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Assessments of Students' Practical Skill in Laboratory: A Case Study in Second Year Chemistry Students of Bule Hora University, Ethiopa

ABSTRACT: *Effective education should offer a balance of theoretical and practical experiences to help learners develop the competencies they need to enter professional practice and to become life-long learners throughout their careers. Laboratory activities have long had a distinctive and central role in the chemistry curriculum; and chemistry educators have suggested that many benefits accrue from engaging students in chemistry laboratory activities. The general objective of the study is to assess the practical skills of chemistry students at the BHU (Bule Hora University) in Southern Ethiopia. BHU is the newly emerged university in Ethiopia. The university is try to apply student centered approach to bring problem of surface learning in to an end and introduce deep learning, which make students critical thinker or imaginative. As a result, the university teacher educators incorporate the practical session to make learner knowledgeable, skill full, and bring attitudinal change. The data of this research was collected through questioner, focus group discussion, interview, and observation. Several problems in chemistry practical activities were identified, such as lack of confidence; shortage of time; and lack of background practical exposure, particularly on chemistry lab, lack of laboratory equipment and chemicals, lack of interest, fear of chemical toxicity, and lack of experimental freedom for independent work. In general, from the tremendous benefit of practical activities in chemistry, the authors suggested that, for example, using simulation and virtual experiments; and encouraging students to show their innate talents and make students familiar with the basic educational tool/technology.*

KEY WORDS*: Effective Education; Chemistry Practical Activity; Students and Teachers; Lack of Confidence; Using Simulation.*

INTRODUCTION

We are living in a world, which is complex and fast changing. This is an epoch in which the world depends on the use of high levels of knowledge and skills. There is a need to build a knowledge based society to address the current complex and fast changing world (Wood, 1987).

Education is a valued asset for economic, social, and cultural development (Lanzi, 2004; and Burchi, 2006). Literature clearly shows that the development of nations depends on the capacity of individuals and peoples to be imaginative to continually adapt and invent in a fast changing and complex world. It is to

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develop the knowhow of concepts and practices of the physical and social world (Asefa, 2008).

Effective education should offer a balance of theoretical and practical experiences to help learners develop the competencies they need to enter professional practice and to become life-long learners throughout their careers. Different higher education preferred different learning methods for instance, experiential learning approach is the one used to enhance students' knowledge, attitude, and skill (Passarelli & Kolb, 2012).

Experiential learning is very important method to bring from surface learning to the deep learning. Experiential learning involves having an experience, reflecting or reviewing the experience, giving it meaning and learning from it, and then applying the learning (Kolb, 1984; and Tomlinson, O'Brien & Garratt, 2000).

Practical work lies at the heart of primary science. Practical work can take place inside or outside the classroom and can happen at any point in a unit of work or lesson. It may be a five minute demonstration, a short activity to practice using an unfamiliar piece of equipment (Nicholls, 1999). What it must be is a varied and integral part of the learning process, which promotes thinking as well as doing.

R. Millar (2004) defined practical work as any teaching and learning activity, which involves at some point the students in observing or manipulating real objects and materials (Millar, 2004). Practical work enables the students to act in a scientific manner. For example, Stephanie Farrell & Robert P. Hesketh (2000) suggested that students typically recall only 20% of what they hear; while if they hear and see something done, they may recall closer to 50% of the experience. If they actually do something, such as conduct an experiment, they are likely to recall as much as 90% (Farrell & Hesketh, 2000).

These develop, progressively, beginning in the classroom with presentation of the theoretical background and the introduction of related skills through explanation or demonstration. Development of the new knowledge, skills, and attitudes continues in a safe (or simulated) environment, where students practice and attain skill competency (McKelvy, 2000).

Finally, it results in opportunities to apply the new knowledge, practice the new skills, and explore attitudes. Therefore, the teacher must be well prepared for the theoretical and practical aspects of teaching to ensure that students have adequate opportunities to learn theory and apply knowledge, skills, and attitudes in the classroom, and practice skills in a simulated environment (Reid & Shah, 2007).

Laboratory activities have long had a distinctive and central role in the chemistry curriculum; and chemistry educators have suggested that many benefits accrue from engaging students in chemistry laboratory activities (Hofstein & Lunetta, 1982; Tobin, 1990; Garnett, Garnett & Hackling, 1995; Lunetta, 1998; and Hofstein & Lunetta, 2004).

Several reporters have written that inquiry based chemistry practical activities have the potential to develop students understanding of concepts, scientific applications, scientific attitudes, practical skills, problem solving abilities, scientific habits of mind, understanding how science and scientists work, ability to formulate scientific questions, ability to form hypotheses, ability to design and conduct investigations, and technical skills in the use of equipment (Carnduff & Reid, 2003; Lunetta, Hofstein & Clough, 2007; and Offei-Koranteng, 2013).

BHU (Bule Hora University) is the newly emerged university in Southern Ethiopia. The university is try to apply student centered approach to bring problem of surface learning in to an end and introduce deep learning, which make students critical thinker or imaginative. As a result, the university teacher educators incorporate the practical session to make learner knowledgeable, skill full, and bring attitudinal change. Therefore, the current study aimed to improve practical/experimental skills of chemistry students in BHU in Southern Ethiopia.

Significance of Research. The study is helpful to link the theoretical and practical skills development components of the course. It also encourages to designing appropriate assessment method in practical session so as to contribute to improvement of practical or experimental skills in chemistry laboratory. It may serves to identify factors that hinder

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Table 1:
Academic Status of Chemistry Department Students

Status of 1st Year Chemistry Students			
Status	**Male**	**Female**	**Total**
Distinction	10	0	10
Pass	20	9	29
Warning	1	2	3
Dismissal	0	10	10
Drop Out	2	1	3
Total	**33**	**22**	**55**
Status of 2nd Year Chemistry Students			
Distinction	4	9	13
Pass	8	33	41
Warning	0	7	7
Dismissal	1	3	4
Drop Out	0	4	4
Total	**13**	**56**	**69**
Status of 3rd Year Chemistry Students'			
Distinction	1	1	1
Pass	30	7	37
Warning	0	2	2
Dismissal	0	1	1
Drop Out	3	12	15
Total	**34**	**23**	**57**

practical skill of students in the laboratory session. It also helps to increases the quality of education in the university and develops self-confidence in students in their future career.

Objectives of the Study. The general objective of the study is to assess the practical skills of chemistry students in BHU (Bule Hora University) in Ethiopia. And the specific objectives are: (1) to identify factors that hinder practical skills of students in laboratory session; (2) to assess the attitude of student in studying chemistry; (3) to encourage students to practical work in laboratory session; and (4) to assess teachers' evaluation method for practical session.

METHODS

Description of Study Area and Population. The study was conducted in BHU (Bule Hora University) in Southern Ethiopia. The total numbers of students in Chemistry Department from first year to third year are 174. Out of these 152 are on learning (55 students in 1st year, 47 in 2nd year, and 50 in 3rd year); and the rests students were droped out and dismissed. From total students 88 students are male and 86 are female. See table 1.

From the total number of second year students 39 have got average grade above 2.30 and 8 have got average grade below 2.30 out of 4. The target groups of this research was 2nd year chemistry students of BHU (Bule Hora University) in Southern Ethiopia. See table 2.

The table 3 indicates the status of second year chemistry students in four major practical courses.

Data Collection. The respondents of the study were teachers and students of Chemistry Department at the BHU (Bule Hora University) in Southern Ethiopia. A total of 62 sample respondents were selected

Table 2:
Status of 2nd Year Chemistry Students

No	Sex	Average	Status	No	Sex	Average	Status
1	F	1.84	Dismissal	28	M	2.58	Pass
2	F	2.01	Pass	29	F	3.59	Deans
3	M	2.80	Pass	30	F	2.52	Pass
4	F	2.39	Pass	31	F	2.48	Pass
5	F	2.25	Pass	32	F	1.26	DO
6	F	1.23	DO	33	F	2.59	Pass
7	F	0.00	DO	34	F	2.00	Pass
8	F	3.20	Pass	35	F	3.42	Deans
9	M	2.93	Pass	36	F	3.40	Deans
10	M	3.63	Deans	37	M	2.56	Pass
11	F	2.79	Pass	38	M	2.21	Pass
12	F	2.30	Pass	39	F	2.52	Pass
13	F	3.31	Deans	40	F	2.83	Pass
14	F	2.27	Pass	41	F	0.55	DO
15	F	2.45	Pass	42	F	2.13	Pass
16	M	3.39	Deans	43	F	2.18	Pass
17	F	0.00	DO	44	F	2.33	Pass
18	F	2.16	Pass	45	F	1.12	DO
19	F	3.41	Deans	46	M	3.09	Pass
20	F	1.78	Dismissal	47	F	1.80	Dismissal
21	F	2.92	Pass	48	F	3.35	Deans
22	M	0.45	DO	49	F	3.70	Deans
23	F	0.15	DO	50	F	2.40	Pass
24	F	2.09	Pass	51	M	3.63	Deans
25	M	3.79	Deans	52	F	1.44	DO
26	F	3.12	Pass	53	F	1.24	DO
27	F	0.00	DO	54	F	3.16	Pass

Table 3:
Status of 2nd Year Chemistry Students in Practical Courses of 2014/2015

No	Grade	Practical Analytical Chemistry	Practical Physical Chemistry	Practical Organic Chemistry	Practical University Chemistry
1	A- - A+	3	8	6	10
2	B- - B+	42	19	29	33
3	C- - C+	15	21	14	20
4	D- - D+	0	1	0	0
5	F	0	2	0	0
6	NG	8	1	2	4

from the total population, i.e. 47 students and 15 teachers. In this study, more of qualitative data were collected. The data was collected through questioner, focus group discussion, interview, and observation. The questionnaires were distributed to the students and teachers; and, finally, it was recollected (Harkin, Clow & Hillier, 2003; and Hummes, Kohrs & Merialdo, 2010).

An interview was conducted on selected students and teachers to get enough information on experimental/laboratory session of Chemistry Department. Interviews were focused on the experience, interest, and attitudes of teachers and students on experimental/laboratory session (Berg *et al.*, 2003; Burkhardt & Schoenfeld, 2003; and Hanif *et al.*, 2009). They were also

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Table 4:
Students' Response on Their Preparatory Education Performance

Item	Satisfactory (50-60)	Good (61-70)	Very Good (71-85)	Excellent (>86)
Respondents preparatory educational performance in chemistry.	25	15	7	0

Table 5:
Students Attitude towards Chemistry Experimental Lesson

Parameters	Number of student	Percentage
Very good attitude	29	61.7%
Good attitude	15	31.9%
Bad attitude	3	8.5%

interviewed about manual, safety, and availability of laboratory equipment.

The focus group discussion was conducted with a group of respondents to produce a wealth of data and lead to discovery new topics and questions. The data was also collected by direct observation of practical session (Drury, 1992; and Burkhardt & Schoenfeld, 2003). This method is important to identify the problems in laboratory and cross check with data gather by other methods. It was also useful to minimize the risk of miss-understanding on practical sessions.

Data Management and Analysis. The recorded data through observation, questionnaires, and interview were analyzed by using descriptive statistics, such as percentage and frequency (Berg *et al.*, 2003; Burkhardt & Schoenfeld, 2003; and Hanif *et al.*, 2009). Finally, the results were presented using tables, charts, and graphs. Data analysis was carried out using Excel 2007 software program.

RESULTS AND DISCUSSION

Back Ground of Study Subjects. From 47 study subjects about 27 of them lived in urban rental house; 13 of them lived in urban area with their family; and about 7 of them lived in rural area with their family during their preparatory study. See table 4.

As is indicated in table 4, most of respondents have satisfactory (50-60) average preparatory education performance in chemistry. This could relate that they have little exposure in chemistry practical activity.

Analysis of Response from Students' Questionnaire. This are consist of: (1) Students' interest in studying chemistry; (2) Students attitude towards chemistry experimental lesson; (3) Factors that hinder the practical skill of students; (4) Contribution of practical Laboratory work; and (5) Possible ways improve the practical skills of students. The description and analysis are as follows:

First, **Students' interest in studying chemistry**. The students' interest in studying chemistry was illustrated in figure 1.

As it is indicated in the figure 1 that 36 (76.6%) students out of 47 responded that they are interested in studying chemistry; 7 (14.9%) respondents have no interest in studying chemistry; while 4 (8.5%) students were not responded at all. This means that majority of students are interested in studying chemistry.

The reasons given by the 76.6% of students, who have interest in studying chemistry, was that it has wide applications in all discipline. However, some of the students complained, due lack of time since most of the courses were not covered at the end of the semester (interview with Respondent A, 2/10/2015; interview with Respondent B, 5/10/2015; interview with Respondent C, 9/10/2015; interview with Respondent D, 13/10/2015; and interview with Respondent E, 17/10/2015).

They suggested that either increase the allocated time per semester or start the semester early. Some students also suggested that increase the time for experimental sessions

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Table 6:
Contribution of Practical Laboratory Work

Parameters	Very Little	Little	Medium	High	Very High
1. To improving your manual skills for working in laboratory.	6.4%	10.6%	21.3%	34.0%	27.6%
2. To improve your understandings of chemistry.	10.6%	4.3%	25.5%	36.2%	23.4%
3. To improve your experimental result interpretation skill.	4.3%	12.8%	29.8%	31.9%	21.3%
4. Contribution for your future career.	12.8%	34.0%	6.4%	23.4%	23.4%

in the subject as it helps to understand the subject matter (interview with Respondent F, 20/10/2015; interview with Respondent G, 24/10/2015; interview with Respondent H, 27/10/2015; interview with Respondent I, 30/10/2015; and interview with Respondent J, 3/11/2015). The most frequent reason given by 14.9% students who have no interest in studying chemistry was that the subject involves a lot of memory work.

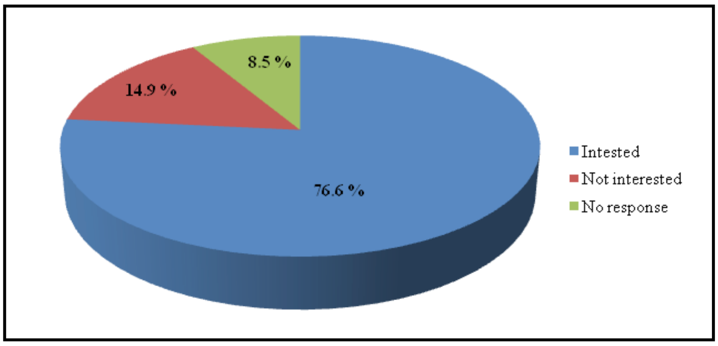

Figure 1:
Students' Interest in Studying Chemistry

Second, **Students attitude towards chemistry experimental lesson.** The respondents' attitude toward chemistry practical lesson is shown in table 5.

As it is illustrated in table 5 that 29 (61.7%) students out of 47 have *very good attitude* toward chemistry practical lesson; 15 (31.9%) respondents have *good attitude*; while 3 (8.5%) of respondents have negative or *bad attitude* toward chemistry practical session. This indicates that majority of students have positive attitude toward chemistry practical lesson.

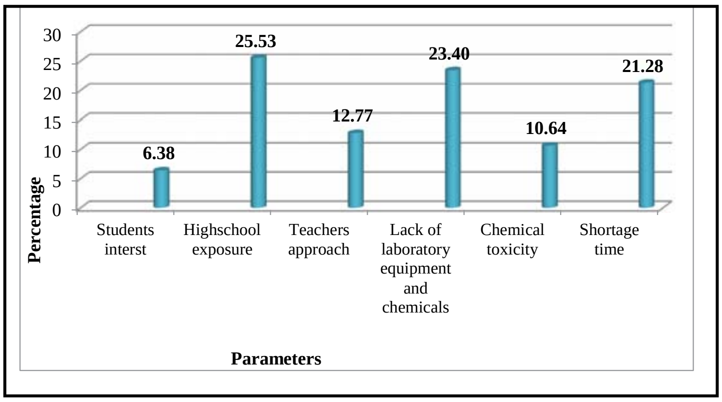

Figure 2:
Factors that Hinder the Practical Skill of Students

Students who have positive attitude claimed that when the theoretical session is supported by experiments, it will become easy to understand (interview with Respondent A, 2/10/2015; interview with Respondent B, 5/10/2015; interview with Respondent C, 9/10/2015; interview with Respondent D, 13/10/2015; and interview with Respondent E, 17/10/2015).

Third, **Factors that hinder the practical skill of students.** Here factors that can hinder practical skill of students were discussed based on student responses. Accordingly, the response of student is illustrated in figure 2.

As it is indicated in the figure 2 that 25.5% of students responded that their high school and preparatory practical exposure followed by lack of laboratory equipment; and chemicals are the major factors that hinder their practical skill. Furthermore, allocating less time for practical session is among the factors that can affect students' performance. Additionally, students suggested that large class size is another hindrance for

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their practical skill, because it is not possible to manage large class size properly (interview with Respondent F, 20/10/2015; interview with Respondent G, 24/10/2015; interview with Respondent H, 27/10/2015; interview with Respondent I, 30/10/2015; and interview with Respondent J, 3/11/2015).

Fourth, **Contribution of practical laboratory work.** About the contribution of practical laboratory work is shown in table 6.

The response of student regarding to contribution of laboratory activity is illustrated in the table 6. Accordingly, about 36% of respondent believed that laboratory work can improve their understanding of chemistry; and about 34% of them responded that laboratory activity can improve their manual skill in experimental work. Similarly about 31.9% of participants responded laboratory activity can enhance their experimental result interpretation skill; and 34% of participant believed that laboratory activity has little contribution for their future career.

Fifth, **Possible ways improve the practical skills of students.** The following ideas, as shown in figure 3, are students' opinions about experimental method that can improve their practical skill.

As it is illustrated in the figure 3, majority of the students (25.5%) responded that allowing the students' experimental freedom is main method that can improve their practical skill. Beside experimental freedom, preparing simple and brief manual followed by justifying the main objectives of each experiment are also among the possible ways that can improve students' practical performance.

The respondents also claimed that appointing skilled lab technician and establishing full and well organized lab also can improve their practical skill (interview with Respondent A, 2/10/2015; interview with Respondent B, 5/10/2015; interview with Respondent C, 9/10/2015; interview with Respondent D, 13/10/2015; and interview with Respondent E, 17/10/2015).

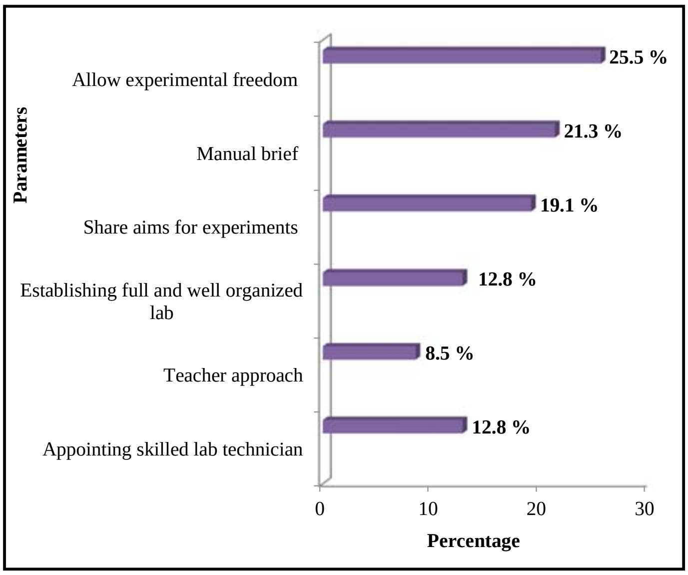

Figure 3:
Possible Ways Improve the Practical Skills of Students

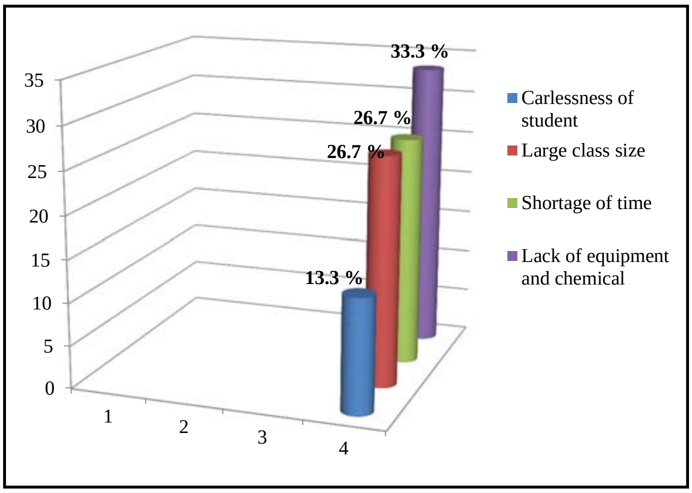

Figure 4:
Problems Related to Student Practical Performance

Analysis of Teachers Questionnaire. This are consist of: (1) Problems related to student practical performance; (2) Possible ways to encourage students in practical session; and (3) Assessment tools for practical session. The description and analysis are as follows:

First, **Problems related to student practical performance.** The focus of this part is to identify the major problems faced in chemistry practical session related to student performance. See figure 4.

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Among the problems teacher faced related to student practical performance during practical session, large class size, and negligence of students take more percent, as shown in figure 4. The teachers' response indicated that shortage of time and unavailability of equipments and enough chemical access were also additional obstacles they faced. The teachers also suggested that work over load is parallel challenge they faced for their practical activity (interview with Respondent K, 7/11/2015; interview with Respondent L, 10/11/2015; and interview with Respondent M, 13/11/2015). Based on the information awareness creation for the student regarding to importance of practical work for their subject understanding, providing enough time for practical session can minimize those listed problems.

Second, **Possible ways to encourage students in practical session.** The idea of this part is in order to seek some of possible ways that can encourage student performance in practical session. See figure 5.

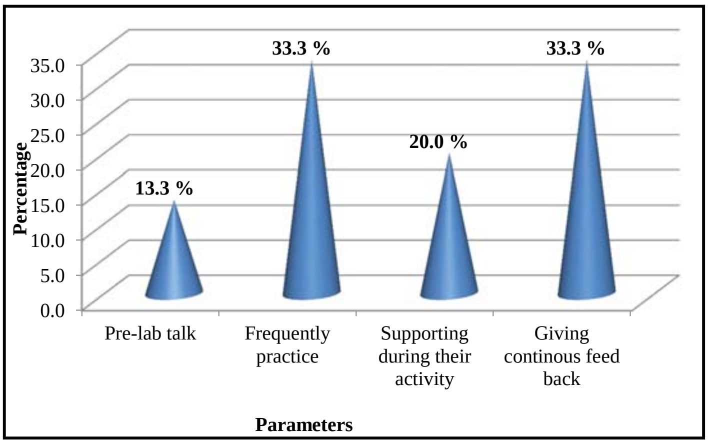

Figure 5:
Possible Ways to Encourage Students in Practical Session

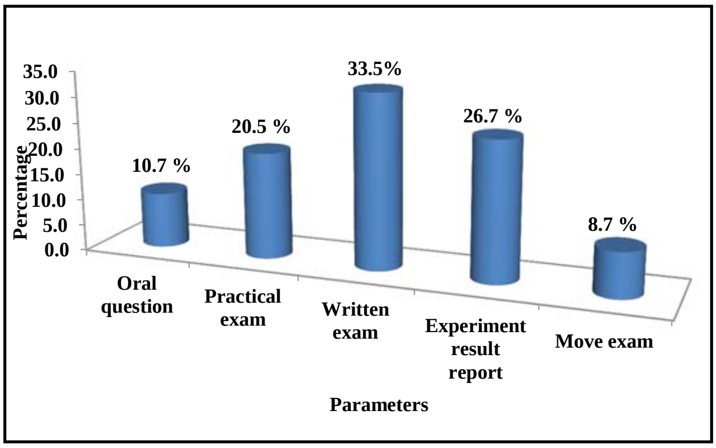

Figure 6:
Assessment Tools for Practical Session

As it indicated in the figure 5 that 33.3% of participants were responded that allowing student for frequent practical activity and giving continuous feedback can encourage students in practical activity. Similarly supporting students during their practical activity and giving pre-lab talk can encourage students' practical skill. It is clear that there are many ways that can encourage students' practical performance including providing of brief experimental manual, showing demonstration using videos (interview with Respondent K, 7/11/2015; interview with Respondent L, 10/11/2015; and interview with Respondent M, 13/11/2015).

Third, **Assessment tools for practical session.** The main focus here is to find out the type of assessment methods chemistry teachers preferably apply in practical session for their students. See figure 6.

Based on participants' response, majority of (33.5%) teachers preferably used written exam for their student assessment. About 26.7% of respondents used experiment result report as an assessment tool and 20.5% of teachers choose practical exam than written. The remaining simply used oral question and move exam, as shown in figure 6.

Some of the respondents suggested that using practical exam is better for student assessment in practical session. However, due lack of enough laboratory equipment and shortage of time, they enforced to use written exam. It is clear that using practical exam as an assessment tool can lead students to prepare themselves for practical exam and before exam they practiced again and again; in this line, they can be familiar for that particular subject matter (interview with

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Respondent K, 7/11/2015; interview with Respondent L, 10/11/2015; and interview with Respondent M, 13/11/2015).

CONCLUSION [1]

Based on the current findings different problems in chemistry practical activities are identified, such as lack of confidence; shortage of time; and lack of background practical exposure, particularly on chemistry lab, lack of laboratory equipment and chemicals, lack of interest, fear of chemical toxicity, and lack of experimental freedom for independent work.

In general, from the tremendous benefit of practical activities in chemistry, we suggested that: Using simulation and virtual experiments; Encouraging students to show their innate talents and make students familiar with the basic educational tool/technology; Developing and introduction of advance experimental designs and techniques, and this might minimize the boring in chemistry laboratory activities and poor performances; Giving a motivational training to develop self-confidence; Evaluating students' progress in experimental activities; Giving frequent experimental activities; Providing rewards for students frequently participate in experimental activities so that the other will be motivated; Supporting students those require especial support; Encouraging students to be independent learners and let them to perform experiments by freedom; Encouraging teachers to use locally available resources for laboratory; Posting safety and precaution rules in the laboratory and giving pre lab brief orientation; Providing simple and brief manual for the students ahead of lab sessions; and Creating awareness among students about the multi-purposes of experimental activities in chemistry.[2]

[1]*Acknowledgment:* The authors acknowledge to second year students and teachers in Chemistry Department at the BHU (Bule Hora University) in Southern Ethiopia, for their consent and cooperation in the study.

[2]*Statement:* Herewith, we declare that this paper is our original work; so, it is not product of plagiarism and not yet also be reviewed as well as published by other scholarly journals.

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Interview with Respondent A, a student of Chemistry Department at the BHU (Bule Hora University) in Southern Ethiopia, on 2 October 2015.

Interview with Respondent B, a student of Chemistry Department at the BHU (Bule Hora University) in Southern Ethiopia, on 5 October 2015.

Interview with Respondent C, a student of Chemistry Department at the BHU (Bule Hora University) in Southern Ethiopia, on 9 October 2015.

Interview with Respondent D, a student of Chemistry Department at the BHU (Bule Hora University) in Southern Ethiopia, on 13 October 2015.

Interview with Respondent E, a student of Chemistry Department at the BHU (Bule Hora University) in Southern Ethiopia, on 17 October 2015.

Interview with Respondent F, a student of Chemistry Department at the BHU (Bule Hora University) in Southern Ethiopia, on 20 October 2015.

Interview with Respondent G, a student of Chemistry Department at the BHU (Bule Hora University) in Southern Ethiopia, on 24 October 2015.

Interview with Respondent H, a student of Chemistry Department at the BHU (Bule Hora University) in Southern Ethiopia, on 27 October 2015.

Interview with Respondent I, a student of Chemistry Department at the BHU (Bule Hora University) in Southern Ethiopia, on 30 October 2015.

Interview with Respondent J, a student of Chemistry Department at the BHU (Bule Hora University) in Southern Ethiopia, on 3 November 2015.

Interview with Respondent K, a teacher of Chemistry Department at the BHU (Bule Hora University) in Southern Ethiopia, on 7 November 2015.

Interview with Respondent L, a teacher of Chemistry Department at the BHU (Bule Hora University) in Southern Ethiopia, on 10 November 2015.

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