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Discrepancy of Expectations and Practice of Chemistry Experiment in High Schools. In Case of West Arsi Zone, Oromia Region, Ethiopia

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Abstract

The purpose of this research was to analysis the current chemistry laboratory practice in the selected secondary schools of Shashamane City Administration. This study was conducted using descriptive research design and quantitative method was used to express the closed ended questions whereas qualitative method was used in analysis of the data gathered through open ended questions, Focus Group Discussion (FGD) and observation. Study area, schools and student respondents were selected by purposive sampling, whereas school principals and chemistry teachers were selected by available sampling technique. Two principals, 15 chemistry teachers and 40 student respondents were participated in this study. The data were gathered through observation, questionnaires, FGD, and chemistry textbook analysis. The results from the observations, questionnaires, FGD and textbook analysis were triangulated, and findings were descried. The findings revealed that there is discrepancy between the experiment titles stated in chemistry textbooks and practice in the selected secondary schools, no separate chemistry laboratory, lab facilities were differed from school to school. However, their science lab room status was poor and practice in conducting an experiment almost the same. School A has many apparatuses, lab materials and chemicals than School B and School C. But none of them currently do not conduct any experiment. Lack of awareness, lack of motivation, irresponsiveness and reluctant were one of the major factors that negatively affects the practical laboratory work of the selected secondary schools.

Keywords: Chemistry experiment; Laboratory facilities; Laboratory status; Laboratory standard

Introduction

Education is a system of formal teaching and learning processes that take place through schools and other institutions [1]. So, Chemistry Education is about teaching and learning of chemistry. As Twoli [2] pointed that chemistry instruction must done through the combination of both theoretical concepts and practical work. Any school that offering chemistry as a subject must have a chemistry laboratory for students to conduct practical activities and to show demonstration experiments. For school, laboratory is defined as "a spacious room where in a group of students carry out their practical" [3]. Therefore, laboratory work is requisite for science teaching and teaching of science education without practical work is ineffective [4]. To illustrate the laboratory work, different science education literatures give emphasis to the importance of laboratory work. For instance, practical laboratory work enhances attitudes, stimulating interest and enjoyment, and motivating students to learn science in general and chemistry in particular [5]. Doing of an experimental in learning of chemistry students understand the abstract theoretical concepts and chemical principles [6], and develop positive attitude towards it [7], it stimulates and motivates students to learn more by doing [8].

Nevertheless, practical laboratory works have lot of importance in teaching and learning of chemistry at High School different studies nationally and internationally revealed that there are several challenges to implement it. For instance, inadequate laboratory room, lack of chemistry laboratory technician, lack of laboratory room [9], lack of skills, time constrain, inadequacy of laboratory facilities, the available science equipment are too old, large class size/disproportion of students and science equipment, lack of laboratory budget [10]. Most of the schools have common laboratory that makes unable to use practical work as it needed, the room are too small to hold all students and not suitable to work in, the available laboratories are not equipped, the laboratory room not built for laboratory purpose, doors, 2 windows, roofs are broken [11]. These and the like factors will make the chemistry subject delivered at High schools become incomplete.

For these and another factors different researchers suggested the possible solutions to mitigate it. For instance, provide training for fulfilling the gap in lab skill, monitoring laboratory works and facilities, providing awareness regarding to utilization of local availability laboratory materials, improving resources allocation for science laboratory, government must give emphasis for school laboratory buildings, laboratory facilities, the available laboratory materials should get maintenance and implement monitoring system in schools to ensure accountability and responsibility to provide quality education [10-12]. Use of virtual lab, mobile lab [3] and small-scale science kits [3,8,13] recommended as alternative to use in case of inconvenience of conventional laboratory work.

According to Ethiopia science curricula, practical activities must be carried out by students. However, there is a gap between what is written in chemistry curriculum documents and actual practice at schools level. In line with this, Hodson [14] pointed that the lesson objectives stated by teachers frequently failed to be addressed during actual lessons. In Ethiopia, most of school students only learn the theoretical concepts of chemistry from textbook to complete the subject matter of the particular grade level. Even students have no chance to look the chemistry laboratory room rather than doing an experiment. As a result, students failed to acquire the conceptual and procedural understandings of chemistry subject of particular grade level [15]. Such lacks of opportunity to carry out laboratory works, de-motivating students and may result poor academic performance in the subject [16]. In this context, the researcher needs to assess the availability and utilization of chemistry materials, chemistry teachers, students and principals' commitment, awareness, motivation, attitudes and perceptions towards practical work, challenges encountered to practice laboratory work and the way challenges are mitigated.

Statement of the Problem

To improve the implementation of practical laboratory work at High School different studies had been conducted nationally as well as internationally. However, the teaching and learning process of chemistry in secondary schools of Ethiopia regarding to practical laboratory work still unsatisfactory. The concept of green chemistry [17] not yet understood by practitioners, use of alternative laboratory learning materials like virtual lab and small-scale science kits also not practiced at High schools. From MoE to down education sector such as Zonal Education expert and classroom teacher, to the community the awareness and motivation towards practical work is less. Chemistry teachers focusing teaching of the theoretical concepts with talk and chalk method and the school principals simple observing and considering as it is the normal method of teaching chemistry. In such way that chemistry teachers and school principals may think that the subject content taught is completed and students may perceive that they completed the chemistry subject given at that particular grade level. Even in some High Schools the available laboratory facilities were handled poorly and the available laboratory room is not functioning, whereas some schools have no practical work at all. In generally, the way secondary schools students learn chemistry contrary to twenty-first (21st) century learning skills. These encouraged the researcher to assess the current chemistry laboratory practice in some selected secondary schools of Shashamane City Administration. Therefore, the purpose of this research was to analysis the current practice of practical laboratory work in some of the secondary schools of Shashamane City Administration, West Arsi Zone, Oromia Region, Ethiopia.

Research Questions

Based on the research objectives, this study attempts to answer the following questions.

a) What is the attitude and perfection of principals, chemistry teachers and students towards an experiment?

b) How is the current chemistry laboratory status in the selected secondary schools?

c) How is chemistry laboratory work performed in the selected secondary schools?

d) What are the major challenges that hinder the implementation of chemistry practical work in in the selected secondary schools and measurements taken to alleviate those challenges?

Objectives of the Study

The general objective of this study is to analysis the current chemistry laboratory practice in some selected secondary schools of Shashamane City Administration. The specific objectives of this study are:

a) To examine the attitude and perfection of principals, chemistry teachers and students towards an experiment;

b) To assess the current chemistry laboratory status in the selected secondary schools;

c) To explore how chemistry laboratory work is performed in the selected secondary schools;

d) To identify the major challenges that hinder the implementation of chemistry practical work in in the selected secondary schools and measurements taken to alleviate those challenges.

Significance of the Study

The results of this study will be useful to the science teachers in general, chemistry teachers in particular who teach in secondary schools to give attention to the practical laboratory activities and may also help the teachers and students to re-think the goal of laboratory, utilization of alternative materials like the

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local available materials, small scale science kits and virtual lab that are cost effective and accessible to all to perform laboratory activities as much as possible when conventional laboratory work is impossible. Moreover, it informs the perspective concerned bodies to give attention to mitigate problems that associated with science practical work at Elementary and Secondary schools and pave a way how to monitor the implementation of the designed science curriculum at schools as intended and will inform the practitioners to take into an account learning in the 21st century skills.

Scope of the Study

This study sought to assess the current chemistry laboratory status and practice in High school. Because of time constraint and resources deficiency the study was delimited geographically only on three Secondary Schools found in Shashamane City Administration, West Arsi Zone of Oromia Regional State and chemistry laboratory status and practice were explained in the context of this selected Secondary Schools.

Research Methodology

Location of the Study Area:

Shashamane is a town in West Arsi Zone, Oromia Region, Ethiopia. The town lies on the Trans-African Highway for Cairo-Cape Town, about 240km from the capital city Addis Ababa. It has a latitude of 7°12' North and a longitude of 38°36' East. In Shashamane City Administration there are six secondary schools namely: Shashamane Secondary School, Shashamane Preparatory School, Burka Kerro (former called Millennium High School), Ifa Boru Secondary School, Bulchana Secondary School and Kuyera Secondary School.

Research design

This research was conducted using descriptive research design. Since, descriptive research focuses on describing behaviors and gather people's perceptions, opinions, attitudes, and beliefs about a current issue in education [18]. Therefore, descriptive survey enables a researcher to gather accurate and detailed data associated with the current chemistry lab status and practice on the basis of the existing natural settings of the selected secondary schools.

Research method

This research was conducted using both quantitative and qualitative research method. Quantitative method was used in closed ended questions and analysis of experiment title in chemistry textbooks to express the results in numerical values, whereas qualitative method was used in open ended questions, FGD, lab standard guidelines and lab room observation to express the obtained data verbally.

Sampling technique

To take the sample by using sample determining formula or deciding by percentage, the study was uncontrolled because of:

a) Delay of the release of project budget: During data collection project budget was not released on time. But the course should be completed on time, then researcher decide to conduct the study on time by manage the sample size.

b) Time constrains: During data collection researcher was attending another two courses in the main campus. So, sharing of time for the three courses were mandatory.

c) Resource problem: To use large sample, it needs more money but the researcher unable to cover the cost needed for data collection from large sample. Therefore, because of these factors the researcher was forced to manage data collection with time and resources using non- probability sampling methods. Study area, schools and student respondents were selected by purposive sampling, whereas chemistry teachers and school principals were selected by available sampling method because they were small in number.

Target population

From the six secondary schools three secondary schools were selected, year of establishment, grade level, number of sections, students, chemistry teachers and principals in gender were presented in Table 1.

Sample size

To select student respondents, the researcher was fixed to take 25% of the sample size of total sections. Therefore, from 104 sections 26 sections were selected. By using stratified random sampling formula from each grade level sample section size was determined. The researcher was choose stratified random sampling because it cancels the chance of selecting more sample from a particular school and give appropriate sample allocation for both male and female student respondents from each selected school. Therefore, from each grade level, sections were selected by simple random sampling method. From the selected sections two outstanding students (one male and one female) were selected by purposive sampling as shown in Appendix Table 1. So, from the three selected secondary schools a total of 50 males and 28 females were selected as shown Table 2.

Data sources

In this study the information was gathered through both primary and secondary data sources. Primary data refers to the first-hand information gathered by the researcher himself. Primary data were obtained from observation, students, chemistry teachers and school principals of the three selected secondary schools. Secondary data means data that collected by

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someone else earlier. Secondary data were obtained from High School chemistry syllabus, textbooks and lab standard guidelines.

Data gathering tools

Primary data were gathered through observation, questionnaires, FGD, and secondary data were gathered through analysis of High School chemistry syllabus, textbooks and lab standard guidelines.

Observation

The observation was done in the normal periods of schooling time and schedule by using observation checklist points and take notes on separate page of research notebook.

Table 1: Target population of each selected secondary schools.

Selected School	Established	Grade Level	No of Section	No of Students			No of Chemistry Teachers			No of Principals		
				M	F	T	M	F	T	M	F	T
School A	2007 E.C	9	12	520	469	989	7	0	7	1	0	1
		10	16	500	448	948						
		11	4	158	143	301						
		12	4	71	91	162						
School B	1942 E.C	9	21	590	639	1229	10	0	10	1	0	1
		10	11	405	531	936						
		11	4	115	107	222						
		12	5	142	197	339						
School C	2000 E.C	9	13	602	497	1099	4	2	6	1	0	1
		10	8	390	289	679						
		11	4	163	147	310						
		12	3	68	57	125						
Total		4	104	3724	3615	7339	21	2	23	3	0	3

Where School A, School B and School C is a pseudonym for the selected school and the specified Grade 11 and 12 were only natural science, M = Male, F = Female and T= Total.

Table 2: Sample of the school and respondents.

Selected School	Respondents							
	Principal		Teacher		Students		Total	
	M	F	M	F	M	F	M	F
School A	1	0	7	0	9	9	17	9
School B	1	0	10	0	10	10	21	10
School C	1	0	4	2	7	7	12	9
Total	3	0	21	2	26	26	50	28

Where, M = Male and F = Female.

Questionnaires

Both open and closed-ended questionnaires were used including 5-point Likert scales (strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree). The administrated questionnaires have three sections.

a) Respondents demographic profile,

b) Questions that deal with chemistry laboratory status and practice and

c) Problems encountered in implementing an experiment and the way problems were mitigated.

Questionnaires were first prepared in English, then translated into Afaan Oromoo to avoid language bias and to gather full information from respondents. The questionnaires were administered to chemistry teachers, school principals and students' respondents with the help of assistant data collector. Before questionnaires administrated to the participants sufficient orientation were given for the participants.

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Focus group discussion

The researcher used FGD, because it invites considerable number of respondents for discussion, it relies on the ability and capacity of participants to provide relevant information and it is cost-effective [19]. FGD was done in heterogeneous group (gender, educational level and experiences) with six to eight participants [20] for a maximum of 15 minutes as wait time approach to discuss on issues of chemistry laboratory status, practice and problems encountered in conducting of an experiment and the way problems were get solution. Before the discussion was began, information was clarified for the participants, then the researcher was posed questions for discussion and take a note in facilitating a group discussion between the participants without taking part in discussion. During discussion the researcher was asked questions when clarification was needed.

Document analysis

Laboratory standard guidelines were used to analyze the current science laboratories status of the selected secondary schools using as a reference. High School chemistry syllabus were seen to check the period allocation per week for practical work. In chemistry textbooks experiment title, apparatuses and chemicals describe were cross checked with the availability and utilization in the lab room of the selected secondary schools to explore their current laboratory practice.

Ethical considerations

This study was conducted with a permission of course supervisor, Shashamane City Administration Education Office and secondary school principals, chemistry teachers, and students at the selected secondary schools. All respondents in this study were voluntary and treated with respect and not forced to take part in.

Data collection procedure

High School chemistry syllabus and its textbook were seen, and laboratory standard guidelines were checked before actual data collection. Next Department of Chemistry at Hawassa University wrote letter of authorization to Shashamane City Administration Education Office, then researcher was introducing the research title and its objective to the Education Office. A permission letter obtained from Education Office was given to the school principals. After principals allowed to conduct the study three days before the inception of the data collection the researcher was introduced research title and its objective to chemistry teachers and student respondents and conducted the study through observation, administering questionnaires and conducting FGD in the normal schedule of schooling time.

Validity of the research

Questions for questionnaires, FGD and observation checklist points was construct by the researcher as per the requirements of the study then the validity of the questions and checklist points were confirmed by the course supervisor. Based on the feedback given, questionnaires, FGD questions and observation checklist points were constructed and rearranged by the researcher to get target information from the respondents.

Data collection techniques

High School chemistry syllabus and its textbooks were seen, and laboratory standard guidelines were checked before observation, administering questionnaires, and conducting FGD. Then observation checklist points were developed, next questions of the questionnaires and FGD were prepared and checked, edited, and corrected. After modification was made, observation was done, questionnaires were distributed to the targeted respondents and FGD was conducted by wait time approach in face to face through short note taking after observation and questionnaires were completed. Information provided by the respondents on questionnaires and FGD were checked for their completeness and consistency, and then categorized based on their similarities for analysis.

Data analysis techniques

The information gathered through observation, questionnaires, FGD and High School chemistry textbooks analysis, and laboratory standard guidelines were triangulated to confirm their validity. The data collected through observation, open ended questions, and FGD were analyzed qualitatively. The information gathered from individual respondents were treated as the participant's perspective views, rather than through researcher assumption on the problem [20]. However, in some cases each individual participant's responses were put together in narrative format, capturing their perspective views as a whole. The data collected through close ended questions and High School chemistry textbooks analysis were expressed quantitatively and their results were presented in numbers, percentage (%), tables and figures for ease of understanding and interpretation.

Results and Discussion

Response rate

The questionnaire administrated for 3 principals, 23 chemistry teachers and 52 student respondents. From these 2 (66.67%), 15 (65.21%) and 40 (74.04%) questionnaires were returned respectively as shown in Table 3. According to Mugenda [22] above 70% of return rate is an acceptable proportion and can be called adequate for analysis.

Background information of the respondents

Respondents' profile in terms of age, gender, educational level and service years were presented in Table 4 to Table 6.

As shown in Table 4 below, age of a total of 40 student respondents 33 (82.5 %) were between 15 and 16, 3 (7.5 %) between 17 and 18, and 4 (10%) were in the age level between

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19 and 20 years old. From these 23 (57.5%) were males and 17 (42.5%) were females. In grade level, 10 (25%) of male and 8 (20%) female student respondents were grade 9, 8 (20%) and 7 (17.5%) were grade 10, 3 (7.5%) and 1 (2.5%) were grade 11 and 2 (5%) and 1 (2.5%) were grade 12 respectively. As evident from the Table 4 the age of students was increased with their grade levels. The majority (90 %) of the student respondents their age level were between 15-18 years old, and they were attending school in the normal age of schooling. Since according to the rule of MoE children started normal class of learning at the age of seven years. Therefore, student respondents were matured enough to express their opinions or feelings towards the current chemistry laboratory status and practice in their school.

Table 3: Response rate.

Respondent	Sample Size	Return Questionnaires	Return Rate in %
Principals	3	2	66.67
Teachers	23	15	65.21
Students	52	40	74.04
Total	78	57	73.07

Table 4: Age, gender and grade levels of student respondents.

Grade Level	Gender	Age					
		< 15	15-16	17-18	19-20	> 20	Total
9	Male	–	10	–	–	–	10
10		–	8	–	–	–	8
11		–	–	1	2	–	3
12		–	–	–	2	–	2
9	Female	–	8	–	–	–	8
10		–	7	–	–	–	7
11		–	–	1	–	–	1
12		–	–	1	–	–	1
Total		–	33	3	4	–	40
%		–	82.5	7.5	10	–	100

Table 5: Age and gender of school principals and chemistry teachers.

Age	Respondents							
	Chemistry Teachers				School Principals			
	Gender							
	Male	%	Female	%	Male	%	Female	%
< 20	–	–	–	–	–	–	–	–
20-30	–	–	2	13.33	–	–	–	–
31-40	8	53.33	–	–	2	100	–	–
41-50	5	33.33	–	–	–	–	–	–
> 50	–	–	–	–	–	–	–	–
Total	13	86.67	2	13.33	2	100	–	–

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Table 6: Service years and education level of the chemistry teachers and school principals.

Service Year	Respondents							
	Chemistry Teachers				School Principals			
	Educational Level							
	MSc/MEd	BSc/BEd	Diploma	Total	MSc/MEd	BSc/BEd	Diploma	Total
< 5	–	–	–	–	–	–	–	–
10-Jun	–	2	–	2	1	1	–	2
15-Nov	–	2	–	2	–	–	–	–
16-20	3	3	–	6	–	–	–	–
> 20	–	5	–	5	–	–	–	–
Total	3	12	–	15	1	1	–	2
%	20	80	–	100	50	50	–	100

As shown in Table 5 above, a total of 15 chemistry teachers, 13 (86.67 %) were males with the age between 31 to 40, and between 41 to 50 years old, whereas 2 (13.33%) were females with the age between 20 to 30 years old and 2 (100%) of the school principals were males with the age between 31 to 40 years old. The result showed that the three was gender imbalance in chemistry teachers and administration case. Therefore, more female chemistry teachers and principals should take part in teaching-learning process and administration system to become a model for female students. Also, the result revealed that the majority of the chemistry teachers and all principals were found in middle aged and enough experience (see Table 6), hence they were young and energetic, and they can do a lot in teaching-learning process and also in management system. However, the finding was against this statement, since in each selected secondary schools the current science laboratories status and practice were poor.

As indicated in Table 6 above, a total of 15 chemistry teachers' respondents, 3 (20%) have second degree with the service years between 16 to 20, whereas 2 (13.33%), 3 (20%) and 5 (33.33%) have first degree with the service years between 6 to 10, 11 to 15, 16 to 20, and above 20 years respectively. From the two principals, 1 (50%) have second degree and another one has first degree. But their services years were the same between 6 to 10 years. The result revealed that all of the respondents have had more than 5 years services and a minimum of first-degree holders. So, they had enough experience which had prepared them enough to conduct an experiment and perform the managing system in their school and can facilitate things for teaching-learning processes. Nevertheless, the result obtained through school observation, FGD and chemistry textbook analysis were against the above statement. Both School A and School B laboratories room were not function for practical activities, whereas School C laboratory room was made but due to lack of quality not received from the contractor.

Here after the data gathered through observation, questionnaires, FGD, and document analysis related to chemistry laboratory were analyzed, interpreted, and presented sequential.

Information gathered through observation

a) Availability and utilization of laboratory materials

Any school that offering chemistry as a subject must have a chemistry laboratory for students to conduct practical activities and to show demonstration experiments [3]. To assess the current chemistry laboratory status of the selected secondary schools use of laboratory standard is critical. However, in Ethiopia till this research has been conducted there was no science laboratory standard guideline in general, chemistry laboratory in particular. Therefore, the researcher was forced to use the science laboratory standard stated by Foster [3] & Young [24].

High School chemistry laboratory standard refers to a set of detailed an external and internal set up, laboratory facilities that available in the acceptable level in terms of quality as well as quantity, arrangement of chemicals and technical guidelines of lab safety and safety materials. The availability of lab equipment and chemicals is one of the factors that facilitates the process of teaching and learning science in any nations [10]. So that laboratory facilities such as chemicals, apparatuses, equipment's, ventilation, light, working area, working tables, water, chemical preparation room, fire prevention, sinks, shelfs and etc. are need for practical work. If such facilities limited for practical lab work science teachers improvise (home-made apparatus) or use alternative materials for practical laboratory work. In this context, the observation results of the three selected secondary schools were analyzed and the finding showed that availability and utility of laboratory facilities were differed from school to school. However, there were a great similarity as well as differences between School A and School B science laboratory rooms.

Some of the common current manifestation, School A and School B science lab rooms have rectangular shape, floor and walls were cemented, windows made of mirror and sunlight allow to light in working room and the ceilings made of cheap wood.

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In both cases the available lab rooms were not functional and non-laboratory materials were stored in it. In both lab rooms no water supply, sinks and drainages were not ready to use and dirties stored in it (see Figure 1a & 1b). Both lab rooms not built-in free area and their working rooms were not arranged for practical work as a result passage and space unfit to the standard guidelines. In both lab rooms light were installed but no ventilation, no fumes cupboard, benches were insufficient and no working tables. In both lab rooms floor, tables, and windows were full of dirty and dust, and they did not give more attention for health and laboratory safety rules and materials.

a) Sink of School A lab room

b) Sink of School B lab room

Figure 1:

Some of the common difference of School A and School B laboratory rooms were as follows: the square area of School B lab room is more larger the School A lab room, the lab room size of school B more wider than school A lab room, blackboard of School B lab room very large than school A lab room. School B lab room has three separate rooms (i.e., working room, chemical storage room and preparation room) whereas in School A the chemical storage room and preparation found very closely to each other, and they use one common door. School B lab room have more stools than School A, whereas School C not compared with other because no practical laboratory room in this school. However, the implementation of practical activities in the three schools almost the same. So, the current laboratory status of the three selected secondary schools were poor. The researcher concluded that there is untouched problem that tied the principals, chemistry teachers and students' hands, heart and mind made reluctant instead of conducting an experiment as much as possible with the possibility they have. So, negating of practical laboratory work in teaching of chemistry just like history rather than experimental science. Conquestly, absence of practical work causes students fail to acquire the conceptual and procedural understandings of that the goals of the laboratory activities [24] that may cause poor performance of students in academic achievement.

The Information gathered through questionnaires

a) Attitude and perception towards chemistry experiment

To examine attitude and perception of the school principals, chemistry teachers and students towards chemistry experiment, for each respondent 7 items that deals attitudes and perceptions having 5 Likert scale were incorporated. To make easier for generalization the 5 Likert scale was reduced to 3 Likert scale. Where, 1- stands for strongly disagree and disagree; 2 – neither agree nor disagree and 3–agree and strongly agree. The results obtained were tabulated in Table 7 below.

To item number 1, a total of 57 respondents, 45 (78.95%) were replied disagree, 4 (7.02%) were replied neither agree nor disagree and 8 (14.03%) were said agree. The finding showed that there was a bias in the understanding of the importance of conducting an experiment.

To item number 2, a total of 57 respondents, 43 (75.44%) were replied disagree, 3 (5.26%) were replied neither agree nor disagree and 11(19.30%) were said agree. The finding revealed that there were two contradicting ideas between chemistry teachers and among students regarding to teacher can conduct an experiment or not. The researcher suspect that this negative attitude may tie the chemistry teachers mind as unable to conduct an experiment as much as possible what they have in their science laboratory room. Therefore, students who cannot conduct an experiment were a victim of lack of acquiring of science process skills.

To item number 3, a total of 57 respondents, 48 (84.21%) were replied disagree, 3 (5.26%) were replied neither agree nor disagree and 6 (10.53%) were said agree. The finding showed that both principals and chemistry teachers were known that teaching

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of chemistry is in effective without experiment. However, what they said, and the reality found in the schools were contrary to each other. For instance, the data gathered through observation, questionnaires, FGD and textbook analysis, especially School A has many chemicals, apparatuses and lab materials as compared to School C, but both did not conduct any experiment in their lab room currently. Therefore, simply knowing theoretically the effectiveness of teaching chemistry with an experiment seems light bulb inside the jar, unless conducting an experiment as much as possible with what they have in their school. Therefore, attitudinal change, motivation and encouragement needed for school principals and chemistry teachers to utilize as much as possible the available apparatuses, materials and chemicals in their lab room, and alternative laboratory materials to conduct an experiment.

Table 7: Attitudes and perception toward conducting an experiment and teaching profession.

Statements dealing with the Attitude toward Chemistry Experiment and Teaching Profession	Alternative	Respondents and Response			
		Principals (n =2) in %	Teachers (n =15) in %	Students (n = 40) in %	Total (n = 57) in %
Conducting experiment is not much important.	1	2 (100)	13 (86.67)	30 (75)	45 (78.95)
	2	–	–	4 (10)	4 (7.02)
	3	–	2 (13.33)	6 (15)	8 (14.03)
Teacher cannot conduct the experiment.	1	2 (100)	9 (60)	32 (80)	43 (75.44)
	2	–	–	3(7.5)	3 (5.26)
	3	–	6 (40)	5 (12.5)	11 (19.30)
Teaching chemistry is effective without experiment.	1	2 (100)	15 (100)	31(77.5)	48 (84.21)
	2	–	–	3(7.5)	3 (5.26)
	3	–	–	6 (15)	6 (10.53)
Experiment is means of making teachers busy.	1	1 (50)	8 (53.33)	20 (50)	29 (50.88)
	2	–	–	–	–
	3	1 (50)	7 (46.67)	20 (50)	28 (49.12)
Teaching profession is an abhorrent job.	1	2 (100)	15 (100)	24 (60)	41 (71.93)
	2	–	–	5 (12.5)	5 (8.77)
	3	–	–	11 (27.5)	11 (19.30)
It possible to conduct chemistry experiment in the absent of conventional laboratory facilities.	1	1 (50)	5 (33.33)	24 (60)	30 (52.63)
	2	1 (50)	9 (60)	5 (12.5)	15 (26.32)
	3	–	1 (6.67)	11(27.5)	12 (21.05)
Teaching of chemistry is incomplete without practical work.	1	2(100)	8 (53.33)	15(37.5)	25 (43.86)
	2	–	–	–	–
	3	–	7 (46.67)	25(62.5)	32(56.14)

To item number 4, a total of 57 respondents, 29 (50.88%) were replied disagree and 28 (49.12%) were said agree. The finding revealed that there was sense of skeptic for teacher can conduct an experiment.

This may raise from misunderstanding of the purpose of conducting an experiment in chemistry education. As Mwangi [15] stated that the main purpose of laboratory work in science education is to provide students with conceptual and theoretical knowledge to learn scientific concepts, and through scientific methods, to understand the nature of science. Therefore, these misunderstanding must be removed from school principals, chemistry teachers and students through making awareness, motivation and support in conducting of an experiment.

To item number 5, a total of 57 respondents, 41 (71.93%) were replied disagree, 5 (8.77%) were replied neither agree nor disagree and 11 (19.30%) were said agree. The findings showed that the majority of respondents were disagree to the statement of teaching profession is an abhorrent job. However, most of the respondents replied positively to teaching profession but their commitment to conduct an experiment were almost null as the results confirmed through observation, FGD and chemistry textbooks analysis. The researcher suggested that commitment of chemistry teachers and school principals have great role to minimize the problems associated with practical laboratory work.

To item number 6, a total of 57 respondents, 14 (24.56%) were replied strongly disagree, 16 (28.07%) were said disagree,

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15 (26.32%) were said neither agree nor disagree, 9 (15.79%) said agree and 3 (5.26%) were said strongly agree. The result showed that the majority of respondents did not now the presence of alternative laboratory materials like local available materials, small scale science kits and visual lab to conduct an experiment in the absence or difficulty of conventional laboratory. Therefore, the researcher suggested that for school principals, chemistry teachers and students, the alternative methods used to conduct an experiment training should give in their schools or at cluster level.

To item number 7, a total of 57 respondents, 25 (43.86%) were replied disagree and 32 (56.14%) were said agree. The result revealed that the majority of respondents were agree that teaching of chemistry is incomplete without practical work. Regard to this, Forster [3] pointed that practical work is crucial in chemistry subject, teaching chemistry without including some practical work is considered as incomplete. However, the respondents' response was contrary to the fact found in their school. The results from observation, FGD and chemistry textbook analysis confirmed that from the three selected secondary schools, School A and School B have a possibility to conduct an experiment in their lab room but not. Therefore, the researcher concluded that attitudinal change has a critical role to mitigate the problems associated with practical laboratory work. In line to this, Hofstein [5] stated that practical laboratory work foster positive attitudes and cognitive development. He added that students' positive perceptions of the science lab promote cooperative learning, collaboration, and enhancing of inquiry learning. But these not practiced in the selected High schools.

b) Current science laboratory Practice of the selected secondary schools

Inquiry is an essential element in the 21st century learning skills [3]. Inline to this, with a total of 57 respondents (2 principals, 15 chemistry teachers and 40 student respondents) were asked 'Do the students conduct the experiment?' As the result depicted in Figure 2 showed that 100% of principal, 50% of chemistry teachers and 66.67% of student respondents of School A were said yes, whereas 50% of chemistry teachers and 33.33% of student respondents of School A were replied to no. Concerning School B, 100% of principal, all of chemistry teachers and all of student respondents of School B were replied to no. From School C, all of chemistry teachers and all of student respondents of School C were said no. The finding revealed that currently in the three selected secondary schools an experiment was not conducted. Regarding to the current laboratory practice the result obtained through observation showed that School A lab room was servicing as store (see Figure 3a), School B lab room was servicing for normal classroom learning and store (see Figure 3b), whereas School C lab room was built but it acts as unmade.

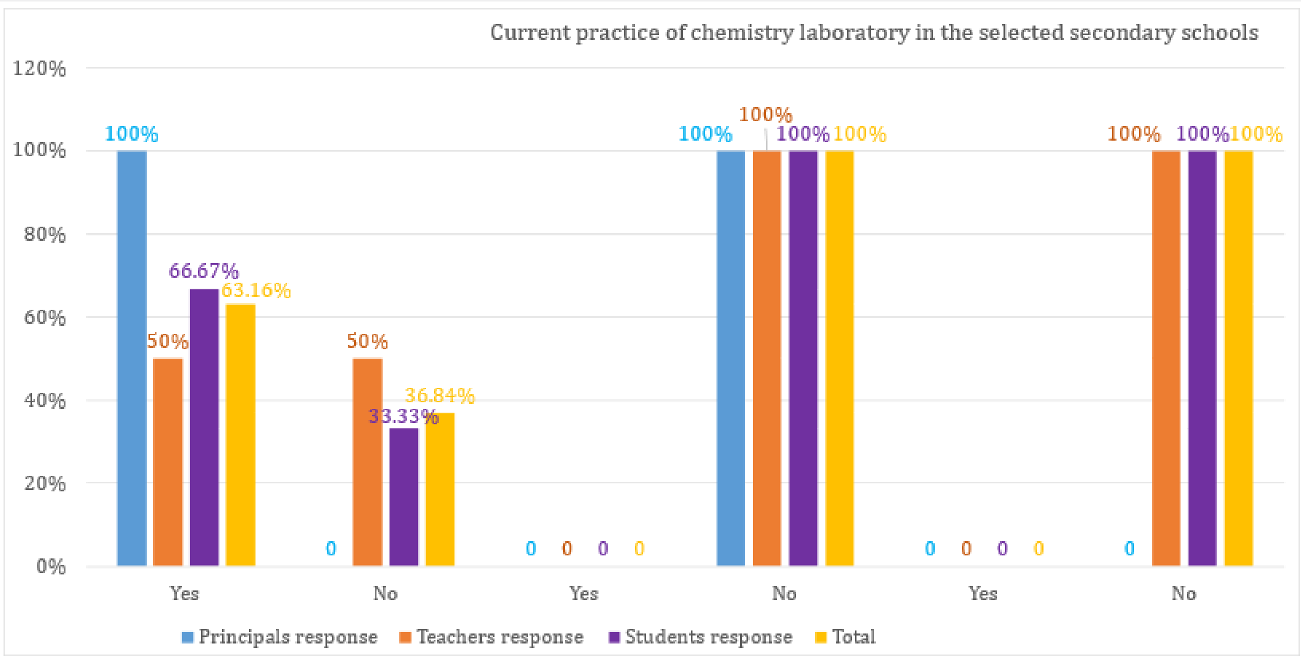

Figure 2: Current practice of chemistry laboratory in the selected secondary schools.

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a) Current laboratory room of School A   b) Current laboratory room of School B

Figure 3:

As Lerman & Morton [25] pointed that the true understanding of science and technology can be achieved through interaction with and involving in it interdependent as well as self-dependent. When students involved in mind-on, hands-on and heart-on practical activities, they can generate their own creative in order to remember and understand abstract concepts of chemistry. Since, it coincides with the Chinese proverb "I hear, and I forget; I see and I remember; I do and I understand." Therefore, students learnt in the three selected secondary schools were unable to acquire and develop components of 21st century learning skills, specifically the 4 Cs 21st-century learning such as critical thinking, creativity, collaboration and communication. Moreover, regarding to practical activities researchers stated that students who learn only from textbook have no chance to look the chemistry laboratory room will fail to acquire the conceptual and procedural understandings of that the goals of the laboratory activities [15]. Such lacks of opportunity to carry out lab works, de-motivating students and a poor use of teaching and learning resources which may end up contributing to poor academic performance of students in the subject [16].

c) Factors affecting to implement chemistry laboratory at high school

Table 8: Factors that affect to implement an experiment in the selected secondary schools.

Problems in Implementing Chemistry Laboratory at School	Frequency Response				
	Principals (n=2)	Teachers (n=15)	Students (n=40)	Average Frequency	Prioritized
Lack of laboratory facilities like water, chemicals, tables, apparatus etc.	0	11	19	10	7
Due to large class size (more students in the class)	2	11	26	13	3
Lack of laboratory room	0	6	30	12	4
Lack of re-current laboratory budget	0	0	0	0	22
Environmental conditions	0	0	3	1	21
The available laboratory room is inconvenient to conduct an experiment	1	9	25	12	5
Lack of skills	2	0	17	6	11
Chemistry teachers dislike conducting an experiment	2	0	11	4	17
Lack of chemistry laboratory technician	1	15	32	16	1
No time to conduct an experiment	1	11	18	10	6
Lack of lab manual	0	0	9	3	20
Students are not interested to conduct an experiment	1	2	6	3	19
Lack of attention from the school principal and concerned bodies	0	13	32	15	2
Fear of hazardous to conduct an experiment	1	3	8	4	16

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Lack of self-commitment	2	5	19	9	8
Lack of awareness	0	12	15	9	9
Laboratory work is tiresome	0	8	10	6	12
Lack of encouragement	0	8	18	9	10
The available chemicals are expired	0	6	6	4	15
The available apparatus is too old	0	4	4	3	20
Some of the experiment prescribed in the textbook is beyond grade level	0	5	11	5	14
Some of the prescribed experiments in the textbook is difficult to conduct	0	7	10	6	13
The prescribed experiment in the textbook irrelevant to the topic of the lesson taught	0	3	8	4	17

The response of respondents' the problem (s) they countered to conduct an experiment in their school were arranged in frequency and prioritized in Table 8 as shown above.

Lack of laboratory technician, lack of attention from the school principals and concerned bodies, large class size, lack of laboratory room, inconvenience of the available lab room, lack of time to conduct an experiment, lack of laboratory facilities, lack of self-commitment, lack of awareness and lack of encouragement were the major factors that negatively affect the implementation of practical laboratory work in the selected High Schools.

d) The attempts made to overcome problems associated with practical laboratory work in the selected secondary schools

The student respondents were suggested the following as a solution to overcome the problems associated with practical work. Providing necessary lab materials, school administrative bodies should strongly do on the lab, building lab room in the school compound, the professionals should empathy the problems and demonstrate their skills trustfully, teachers should develop self-commitment, school principals and concerned bodies should give proper attention for the science lab, encouraging teachers and students to conduct an experiment from local available materials, recruiting lab technician, awakening and motivating teachers to conduct an experiment, all the concerned bodies from top to bottom must do jointly and collaboratively to alleviate the problems associate to an experiment.

Chemistry teacher respondents were stated that recruit lab technician, made available demonstration room as much as possible, school should make ready gas cylinder and spirit lap, school and education office should give proper attention to practical lab work and make the lab room start to function, school should provide supportive materials like science kits, making the lesson connection with the students daily life experiences and advise them try to realize at their home, priority should give to the quality of education and chemistry in its nature experimental need lab facilities to mitigate problems associated with practical laboratory work.

The school principals stated that making strong connection with concerned bodies, orienting students with full information about the school problems and use alternative materials, fostering self-commitment to overcome the problems associated with a chemistry experiment.

e) Ratio of number of students in a class and a laboratory room

As Ellen [26] stated that during her reading investigation the classroom is crowded by 23-25 children. In Ethiopia context, according to the MoE policy the number of students to a classroom at primary education 1st cycle (grade 1-4) and at primary education 2nd cycle (grade 5-8) level is 50 children per room and at secondary level (grade 9-10) 40 students [27]. The policy of class size set by MoE compared to Ellen statement was overcrowded. However, the reality exists at the selected secondary schools were extremely overcrowded compared to policy of class size set by MoE (see Table 9).

In school A, the normal class size according to the policy set by MoE for grade 9 is 25:989. This means, for 989 students of grade 9 twenty-five sections were needed. But the reality exist in this school was incompatible to this ratio, grade 9 has 12 sections with total of 989 students. By the same explanation grade 10 is 24:948, grade 11 is 8:301 and grade 12 is 4:162. Only the ratio of number of students to classroom/number of sections of grade 12 is compatible to the policy of class size set by MoE. In general, the total number of sections to number of students in School A is 60:2,400 (see Table 9). This means that to teach 40 students in one classroom for School A, 60 sections were needed for 2,400 students but the reality is 36 sections accommodate 2,400 students. This shows the ratio of number of students in a classroom deviate by the factor of 5/3 from the policy set by MoE. The finding revealed that there is large class size in school A.

In school B, the normal class size according to the policy set by MoE for grade 9 is 31:1,229, grade 10 is 23:936, grade 11 is 6:222 and grade 12 is 8:339. But the reality exist in the School B all of the grade level did not obey the policy of class size set by MoE. In general, the total number of sections to number of students

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in School B is 68:2,726 (see Table 9). This means that to teach 40 students in one classroom for School B, sixty-eight sections were needed for 2,726 students but the reality is 40 sections accommodate 2,726 students. This shows that the ratio of number of students in a classroom deviate almost by the factor of 2 from the policy set by MoE. The finding revealed that there is also large class size in school B.

Table 9: Ratio of chemistry teachers to students and available lab room to students in the selected secondary schools.

Selected School	Grade Level	No of Section	No of Student	No of chemistry teacher	Ratio of Class Size (1:40)	Ratio of the available Lab Room to Students (1:20)	Ratio of Teacher to Students in Classroom (1:40)
School A	9	12	989		25:989	1:49	
	10	16	948		24:948	1:47	
	11	4	301		8:301	1:15	
	12	4	162		4:162	1:8	
Total		36	2400	7	60:2,400	0.125	1:80
School B	9	20	1229		31:1,229	1:61	
	10	11	936		23:936	1:47	
	11	4	222		6:222	1:11	
	12	5	339		8:339	1:17	
Total		40	2726	10	68:2,726	1:136	1:68
School C	9	13	1099		27:1,099	1:55	
	10	8	679		17: 679	1:34	
	11	4	310		8: 310	1:16	
	12	3	125		3:125	1:6	
Total		28	2213	6	55:2,213	1:111	1:55

In school C, the normal class size according to the policy set by MoE for grade 9 is 27:1,099, grade 10 is 17:379, grade 11 is 8:310 and grade 12 is 3:125. But the reality exists in the School C expect grade 12 all of the grade level did not obey the policy of class size set by MoE. In general, the total number of sections to number of students in School C is 55:2,213 (see Table 9). This means that to teach 40 students in one classroom for School C, 55 sections were needed for 2,213 students but the reality is 28 sections accommodate 2,213 students. This shows the ratio of number of students in a classroom deviate almost by the factor of 2 from the policy set by MoE. This confirms there is large class size in school C.

Regarding to number of students perform practical laboratory work in one lab room Foster [3] pointed that 40 students which is sub-divided in two groups of 20 each for practical work and on each five working tables four students perform practical work. Which means, in one lab room 20 students (1:20) perform practical activity for given time. In line to this, the three selected secondary schools as shown in Table 9 above, in School A, grade 9 in one lab room 49 students (1:49), grade 10 in one lab room 47 students (1:47), grade 11 in one lab room 15 students (1:15) and grade 12 in one lab room 8 students (1:8) can conduct an experiment at a given time. In School A of grade 9 and grade 10 the number of students enable to conduct an experiment in one lab room for a given time is not fit to the lab standard guideline of a ratio of 1:20. In general, in School A in one lab room 120 students (1:120) can conduct an experiment for a given lab session, which is six times the standard stated.

In School B, grade 9 in one lab room 61 students (1:61), grade 10 in one lab room 47 students (1:47), grade 11in one lab room 11 students (1:11) and grade 12 in one lab room 17 students (1:17) can conduct an experiment at a given time. In School B of grade 9 and grade 10 the number of students enable to conduct experiment in one lab room for a given time is not fit to the lab standard guideline of a ratio of 1:20. In general, in School B in one lab room 136 students (1:136) can conduct an experiment

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for a given lab session, which is approximately seven times the standard stated.

In School C, grade 9 in one lab room 55 students (1:55), grade 10 in one lab room 34 students (1:34), grade 11in one lab room 16 students (1:16) and grade 12 in one lab room 6 students (1:6) can conduct an experiment at a given time. In School C of grade 9 and grade 10 the number of students enable to conduct experiment in one lab room for a given time is not fit to the lab standard guideline of a ratio of 1:20. In general, in School C in one lab room 111 students (1:111) can conduct an experiment for a given lab session, which is approximately 5.5 times the standard stated.

According to the policy of class size set by MoE from grade 9 to grade 10 one classroom for 40 students (1:40). In this context, the ratio of number of chemistry teachers to students depicted in Table 9. In School A the total number of students were 2,400 and number of chemistry teachers were seven. Which means that one chemistry teaches in a classroom teach 80 students (1:80). By the same explanation in School B, one chemistry teacher teaches in a classroom 68 students (1:68) and in School C, one chemistry teacher teaches in a classroom 55 students (1:55). The results showed that in the three selected secondary schools the number of chemistry teachers to numbers of sections and number of students in the classroom were not fellow the policy of class size set by MoE.

As indicated in Table 9 as grade level increased the number of students in the classroom and number of sections were decreased. So, large class size was more prominent in grade 9 and grade 10. Large class size has negative impact on the practice of chemistry experiment and availability of laboratory materials, equipment, apparatus, tools and chemicals. As different researchers reported that large class size is one of the challenges in conducting an experiment. Also, this finding confirmed that in the three selected secondary schools the number of students in classrooms, number of sections and the available chemistry teachers were not aligned to the ratio of 1:40 set by MoE. These infer that due to teachers overload and large class size currently the three selected secondary schools were not conduct any experiment in their school.

According to the Ethiopia Education syllabus, at High School level chemistry as a subject matter taught three period per week in grade 9 and 10, and in grade 11and 12 four period per week. Concerning the period allocation of grade 9 and 10, in a single shift a teacher in each working day can teach 6 periods and 30 periods per week. Therefore, one chemistry teacher in single shift can accommodate 10 sections which totally 30 periods per week. In line to this, as shown in Table 9, School A has sixty sections need 6 chemistry teachers. Actually, there were 7 chemistry teachers in this school approximately they share 9 sections with a total of 27 periods per week. By the same explanation, School B has sixty-eight sections need 7 chemistry teachers. Actually, there were 10 chemistry teachers approximately they share 7 and 8 sections with a total of 21 and 24 periods per week respectively. This indicate that in each day in a single shift one chemistry teacher can teach a minimum of 4 periods and 5 periods. Regarding to School C, there were fifty-five sections which need 6 chemistry teachers. Actually, there were 6 chemistry teachers in this school approximately they share 9 sections with a total of 27 periods per week. This means that in each day in a single shift one chemistry teacher can teach a minimum of 5 periods. In conclusion, School B chemistry teachers have one more free period than School A and School C chemistry teachers. However, the results obtained through observation, questionnaires, FGD and chemistry textbook analysis revealed that the three selected secondary schools currently did not conduct any chemistry experiment in their science lab room. In general, according to chemistry syllabus time allocation, chemistry teachers are unable to conduct an experiment during normal periods of learning, unless they use against shift.

Information gathered through focus group discussion

The FGD was conducted from students, chemistry teachers and school principals to the information related to chemistry laboratory practical work in their schools. The posted questions and the response of respondents were described as follows:

a) Did you conduct chemistry experiment and what is your view concerning the current chemistry laboratory status and practice in your school?

The student respondents from School A were reacted to these questions in saying "we are not get chemistry education according to our interest…teachers cannot practice us. Since some of them are overloaded and some of them are not interested to do an experiment." They continued in saying "we don't know the area of lab room. Since nobody called us for lab work." They added "Is there chemistry lab? We can't conduct an experiment in the lab, we don't know why? But we can't learn---." In the same manner student E continued in saying "I know in theory about oxygen and magnesium, but I cannot see them… the director just simply neglected the experiment without giving enough consideration." He added "…students watching chemistry education as a game… we lost base at this level how we will investigate new medicine? We cannot do any chemistry experiment until now, but we simply learn the theory."

From school B, Student respondents were said "we never do an experiment, since no experimental materials, no chemicals, no lab technician, teachers are not interested to conduct an experiment." Another student C responded that "our teacher jumps the topic of experiment and when we ask questions from experiment, he ignored our question." She added "I am doing the theoretical concept well, but I do not know my achievement if I examined a practical aspect." Student H said, "I do not like to conduct an experiment, since it simply ordered me to do

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this and that as mentioned on the text." From School C student respondents replied, "we cannot conduct an experiment till now… no lab room in the school, we asked the principal but no response." Some students said "our chemistry teacher bring materials to the classroom and showed …. for us one more time, without these we never see nothing else."

The chemistry teachers from School A reacted to the posted questions in this way, teacher K said nervously "the lab technician was recruited but when he upgrades, the education office not allowed salary growth for him because of that he left the school… the budget is there but they cannot recruit another lab technician." Teacher H said "currently we cannot conduct any chemistry experiment because of workload the minimum load 28 and maximum 30. No lab technician as a result we are unable to conduct the experiment as much as possible." Another teacher L from School A reacted "in our school there are many chemicals, but we cannot do it due to workload, the problems associated with COVID-19 and large class size up to 90 students in one class has made things more complex." He also pointed that "in the presence of chemicals and apparatus we can perform an experiment like College but now we cannot, ---expired chemicals are stored in the lab but not identified, students asked us to do an experiment, but we are unable to conduct an experiment due to workload, no lab technician, the available lab room size is small and the number of students were unfit."

Teacher M from School B reacted to the posted questions in saying, "the built science lab is not functioning … no lab technician, the lab room is unfinished, and water is not made available for lab work." Another teacher P said, "chemistry teachers cannot conduct an experiment…there is a shortage of time, there is scarcity of water to conduct an experiment." Lastly this teacher said loudly "avoid being tensioning of students." The researcher was asked this respondent, can you elaborate the meaning of the statement you are said now? He replied, "we are not doing an experiment…do not terrible students by simply asking about the chemistry experiment." Another teacher T added "…large number of students in the classroom, the lab technician was in jail … and lack of lab facilities, we cannot perform the experiment." The researcher was asked that how much years or mouths the lab technician was at a jail? And they replied, "almost a mouths." If so, did you conduct experiment while the lab technician was with you? Some of them were said "yes, the lab technician arrange schedule for the students to conduct an experiment in against shift." Concerning the lab session, the researcher was confirmed during observation of School B lab room the lab schedule was posted on the door of chemical storage.

To the posted questions teacher W from School C responded "we cannot perform the experiment because no lab room in the school compound, but I showed some demonstration in the classroom while teaching properties of ionic compounds. During this lesson I brought battery, electric wire, sodium chloride and water to the class and I showed to the students …" He added "also I used ball and stick model when I teach hydrocarbons about alkanes. …when I teach acid-base, I use litmus paper to show the color changes by putting the chemicals and litmus in my locker." Teacher Y from School C continued his turns in saying "we cannot conduct an experiment… no facilities, some lab materials… are brought but they simply stored in locker due to lack of lab room." Again, he forwarded that "initial the city administration had been built the lab room but the school cannot accept it due to lack of quality …the room was closed without giving any service." He continued in saying "nobody asked about our problems… still we are continue teaching chemistry in traditional approach with our problems."

Regarding to this question the three school principals were raised different problems. One of the principals whose laboratory full of chemicals and apparatus (School A) said "the lab room is closed and the key is in my hand, because the lab technician turnoff his work and recruited in private company." He added "I was made discussion with the district education office about lab technician but no response." The another school principal whose laboratory room used for the normal teaching-learning process (School B) said "the chemical room is closed because the lab technician is in jail and the key is in his hand" and he added "if the situation is serious tolerate me for one week until I called the --- the lab room is not finished, no water, no drainage, no enough benches in lab room." "We have nothing!" one Principal in another school (School C) said "initially the lab room was built by Shashamane city administration but because of lack of quality not received from the contractor." He added "the teachers are teaching theory--- nothing we have either chemicals, apparatus, or lab room."

b) Did you discuss the problems associated with chemistry laboratory with the concerned bodies?

Student C from school A replied, "school did not work on the problems associated with the lab …just they simply observe it as simple because no accountability." Student E responded, "my parent ignored about the lab work, since the concerned bodies are neglected the importance of lab as a result simply discussing the role of school administrative is valueless for them." Student respondents from School B answered in saying "school principal do not worry about the experiment, he considered that theoretical teaching is enough…" They also said that "the student need should fulfill… the school principal and supervisor did not have enough attention to the lab work, but they simply focusing on theoretical aspects." From School C student respondents forwarded "really, we discussed some many times with the principal about the lab problem but no response yet. …we tried to get solution, but they prefer silent, now we are convincing ourselves ready to learn only theory as it is without observing any evidence for the theoretical aspects."

Chemistry teachers from School A responded, "we discussed with the school principal about water, in general no water in the

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school compound, we discussed to recruit the lab technician but still not." They added "we discussed the problem of number of students and lab size is not much but not solved yet." During lab room observation the researcher was confirmed that the available science lab room size below the lab standard. School B of chemistry teachers said, "we discussed some many problems with the school but no solution, the problem still exist." Chemistry teachers at School C reacted that "we tried some many times to solve the lab problems but we cannot." Teacher Z explicitly said, "a principal and education office as gave more attention to textbook and school fence, should gave equal emphasis also for lab work unless the problem is continued as a problem." Regarding to this question the response of the three school principals were the same, they said "we made discussion with education office to solve the problem…but no solution year after a year."

c) Does only teaching theoretical concept of chemistry is enough?

Students responded, "only learning theory is not enough …in practical we can recognize the real things." Students surprisingly said, "practical make learning complete…we import chemicals from abroad because we cannot learn it." They also elaborated in saying "…those who learn practical had made chemicals but those who were not learn practical continue importing chemicals from abroad." Regarding to this question chemistry teachers replied "chemistry without experiment is meaningless. In its nature chemistry is an experimental science….so if students do not conduct the experiment how they understand the abstract concepts?" They continue discussing in saying "to make the students familiar to the theoretical concepts we associate with their daily life like ash in case of base, orange in teaching of atomic models, …preparation of tea at home while explaining about saturated solution, in distillation associating to the local alcohol (Arake) making … anyway the student must learn theory with experiment to understand the concept unless they cannot understand the concept fully." The chemistry teachers' responses and what they are actually practicing in their school regarding to practical laboratory work were contrary, since any of the selected schools were not perform an experiment in their lab room.

d) Is not possible to conduct experiment without laboratory room?

The chemistry teachers replied "yes, in some case it is possible to conduct an experiment from local available materials, but they are not effective as the commercial one." Concerning to the use of alternative like virtual lab and science kits. They responded, "we know the science kits and in the former government, science kits were distributed for schools but now not." Regarding to virtual lab most of chemistry teachers did not know about the word itself rather than to use it. Most of them said that "I do not know about virtual lab, but to alive one country quality education must exist." So, the researcher realized that awareness and training of the use of alternative lab materials needed for chemistry teachers.

e) Do you like teaching profession?

To this question student A saying "I cannot love teaching profession. Because I can't struggle with students… I seek another job opportunity." Student M replied, "I cannot to be a teacher, since no respect from society, government and the income of teacher is low …I cannot get enough benefit." Student F responded, "if God gave me to teach, I will teach."

Chemistry teacher H said, "I like teaching, I taught for 35 years… really in the Haille Silassie and Dargue regime teachers have respect from society… now his income become low as a result unable to compete… so he searches compatible area to relax… when peoples saw him around that area, they dislike teaching profession." Teacher H seriously said, "anyway you cannot associate teaching perfusion with income…I am producing a lot of doctors, engineers and the like, so education is the father of all jobs." He continued in saying "I prouder when I saw by students become doctor and greeting me by saying teachery…really, I am happy when they said that…yes indeed the pocket of teachers is poor, but their mind is not poor." In addition, he said "those who dislike teaching have two problems either who have no subject matter knowledge to teach or only their minds money oriented or money seeker in general." Another teacher B said, "I taught for 26 years, yes the community attitudes toward teaching profession is negative but I like it because education is the base of all jobs." He added "this attitudinal problem can be solved when the concerned bodies gave attention to this problem to keep quality of education. The quality of education is not solved by keeping teachers aside, now we simply watching the problems."

f) What you suggest alleviating the problems associated with lab work?

Regarding to this question students' respondents said "if a director do in committed way by making continues discussion with the concerned bodies and enforcing chemistry teachers to conduct an experiment every problems related to practical work can get solution." They added "school should control the teaching-learning process regularly and make discussion with teachers and concerned bodies as much as possible to mitigate the problems associated with practical laboratory work… convincing the concerned bodies to fulfill necessary lab materials and motivating teachers to perform an experiment."

Concerning these questions chemistry teachers said "lab room must made and ready to function according to the lab standard …conducting experiment in the against shift, providing science kits to substitute lack of chemicals and apparatus, principal should discuss with teachers while planning schoolwork…things should be done by prioritizing … experiment like textbook should get immediate solution. Concerned bodies must listen what the teachers said regarding to teaching–learning process in all aspects to mitigate problems related to quality of education in general, experiment in particular."

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The school principals reacted to the question in saying "… we try to solve the problems with education office, attitudinal change and emphasis should be given to the experiment like other sensitive issues." They added "teachers should conduct an experiment with what we have as much as they can." Their response towards an experiment is positive but the attempt made to conduct an experiment in their school totally null.

Information gathered through document analysis

The alignment of number of experiment titles mentioned in chemistry textbooks and the availability and utilization of laboratory materials and chemicals in the High Schools were checked and the results obtained were presented in Table 10.

Table 10: Number of experiment titles and percentage of availability and utilization of apparatuses and chemicals in the schools.

Grade Level	No of Experiment Title	School A	School B	School C
9	19 experiments	100% of apparatuses, tools and 84% of chemicals were present for the described experiments.	At a time of observation, the lab technician was in Jail and chemical storage room was closed.	No lab room
10	32 experiments	90.62% of apparatuses, tools and 81.25% of chemicals were present for the described experiments.		
11	16 experiments	100% of apparatuses, tools and 81.25% of chemicals were present for the described experiments.		
12	15 experiments	100% of apparatuses, tools and 93.33% of chemicals were present for the described experiments.		

As indicated in Table 10 in the chemistry textbook of grade 9 nineteen experiments, in grade 10 thirty-two experiments, in grade 11 sixteen experiments and in grade 12 fifteen experiments were specified. The experiments were stated for different grade level, for different students, with different chemistry teachers, with different school principals, with different school environment and with different laboratory room and status. In line to this, through observation confirmed that School A has many chemicals, apparatuses and lab materials when compared to School B and School C, but all of them did not conduct at least one experiment in their lab room currently. Another point either in the syllabus or chemistry textbook the allocation for practical activities per week were not mentioned. This is also one of the problems in the implementation of chemistry practical laboratory work in the three selected secondary schools.

When the High School chemistry textbooks were analyzed the described laboratory activities from grade 9 to 12 not tailored according to the diverse needs of students. Since, the described laboratory activities were ignored individual skill of interest. The laboratory activities are designed just by the approach of one-size-fit for all. This is also other factors that hindered the implementation of practical laboratory work in the selected secondary schools.

Conclusion

Confucius (552-479 BC), Chinese philosopher and educator said that "I hear, and I forget; I see and I remember; I do and I understand." When students involved in mind-on, hands-on and heart-on practical activities, they can generate their own creative in order to remember and understand abstract chemistry concepts. The results from the observation, questionnaires, FGD and document analysis were triangulated, and the findings revealed that most of school principals, chemistry teachers and student respondents have positive attitude and perception towards an experiment but no practice in conducting an experiment, in the selected two secondary schools no separate chemistry laboratory, but there was a common science laboratory and in one school science laboratory was built but closed due to lack of quality.

The availability of lab room and its quality, and lab facilities were differed from school to school. This shows their laboratory status were differ from school to school. School A has more apparatuses, laboratory materials and chemicals than School B and School C, but none of them did not conduct a chemistry experiment currently that described in the student chemistry textbooks from grade 9 to grade 12. This implies students were unable to acquire and develop components of 21st century learning skills, specifically the 4cs-21st learning such as critical thinking, creativity, collaboration and communication. The ratio of chemistry teachers to number of students in a classroom largely greater than the rule of MoE set and ratio of students to lab room does not obey the guideline of laboratory seat for practical work in a given session. These negatively affect the practice of practical laboratory work.

At different time, different researchers had been reported different factors or problems that hindered practical laboratory work [10,11,16,28,29]. In addition to these, in this research lack of awareness, attitudinal problem, work load, lack of encouragement and support, lack of continues fellow up and monitoring system of lab work, reluctance, skeptic, irresponsiveness, lack of allocating periods for practical work, neglecting assessment of students' practical knowledge and abilities, lack of familiarizing with small scale science kits and Virtual lab, lack of generating innovative ideas and ignoring individual skill of interest (failure of considering multiple intelligence) while designing an experiment

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were the identified challenges in doing of practical laboratory work in the selected High Schools. In general, the expectations as stated in chemistry textbooks from grade 9 to 12 regarding to experiment is mismatch with the current practice of chemistry experiment in the selected secondary schools.

To alleviate the problems from its grassroots associated with reluctance of chemistry teachers towards conducting practical laboratory work in-depth investigation will needed.

Recommendations

a) The concerned bodies should develop continuous fellow up and monitoring system the way science laboratory in general, chemistry experiment in particular performed in schools.

b) All concerned bodies from top to bottom should develop common work spirit and must do jointly and collaboratively to mitigate the problems associated with practical laboratory work.

c) Attitudinal changes on school principals, chemistry teachers and students should done in continues way to alleviate the problems associated with practical laboratory work.

d) Concerned bodies should provide support and encourage chemistry teachers to initiate them in order to conduct an experiment.

e) Chemistry teachers should develop positive attitudes, commitment and motivation to conduct an experiment as much as they can and incorporating practical laboratory in assessment.

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