they need to work on for the next time they are assessed. However, among the student respondents 34 (83%) believed that giving feedback is not a such important where as 7(17%) of them said that feed back is necessary. Surprisingly, 41 (100%) of the student respondents said that they prefer to be assessed at the end of each laboratory sessions. On the other hand, majority of the instructors and the laboratory assistances during FGD and interview respectively preferred making an assessment at the end of instruction. Majority of student respondents, i.e., 35 (85.4%) LPA is not better than to be assessed their performances rather they want to be assessed by laboratory reports and final written exams. Where as 6 (14.6%) of the student respondents said that they are interested their performance to be assessed by LPA. Therefore, it is possible to say that the three groups of respondents, i.e., instructors, laboratory assistances and students have low awareness and negative attitude towards assessment of laboratory courses.

4.6 Factors affecting LPA in KCTE and its possible solutions.

The problems that hinder science teachers to have a practical assessment system arises from curriculum, teachers themselves, school administration, nature of science itself and educational institutions. Further more, the main obstacle in using the *'practical examination'* approach is that its implementation is limited to those experiments that can be readily administered to students in a limited time, which obviously restricts both the scope and validity of the assessment. In addition, it can also have undesirable effects on the choice of experiments conducted throughout the year. In other words, in general, teachers limit their choice of experiment to those highly related to the type of experiment utilized in a practical test. There has been a change towards continuous internal assessment of practical abilities conducted and monitored by teachers in their school system in attempting to overcome these limitations and obstacles.

There are a number of factors that affect LPA. Among these factors some of them are the following ones: number of students per laboratory session; shortage of instructional materials; absence of continuous on job training on LPA; lack of time and work load. During FGD and interview the instructors and the laboratory assistances respectively expressed that there are a number of problems which could affect the teaching learning process in the laboratory practical courses. Some of them are the followings ones: - lack of instructional materials particularly chemicals and apparatus, work load, shortage of time, number of students per laboratory session, poor administration support and absence of written documents for job description of the instructors and the laboratory assistances. Regarding the support from administration, one of the instructor's interviewees, fictitiously named sultan said:-

> *Instructors did not conduct LPA with available chemicals, apparatus, the given time and using the available man power. In fact LPA can be conducted at the same time while students are doing practical activity. The instructors missed the concept of assessment to be conducted during laboratory session. So the administration is not accountable and should not be complained. Because it is not tested in this regard. Therefore, the problem of conducting LPA falls on the instructors and the department (Feb3, 2011).*

Concerning the availability of instructional materials the laboratory assistance respondents said that most chemicals and apparatus are available, particularly for first year courses contrary to the instructors view. During laboratory session observation, this researcher has also seen the presence of chemicals and apparatus. In connection to hindrance factors of LPA one of the instructor's interviews, fictitiously named Beyene said that:-

> *Teaching laboratory practical courses need extra time and energy. Instructors are expected to stay 2 1/2 hours for each laboratory courses. And also, they are expected to correct different laboratory reports of each student (having 5 to 10 pages) on average weekly bases. 1 credit hour laboratory course takes more time and energy rather than 3 credit hours of other theory courses. In addition to this, the credit given by education system is very small, i.e., 1 credit hour. Teaching 12 laboratory hours is not considered as teaching 12 lecture hours of theory courses, rather 8 hours. This discouraged instructors to conduct LPA. (Feb3, 2011).*

In relation to the above view, head of the department of chemistry fictitiously named Dereje Said that:-

> *We can conduct LPA with available chemicals and apparatus. But these activities need pain and most instructors do not sacrify this pain. He further stated that most instructors prefer to teach laboratory practical courses rather than theory courses. If LPA is properly implemented, then the preference of majority of instructors will be the opposite (Feb10, 2011)*

There are a number of possible solutions to minimize hindrance factors for LPA and some of them are the following ones:- reducing the number of students per laboratory session; preparing continuous on job training for both the instructors and the laboratory assistances and induction training for students on LPA; purchasing and providing sufficient instructional materials continuously.

Both the instructors and laboratory assistances during FGD and interview respectively said that there should be initiation, guideline principle to conduct LPA as well as instructors and laboratory assistances should strictly carryout their duties and responsibilities. Besides this, the old trend of assessment techniques should be modified. Also, there should be rules and regulations to conduct LPA, and number of students per laboratory session should be reduced. Moreover, sufficient instructional materials like chemicals and apparatus should be purchased and provided. And also, they suggested that if the government is saying it has given due attention to the science fields, i.e., 70% to advance science in Ethiopia the above condition have to be fulfilled in order to conduct LPA in laboratory courses properly. In relation to the above idea, one of the interviewees fictitiously named Bekele said that:-

> *Science professional in general and chemistry professional in particular who have the knowledge of pedagogy should be actively involved during the design of science (chemistry) curriculum. The administration should invest money to build laboratory rooms with basic facilities as well as to purchase sufficient chemicals and apparatus. Besides this, there should be continuous purchasing trend from year to year and giving more attention, respect and emphasize for science courses. There should be special motivation and reward for science instructors (Feb10, 2011).*

For LPA implementation, things expected from instructors are: -to work together by breaking old tradition, devotion, determination, follow up, sitting and discussing together to make discussion forum, readiness, set standard criteria, involving on job training and practicing it, designing uniform criteria for the same course. And, updating and revising laboratory manuals from year to year, conducting LPA with available chemicals and apparatuses. Interest, motivation, preparing and checking chemicals and apparatus in advance are expected to laboratory assistances. Besides this, most instructors said that their responsibility is also directly concerned the laboratory assistances and they seek additional support from administration. Giving support by creating awareness, orientations, workshops, on job training, seminar, willingness, giving attention, and immediate response should be given to the request of the department, allocation of sufficient budget for science fields and showing positive attitude are expected from the administration. Finally, internal initiation, subject matter knowledge, matured act, interest, readiness, motivation, respecting the rules and regulations of the education system in general and the college in particular, changing the attitude and involving in induction training are expected from the students.

Unit Five

Summary, Conclusion and Recommendation

5.1 Summary of Findings

The main purpose of this study was to investigate and describes the awareness, attitudes and practice of assessment of laboratory course in chemistry subject at KCTE The study was designed to answer the following basic research questions:-

1. What was the current status of the implementation of laboratory practical course assessment?
2. What were the levels of awareness of instructors, laboratory assistances and students on chemistry laboratory practical assessment?
3. What was attitude of instructors, laboratory assessment and students towards of laboratory practical course assessment?
4. What were the major factors that affect the existing levels of implementation of laboratory practical assessment and at the same time what were the possible suggestions?

In order to answer these questions, the descriptive survey research method was employed and the following major findings were drawn. The data analysis leads the following major findings:-

1. It was found that 85% of the student considered LPA as giving a series tasks of laboratory reports and final written exams.
2. The study discloses that all the instructors and the laboratory assistances didn't have training on the implementation of LPA in the laboratory rooms.
3. Regarding guide line supply for LPA, all the instructors and the laboratory assistance explained that no guide lines provided to them.
4. It was found that (80.5%) of students had the idea of assessment laboratory courses not to be continuous.
5. Among the different assessment techniques, it was found that laboratory reports (100%) and final written exams (100%) were used by the instructors. But, from the most form of valid assessment of laboratory courses, observation and laboratory practical exam were not used by the instructors.

6. It was found that (92.7%) and (90.2%) students preferred to be assessed by laboratory reports and final written exam and they did not like to be assessed with different assessment techniques respectively
7. It was fond that all instructors and laboratory assistances didn't like giving feed back for their students.
8. It was found that (100%) of the students said that they preferred to be assessed at the end of each laboratory session. In fact, assessment could be conducted before, during and after laboratory session.
9. Further more, the research result should that lack of instructional materials for teachers and student to work with; the instructors and the laboratory assistances lacked commitment; both inadequate Knowledge about the ways and techniques of LPA; poor support form the administration, time constraints and large number of student per laboratory session were the major factors which hindered the proper implementation of LPA.
10. Finally, the study revealed that inadequate controlling mechanisms and supervisions were employed which unable to make necessary follow up and absence on job training about the implementation of assessment of laboratory practical courses in general and LPA in particular in the teaching learning process of laboratory practical course

5.2 Conclusions

1. College instructors practice assessment but not with a purpose and rigorous plans and steps
2. Changes are necessary in order to improve the validity and the use fullness of assessment techniques
3. Current attitude and awareness of instructors and students about assessment techniques should be changed. There seem to exist a wide and unacceptable gap between the officially intended at national level and the actual practices and realities at College level.
4. If significant change is desired in the methods of Teaching and learning, first methods of techniques of assessment should be changed and for this college instructors need to get much better knowledge and understanding on the process of assessment and its techniques
5. As the result of this study shows instructors have the notion of their role and responsibility, despite putting it in to practice have the problem. The assessment technique that most of the instructors employed to evaluate the students' mastery of practical activities was found to be the type of written test or paper pencil strategies and laboratory report. Hence, focusing only on theoretical knowledge's in evaluating students' performance would not be adequate.
6. The awareness of instructors, and students towards LPA was poor. A substantial number of instructors considered laboratory practical assessment as continuous giving task of laboratory reports and final written exam. This wrong conceptualization of assessment stemmed from lack of awareness of appropriate assessment and its method of implementation
7. Lack of awareness and skill on the case of LPA in the college develop negative attitude towards laboratory practical assessment.

8. The trend of using laboratory reports and final written exam for students was more emphasized than the valid and reliable form of assessment like laboratory practical examination. All these imply that instructors did not use different assessment techniques that enable them to assess the affective and psychomotor skills of their students.
9. Lack of proper follow up supervision on the part of administration, curriculum experts and the policy makers has affected negatively the implementation of LPA in the college.
10. Therefore, the assessment system of laboratory practical courses is in crisis. The demands of the 1994 ETP in relation to science (Chemistry) curricula will not be met using the existing college environment. Science in general and chemistry in particular as a practical subject or as a means of solving practical problems needs a drastic change in its assessment and also it needs concert effort of those involved in the education sector. This study is only an indicative one. Further more science (Chemistry) teaching-learning and assessment need to be done at all Higher Institutions and accordingly necessary measures have to be taken.

5.3 Recommendations

1. In the light of the findings of the study and conclusion drawn, the following recommendations forwarded to improve assessment in the college under study.
2. College instructors need a kind of practical guide line on assessment techniques
3. College instructors need retraining in assessment techniques this could be in a form of:-Exchange of ideas and experience among instructors in higher institutions through workshops, seminars, short and long term in service training
4. Instructors should look at the process of assessment as a part of the teaching learning process from the point of making it practical
5. Efforts should be made to change teachers' and student's current attitudes and awareness towards assessment techniques
6. Further studies should be made on practice of assessment techniques in College that may also consider some of the difficulties instructors face in implementing sound and efficient assessment techniques and seek solutions
7. Even though laboratory report is part and parcel of laboratory activity, the way of correcting laboratory report is not properly done. So, there should be uniform criteria to correct student's laboratory report. Further more, immediate feedback should be given at the end of each laboratory report. Presentation, reflection, etc., should be incorporated with in the task of laboratory report to check whether students done the laboratory report by their own or not
8. To raise the level of awareness of the instructors and the laboratory assistances towards assessment and its implementation and there by positive influence the attitude of instructors and laboratory assistances towards the scheme, intensive training on the concepts and roles of assessment should be organized in the form of on job training, workshops and seminars. In addition to this the already started program of higher diploma in higher institution should be strengthened.
9. Lack of Instructional materials and facilities were among the main hindering factors in the teaching learning process in general and in the implementation of LPA in particular. Thus more should be done by concerned bodies to allocate enough budgets for the college.

10. LPA guides or workbooks on each field of study area should be prepared and the guide's work books should embrace different types of assessment techniques that are relevant to assess practical skill and performance of students in the areas of the study

11. The study indicated that the present assessment practices is not fully in line with the idea of LPA, hence, it leads to one question the quality of learning as well as the Diploma given to students as a result of assessment. Therefore, to improve the quality of learning in college, it is necessary to establish and/or strengthen centers of Excellence and Assessment centers.

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APPENDCIES

Appendix A

Addis Ababa University
College of Education
Department of Curriculum and Teachers' Professional Development Studies
Questionnaire for Students

I am conducting a research entitled "Assessments of Student's Performance in Chemistry Laboratory Practical Courses: The case of Kotebe College of Teachers Education" and the purpose of this questionnaire is to obtain information about the awareness and attitude of students' towards assessment of laboratory practical courses and how it is practiced in Kotebe College of Teachers Education. Your genuine response contributes much to the success of the research to be under taken. Hence, you are kindly requested to fill the questionnaire.

Thank you very much.

Part I: Background information

1. year ____________
2. Sex ________________   3. Age ______________

Part II. Title: Attitudes and awareness of students in assessment of laboratory practical courses.

Direction: Here is a five point scale to measure your level of awareness and attitude towards assessment of laboratory practical courses in chemistry subject Please put a tick mark (✓)to show your level of agreement. The scales are:
Strongly Agree (SA) = 5Agree (A) = 4 Undecided (U) = 3
Disagree (D) = 2 strongly disagree (SD) = 1

No.	Items	5	4	3	2	1
1	I consider laboratory practical assessment as giving a series task of laboratory report and final exam to measure pupil's laboratory practical performance.					
2	Laboratory Practical assessment enables students to identify their weakness and strengths.					
3	I prefer laboratory report and final exam than laboratory practical assessment.					
4	I prefer to be assessed with different assessment techniques (like observation, group work,					

No.	Items	5	4	3	2	1
	individual work, laboratory practical exam, etc.)					
5	I believe laboratory practical assessment assess better my practical performance and ability than laboratory report and final exam.					
6	If my performance was poor in assessment laboratory practical course result, then additional lesson would be given.					
7	Assessment method for laboratory practical courses cannot be reliable and valid.					
8	I believe that instructors should not give feed back for students about their assessment results					
9.	Objectives and assessment method should not be included in the laboratory manual.					
10.	Instructors should not use uniform criteria with in the department to correct laboratory reports					
11.	Assessment of laboratory practical courses should not be continuous.					
12.	Instructors should have sufficient time to correct laboratory reports					

Part III. Title: assessment method used in practical chemistry courses Direction: Indicating thick (✓) mark for the assessment methods used in practical courses by your instructors

No.	Assessment method	Used always	Used several times	Some times	Too often	Didn't use
1	Individual assessment					
2	Group assessment					
3	Laboratory report					
4	Observation					
5	Oral questions					
6	Mid written exam					
7	Portfolio					
8	Laboratory Practical exam					
9.	presentations					
10.	pre-laboratory quiz					

No.	Assessment method	Used always	Used several times	Some times	Too often	Didn't use
11.	Demonstration					
12.	Peer assessment					
13.	Post- laboratory quiz					
14.	Final written exam					
15.	Self-assessment					
16.	Others (please specify, if any) ______. ______. ______. ______.					

Part IV. Title: Attitudes, awareness of students and practices of assessment.

Directions: You are kindly requested by indicating a tick (✓) for your response on the given box.

1. When do you prefer to assess in laboratory practical courses?

A. During laboratory session ☐

B. Before laboratory session ☐

C. After laboratory session ☐

D. All the time ☐

E. If any other, specify ______ ☐

2. Do Instructors provide objectives for laboratory courses?

A. Yes ☐ B. No ☐

3. If your answer is "Yes", for question Number 1, Objectives are clearly stated

A. Yes ☐ B. No ☐

4. Are assessment methods clearly stated in the laboratory manuals A. Yes ☐ B. No. ☐

5. Do you get appropriate feedback from your laboratory instructors after correcting:

.final exam?

A. Yes ☐ B. No ☐ .laboratory reports.

A. Yes | ☐ B. No ☐ others,

specify____________________________

6. If your answer to number 5 is yes, how often do instructors give comment on the results of assessment?

A. always ☐ B. sometimes ☐ C. usually ☐ D. frequently ☐

7. Do you think that instructors have interest to correct laboratory reports?

A. Yes ☐ B. No ☐

8. Do you write laboratory reports submitted to instructors is done by yourself?

A. Yes ☐ B. No ☐

9. If your answer is No for number 8, what is your reason?

A. Copied from previous work ☐

B. Somebody doing for me ☐

C. Copied from my friends ☐

D. If any other, specify ____________

10. Assessment method used by instructors for varies laboratory courses are based on objectives of manual?

A. Yes ☐ B. No ☐

11. Do you think that instructors used uniform criteria to correct laboratory reports?

A. Yes ☐ B. No ☐

Appendix B

Addis Ababa University
College of Education
Department of Curriculum and Teachers' Professional Development Studies
Laboratory Observation
Laboratory observation checklist for the implementation of Assessment in Practical Courses

Part I: General Information

1.1 Observer's Name ____________________ 1.2 Date __________

1.3 Course observed _______________ 1.4 Year __________

1.5 Total number of student's ____________

1.6 Average group size in a single apparatus______

No.	Items Observed	yes	No
1	Students conduct laboratory practical activity in group		
2	Recording assessment results		
3	Use assessment tools:		
3.1	Peer assessment.		
3.2	Individual assessment.		
3.3	Laboratory report.		
3.4	Observation.		
3.5	Oral questions.		
3.6	Mid written exam.		
3.7	Presentation.		
3.8	Portfolio.		
3.9	Pre -laboratory quiz.		
3.10	Demonstration.		
3.11	Final written exam.		
3.12	Post-laboratory quiz.		
3.13	Group assessment.		
3.14	laboratory practical exam		
3.15	self assessment		
3.16	others(please specify, if any) ________________________________. ________________________________. ________________________________. ________________________________.		
5	Students submit laboratory reports		
6	Student laboratory report corrected.		
7	Students have feed back about result of laboratory report		
8	Availability of instructional materials to conduct laboratory practical assessment		
9.	Students and teachers have the laboratory manual for practical course in chemistry subject on which		
	a. The objective is stated		
	b. Assessment type are mentioned		
	c. The assessment criteria stated		

Appendix C

Addis Ababa University

College of Education

Department of curriculum and Teacher's professional development studies

Semi structured interviewees for laboratory assistances

Sex ____________________ Qualification ____________________

Age ____________________ Year of Experience ______________

1. How do you perceive laboratory practical assessment and what is your opinion about the importance of practical assessment for instructional purpose?
2. What kind of assessment methods instructors used to know the performance of students for laboratory practical course?
3. Have you checked /corrected/ student's laboratory report before?
4. Do you have uniform criteria with in the department to correct laboratory report
5. Do you have a mechanism to check whether students did laboratory report by independently or not?
6. Do you provide feedback for your students after correcting laboratory report
7. Are chemicals, equipments available to conduct laboratory practical assessment?
8. What do you think that hinder or facilitate instructors to implement laboratory practical assessment for practical courses in chemistry subjects?
9. What do you suggest to minimize factors that hinder in using laboratory practical assessment for practical courses?
10. What should be done to implement laboratory practical assessment on the part of;-
    a. Instructors
    b. Administrators
    c. Laboratory assistances
    d .Students

Appendix D

Addis Ababa University

College of Education

Department of curriculum and Teacher's professional development studies

Semi structured interviewees for instructors

Sex ________________ Qualification ________________

Age ________________ Years of experience __________

1. When do you prefer to assess your student in laboratory practical courses of chemistry subject?
2. Is there any problem on how students :
   - Laboratory report is checked?
   - Taking feedback after instructors correcting laboratory reports?
3. Is there any college guide line policy on how laboratory practical assessment is treated?
4. What is your opinion about currently used assessment method for laboratory practical courses in chemistry subjects?
5. What do you understand the relation between objectives and assessment method in teaching laboratory practical courses?
6. Did you get any guiding principle to use laboratory practical assessment in assessing student's performance in practical courses from department?
7. What kind of support do you get from college administration in implementing laboratory practical assessment?
8. How do you perceive laboratory practical assessment and what is your opinion about the importance of laboratory practical assessment for instructional purpose
9. What factors do you think that hinder or facilitate laboratory practical assessment for practical courses in teaching chemistry in your college?
10. What do suggest in minimizing factors that hinder in using laboratory practical assessment?
11. What should be done to implement laboratory practical assessment on the part of :-
    a. instructors
    b. laboratory assistances
    c. administrators
    d. Students

Appendix E

Addis Ababa University

College of Education

Department of curriculum and Teacher's professional development studies

Focus group discussion with instructors

1. When do you prefer to assess your student in laboratory practical courses of chemistry subject?

2. Is there any problem on how students :

   - Laboratory report is checked?

   - Taking feedback after instructors correcting laboratory reports?

3. Is there any college guide line policy on how laboratory practical assessment is treated?

4. What is your opinion about currently used assessment method for laboratory practical courses in chemistry subjects?

5. What do you understand the relation between objectives and assessment method in teaching laboratory practical courses?

6. Did you get any guiding line principle to use laboratory practical assessment in assessing student's performance in practical courses from department?

7. What kind of support do you get from college administration in implementing laboratory practical assessment?

8. How do you perceive laboratory practical assessment and what is your opinion about the importance of laboratory practical assessment for instructional purpose

9. What factors do you think that hinder or facilitate laboratory practical assessment for practical courses in teaching chemistry in your college?

10. What do suggest in minimizing factors that hinder in using laboratory practical assessment?

11. What should be done to implement laboratory practical assessment on the part of :-

    a. instructors
    b. laboratory assistances
    c. administrators
    d. Students

Appendix F

Title of the course:- practical Analytical Chemistry I

Course No:- 223

No	Title of the experiment	Objectives
1	Separation and identifications of Group I Cations	-
2	Separation and Identifications of Group II Cations	-
3	Separation and identifications of Group III cations	-
4	Group IV cations	-
5	Separation and identification of Group V cations	-
6	Reactions of Group VI cations	-
7	Reactions and Schematic Analysis of Group I Anions	-
8	Reactions and Schematic analysis of Group II Anions	-
9	Reactions and Schematic analysis of Group III Anions	-
10	Reactions and Schematic analysis of Group IV anions	-
11	Reactions and Schematic analysis of Group V anions	-

Appendix G

Title of the Course:- Practical General Chemistry I

Course No: - Chem 103

No	Title of the experiment	objectives
1	Safety Rules	—
2	Science and Scientific Methods	To develop scientific way of thinking
3	Bunsen Burner and Elementary	To study the function and parts of the Bunsen Burner and discover the different types of Flames and Structures (Zones) of the flame
4	Measuring Devices	To study some measuring devices such as a balance, burette, pipette and Measuring cylinder
5	Data treatment	To interpret raw date
6	Separation of mixtures and compounds	To Separate and quantify a given mixture by physical methods To Separate a compound by a chemical
7	The law of conservation of Matter (mass)	means To study whether matter (mass) is conserved or not in a chemical reaction
8	Chemical Reactions and Equation	To study types of chemical reactions and to develop the correct writing chemical equations
9	Models of Molecular shapes	To build models of some molecules following the rules of valence shell Electron pair Repulsion (VSEPR) theory
10	Avogadro's Number and The mole concept	To relate the gram formula weight of a substances to Avogadro's number
11	Electrolytes and non-Electrolytes	To classify substances as electrolytes and non electrolytes

Appendix H

Title of the course: - Practical analytical chemistry II

Course No: -chem. 323

No	Title of the experiment	Objectives
1	Determination of water of Hydration	• To determine the percentage of water of hydration in hydrated $CUSO_4$.
2	Determination of Barium in Barium Chloride	• To determine gravimetrically in a soluble sample.
3	Standardization of sodium hydroxide solution	• To standardize NaOH using a secondary standard HCl
4	Determination of NaOH and Na_2CO_3 in the same solution	• To determine the exact amount of NaOH and Na_2CO_3 in a solution by taking advantage of the existence of two equivalent points on the titration curve of Na_2CO_3
5	Determination of Ammonium salts	• To determine the amount of Ammonia in ammonium chloride using two indirect techniques of titration known as back titration and substitution methods
6	Determination of Iron in Ferric Chloride solution.	• Determination of iron by oxidation using potassium permanganate as oxidizing agent
7	Determination of Potassium Dichromate using sodium thiosulphate	• To determine potassium by dichromate using sodium thiosulphate by substitution method.
8	Precipitation method of determining Halides	• To determine chloride using argentimetric titration
9	Determination of Zinc with potassium Ferro cyanide	• To determine zinc by precipitation titration with potassium ferrocyanide
10	Determination of Hardness of water	EDTA complex metric determination of hardness of water.

Appendix I

Title of the course: - Practical General Chemistry II

Course No: - Chem104

No	Title of the experiment	Objective
1	Gas laws	• To examine the relationship between the volume of a given mass of gas with the absolute temperature at constant pressure (Charles's law)
2	Diffusion gases	• To measures relative diffusion rates of two gases and to relate with their molecular masses.
3	Solubility determination	• To determine the solubility of a salt at a two different temperature.
4	Preparation of solutions	• To prepare solutions and describe their concentrations.
5	Acids and Bases	• To investigate the characteristics properties of some acids and bases in aqueous solutions.
6	Acid – Base titration	• To determine the concentration of a base present in an unknown solution by using a technique called titration.
7	Heat of reaction	• To estimate the heat of - Dissolution of NaOH and NH4Cl in water - Neutralization reaction of NaOH and HCl
8	Chemical equilibrium	I.To predict the directions of shifts in the equilibria of some reversible reactions at equilibrium
9	Electrochemical cells	• To construct simple galvanic cells • To explain how chemical reactions can because to generate electrical energy. • To determine voltage differences generated by different half cells and direction of current flow. II. To explain how electrical energy causes chemical changes in the electrolysis of water.

Appendix J

Title of the course: - Practical Organic Chemistry

Course No: - Chem. 243

No	Title of the experiment	Objective
1		• To purify a contaminated solid compound by recrystallizaion.
2	Determination of melting point and simple distillation	• To determine the melting point a solid substance obtained from the previous experiment
3	Fractional Distillation	• To separate a mixture of two liquids by fractional distillation.
4	Steam Distillation	• To separate volatile but water insoluble substances from non-volatile materials.
5	Chromatography	• To learn the use of chromatographic techniques in the separation and identification of organic Compounds
6	Three Dimensional representation of molecules (stereochemistry)	• To observe three dimensional structures of molecules by constructing models of different compounds.
7	Survey of some functional groups	• To study the characteristics chemical properties of some functional groups.
8	Preparation of Aspirin and oil of wintergreen	• To prepare acetylsalicylic acid, commonly know as "aspirin"; and Methylsalicylate, commonly as "oil of wintergreen"
9	Preparation and properties of soap	To prepare ordinary soap to examine its properties.

Appendix K

Title of the course: - Practical Inorganic Chemistry

Course No: - Chem. 214

No	Title of the experiment	Objective
1	Hydrogen preparation and its properties	• To prepare hydrogen gas from different chemical reactions and to study some of its physical and chemical properties
2	Alkali metals and their properties	• To study some properties of alkali metals
3	Alkali earth metals and their properties	• To study some properties of alkali earth metals
4	Group III elements and their properties	• To examine some properties of Group III elements.
5	Group IV elements and their properties	• To study some properties of Group IV elements.
6	Group V elements and their properties	• To study some properties of Group V elements.
7	Group VI elements and their properties	• To study some properties of Group VI elements.
8	Preparation of halogen and other inorganic gases	• To prepare different inorganic gases and study some of their physical and chemical properties.
9	Galvanic cell	• To observe a voltage difference generated by two half cells in a galvanic cell arrangement
10	Copper family	• To study some properties of copper family
11	Zinc family	• To study some properties of zinc family
12	Chemistry of Chromium	• To study some properties of Chromium chemistry of chromium
13	Chemistry of Manganese	• To study some properties of manganese chemistry
14	Chemistry of Iron	• To study some chemistry of Iron
15	Cobalt Chemistry	• To study some chemistry of Cobalt

Appendix L

Kotebe College of Teacher Education

Department of Chemistry

Practical General Chemistry I (Chem. 103)

Final Examination (70%)

Time allowed: 1:15hr.

Date: January, 2011

Name: ____________________________ID.NO. _________ Section _________

Instructor name:________________________________

Part I: Choose the best answer and write the letter of your choice in the spaced provided.[1.5 pts each]

______1.A flask has a mass of 12.50gm when empty and 22.60 gm when completely filled with water (density of water =1.00gm/ml). What will be the volume of water?

A. 12.50ml
B. 15.05ml
C. 10.10ml
D. None of the above.

_____2.what is the cause for the yellow coloration of luminous flame?

A. hydrogen
B. Water
C. carbon
D. oxygen

_____3.Which one of the following is wrong **in weighing chemicals on a balance?**

A. Check the rest point of the balance.
B. Never weigh an object while it is warm.
C. Put chemicals directly on the pan.
D. Keep the balance pan clean and dry.

______ 4. Parts of Bunsen burner that regulates the amount of air enters and a nozzle through which the fuel gas enters at high speed respectively are:

A. Barrel; spud B. Spud, Air hole
C. Collar, spud D. Wing top, Barrel

_____ 5.The hottest part of non-luminous flame is found at _____.

A. top of outer zone
B. top of middle zone
C. top of inner zone
D. bottom of middle zone

_______6. Which of the following statement is **false** about Pyrex glasses?

A. They are shock resistant glasses.

B. They are used as containers to heat reagents in laboratories.

C. Their compositions are sodium or calcium silicates.

D. They are classified as hard glasses.

_______7.Which of the following devices measures the volume of liquids most accurately?

A. Measuring cylinder B. Burette

C. Pipette D. B and C

_______ 8. Which of the following is a correct procedure while you are working in the laboratory?

A Tasting any thing in the laboratory.

B. Leaving an experiment in progress

C. During dilution, adding concentrated sulfuric acid to water.

D. Keeping the gas tap open while leaving for a lighter.

_______ 9.Two students, A and B have the following experimental values for the density of water

Student A:	0.96	0.98	0.97 g/ml
Student B:	0.96	0.94	0.92 g/ml

Which of the following is true about the data of students A and B? (Density of water =1.00 g/ml).

A. B is more accurate than A

B. B is more precise than A

C. B is more precise and more accurate than A

D. A is more precise and more accurate than B

_______10.which one o the following is **not true** about rules for determining significant figures

A. All digits other than zero are significant

B. Zeros between non-zero are not significant

C. Final zeroes to the right of a decimal point are not significant

D. B and C

_______11.You can separate a mixture of sand, salt and iron filling using the order:

A. Dissolution, Filtration, Magnetic separation, Evaporation

B. Magnetic separation, Dissolution, Filtration, , Evaporation

C. Magnetic separation, Filtration, Dissolution, Evaporation

D. Dissolution, Filtration, Evaporation, Magnetic separation,

______12.How many significant figures are there in 0.003080 cm

A.7 B. 6 C. 3 D.4

______ 13. Which one of the following molecules has a shape of triangular planer?

A. CO_2 B. BF_3 C. H_2O D. NH_3

______ 14. Which of the following chemical reaction symbol shows a precipitate product?

A. $\longrightarrow$ B. $\triangle$ C. $\uparrow$ D. $\downarrow$

______ 15. Which one of the following substance does not conduct an electric current?

A. Magnesium metal B. Sodium chloride solution

C. Dilute hydrochloric acid solution D. Solid sodium chloride

______ 16.. How many moles of 36 g of water? (At mass H= 1, 0=16)

A. 2 B. 1 C. 0.5 D. 1.5

______ 17.. Which of the following linear molecule?

A. $BeCl_2$ B. CO_2 C. CH_4 D. A and B

______ 18.. According to the valence shell electron pair repulsion theory, the repulsion among electron pairs increases in the order of: (LP= lone pair, BP=bond pair)

A. LP-BP < LP-LP < BP-BP B. BP-BP < LP-BP < LP-LP

C. LP-LP < LP-BP < BP-BP C. LP-LP < BP < BP < LP-BP

______ 19. How many molecules are there in 2 mole of CO_2? (At. Mass C=12, O=16)

A. $6.02x10^{23}$ B. $3.01x10^{23}$ C. $12.04x10^{23}$ D. None

______ 20. A chemical reaction may be marked by:-

A. Formation of gas B. Color change

C. Absorption or release of heat energy D. All

______ 21. 1 mole of $CaCl_2$ (At mass Ca=40, Cl=35.5)

A. Weighs 141 gm	B. Contains 6.02×10^{23} $CaCl_2$ units

C. Contains 2 mole of Cl^- ions	D. All

______ 22. The bond angle in CO_2 is ________

A. 120^0	B. 90^0	C. 180^0	D. 109.5^0

______ 23. The initial substances which undergo chemical reactions known as

A. Reactants	B. Catalyst	C. Products	D. Output

______ 24. "Electrons pairs surrounding the central atom arrange themselves as far apart as possible to minimize electrostatic repulsion." This statement termed as _____

A. Molecular theory	B. Valance Bond theory	C. Atomic theory

D. Valence shell electron pair repulsion theory

______ 25. In PCl_5 molecule, the central atom is ________

A. P	B. Cl	C. S	D. A and B

______ 26. Balancing chemical equation is governed by ___________

A. Law of conservation of mass	B. Law of triads

C. Law of octaves	D. Periodic law

______ 27. Ions which do not participate during chemical reactions are said to be

A. Spectator ions B. Polyatomic ions	C. Cations	D. Anions

______ 28. If silver nitrate solution and sodium chloride solution are mixed, a white precipitate will be observed. Which one of the following the chemical formula represents this precipitate?

A. $AgNO_3$	B. NaCl	C. AgCl	D. $NaNO_3$

---------29 which of the following is commonly used to express accuracy of measurement?

A.mean	B.relative error	C.standard deviation D.absolute error

--------30 which types of flame is similar to the flame of candle?

A. non-luminous flame	B.luminous-flame C. A and B

D. none of the above

Part II. Matching Items

Instruction: Column "A" contains type of reaction and Column "B" contains their examples. Match column "A" with column "B" and write your response on the space provided. (1 Points of each)

Column "A"	Column "B"
________ 1. Direct combination	A. $Cu + 2HCl \rightarrow CuCl_2 + H_2\uparrow$
________ 2. Decomposition	B. $2KClO_3 \xrightarrow{\Delta} 2KCl + 3O_2\uparrow$
________ 3. Single Displacement	C. $Mg + 2HCl \rightarrow MgCl_2 + H_2\uparrow$
________ 4. Double Displacement	D. $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl\downarrow$
	E. $Cu + O_2 \xrightarrow{\Delta} CuO$

Part III: Short Answer Types

1. Differentiate the following terms. (2 Points of each)

a. Lone pair electrons and Bond pair electrons

b. Electrolyte and non-electrolyte

c. Law of conservation of mass and law of definite proportions

d. Tap water and distilled water

e. Accuracy and precision

2. Write the difference between complete combustion and incomplete combustion in the column of the following table.**[10 pts]**

Complete combustion	*Incomplete combustion*

Appendix M

Kotebe College of Teacher Education

Department of Chemistry

Practical Analytical Chemistry (Chem.224) Written Examination

Time allowed: 1:30 hr

Date: January, 2011

Name ______________________

ID.Nº ______________________

Section ____________________

General Instructions

1. Write your **Name, IDNo, and Section**
2. Attempt all questions to maximize your score
3. Check that there are **5** written pages including the cover page
4. *Do not turn this page until you are told to do so*

Instruction: Read each of the following questions and write your answers clearly and briefly.

1. Define each of the following terms. **[10 pts]**
   a. Standard solution

   b. Equivalence point

   c. End point

   d. Analyte

   e. Titration

2. A concentrated hydrochloric acid solution has a density of 1.19 g/mL and contains 37% HCl by mass. **[6 pts]**
   a. Calculate the molarity of the acid solution

   b. How many milliliters of the solution are needed to prepare 150 mL 0.1 M HCl by dilution?

3. What is the volume of 0.2 M NaOH solution needed to completely neutralize 50 mL of 0.1 M H_2SO_4 solution? **[4 pts]**

4. When 15 mL mixture of NaOH and Na_2CO_3 is titrated with 0.1 M HCl. It consumed 12.5 mL of 0.1 M HCl using phenolphthalein indicator and the subsequent titration with methyl orange indicator consumed 2.5 mL of 0.1M HCl. (At wt Na = 23, O = 16, H = 1, C= 12, Cl = 35.5) Calculate:
[10 pts]

a. the mass of NaOH present in the mixture.

b. the mass of NaOH present in the mixture.

5. A 10 mL unknown concentration of NH_4Cl solution was titrated with excess 20 mL of 0.1 M NaOH solution. The excess NaOH was titrated with 5 mL of 0.1 M HCl solution. Calculate : **[10 pts]**
   a. number of moles of NH4Cl

   b. mass (in gram) of NH_4Cl

6. A 10 mL of hard water containing Ca^{2+} ions required 5 ml of 0.01 M Mg^{2+} - EDTA solution up to its equivalent point. Calculate the mass of Ca^{2+} in the sample. (At wt Ca = 40).
[5 pts]

7. 15 mL of an unknown concentration of sodium chloride was titrated with excess 25 mL of 0.01 $AgNO_3$. The excess silver nitrate was titrated with ammonium thiocyanate and consumed 5 ml of 0.01 NH_4SCN. What is the mass of sodium chloride in the sample?
[5 pts]

8. The aluminum in a 1.2000 g sample of impure aluminum ammonium sulfate ($NH_4Al(SO_4)_2$) was precipitated with aqueous ammonia as the hydrous oxide $Al_2O_3 \times H_2O$. The precipitate was filtered and then heated to 1000°C to produce anhydrous Al_2O_3 which weighed 0.1798 g. Calculate the % of aluminum in the original sample.(At wt Al = 27, O = 16) **[10 pts]**

Appendix N

Kotebe College of Teacher Education
Department of Chemistry
Practical Organic Chemistry
(Chem 243)
Final Examination

Time allowed 1:00 hr.

Name ______________________________ ID. No. ________________ Sec.
____

Instruction I: Choose the best answer and write the letter of your choice in the space provided beside each question. (2 points each)

1. Soaps can be prepared from the following except

   a. Neutral fats c. Oils

   b. Fatty acids d. None of the above

2. Which one of the following is not correct?

   a. Fats are saturated

   b. Soap solutions are acidic

   c. Oils are unsaturated

   d. Soaps are less effective in hard water

3. In your laboratory session you used reflux set up in:

   a. The preparation of soap

   b. The preparation of aspirin

   c. Steam distillation

   d. Recrystallization

4. The quality of aspirin can be tested by ferric chloride test, because;

   a. It has no carboxylic acid functional group

   b. It has no phenolic hydroxyl functional group

   c. It contains benzene ring

   d. It is not soluble in methanol

   e. None of the above

5. During distillation

a. The distillate contains only one of the components

b. The residue contains higher proportion of the more volatile component

c. The distillate contains higher proportion of the more volatile component

d. The relative vapor composition is the same as that of the mixture component

6. Saponification refers to:

a. acid hydrolysis of esters

b. hydrolysis of organic salts

c. alkali hydrolysis of inorganic salts

d. alkali hydrolysis of esters

7. Which of the following is **a partition** chromatography?

a. Paper chromatography

b. Thick layer chromatography

c. Column chromatography

d. Thin layer chromatography

8. Steam distillation is useful for separating

a. Volatile and water soluble substance from non volatile impurities

b. Volatile substance from non volatile substance

c. Volatile and water insoluble substance from non volatile impurities

d, None of the above

9. At what temperature water boils when the atmospheric pressure is 1.50 atom?

a. At 100^0c

b. Below 100^0c

c. Above 100^0c

d. The information is not enough to predict the boiling point

10. The purpose of safety tube in steam distillation set-up is:

a. to condense the vapor

b. to regulate the vapor pressure in the flask

c. to boil the water

d. to collect the distillate

11. During paper chromatography, the stationary phase is

a. the developing solvent (n-butanol/ethanol/2N ammonia)

b. water molecules adhering to the cellulose fiber

c. the cellulose fiber

d. none of the above

12. Which of the following words is **not** closely associated with recrystallization?

a. solubility   c. crystal growth

b. solvent power   d. condensate

13. The purpose of using fluted filter paper for filtration is

a. to make use of an increased surface area of the filter paper

b. to decrease the rate of filtration

c. to facilitate crystal formation

d. to help the proper functioning of the suction filtration set-up

14. What is the **main reason** for using a minimum amount of cold water for washing the precipitate in recrystallization process?

a. To be very economical in using solvent

b. To obtain maximum possible yield

c. Not to wash away the impurities

d. To wash away the crystals along with the impurities

15 . A and B are miscible liquids. If the boiling point difference between the two liquids is more than 100^0c then the mixture of the two can safely be separated by:

a. simple distillation c. fractional distillation

b. steam distillation d. distillation under reduced pressure

Instruction II: Answer the following questions in the space provided.

1. During recrystalization process the solution is separated from the residue while it is hot. What happen if it is filtered when it become cooled? (3.5 pts)

2. Mention the criteria of a most suitable solvent in recrystalization process. (5 pts.)

3. Why is cold water circulated through a condenser from the bottom upward rather than from the top downward? (3.5 pts.)

4. How did you prepare the following compounds during your laboratory session? Write only the chemical equation. (9 pts)

   a. Oil of wintergreen

   b. Aspirin

   c. Sodium stearate

5. Explain why you did the following during laboratory sessions. (9 pts.)

   a. Boiling chips in boiling liquids

   b. Dry test tubes in aspirin preparation

   c. Brine solution in soap preparation.

DECLARATION

I here by declare that this thesis is my original work and has not been presented for a degree in any other University, and that all sources of material used for the thesis have been duly acknowledged.

Name: Hawaria Merhatsidk

Signature: HAM

Date: 24/10/03 E.C

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

Name: Akalewoled Eshete (Assistant professor)

Signature: ______

Date: 24/10/03 E.C