COMMON DIFFICULTIES EXPERIENCED BY GRADE 12 STUDENTS IN LEARNING CHEMISTRY IN EBINAT PREPARATORY SCHOOL

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ABSTRACT

The objective of this study was to examine the nature and causes of common difficulties experienced by grade twelve students in learning chemistry in Ebinat preparatory school. A qualitative method was employed to investigate the questions, which used interviews and questionnaires with students and teachers. The key findings of the study indicated that students are being more challenged by topics like chemical bonding, thermodynamics, chemical equilibrium, kinetics, and colligative properties. The main factors that are contributed for the learning difficulties in chemistry faced by our students include: absence laboratory works, absence of teaching and learning resources, poor teaching and learning strategies, poor English and Mathematical skills and there is a need to improve these cause by using equip laboratory, improvement in assessment, use of proper English language by teachers etc. *[African Journal of Chemical Education—AJCE 6(2), July 2016]*

INTRODUCTION

Chemistry curricula commonly incorporate many abstract topics, which are central to further learning in both chemistry and other sciences [1]. The difficulties of chemistry topics are their abstract nature and words from everyday language with different meanings [2]. One of difficult topic student's experiences in learning chemistry is chemical bonding because it involves variety of abstract natures [3]. Chemical equilibrium is one of the fundamental concepts in chemistry but it is difficult subject for students learning [4]. Thermodynamics is difficult topic at all level of learning and not popular subject among students [5]. Chemical equilibrium is affected by different factors such as concentration, temperature and pressure [6].

This difficulty could be influenced by experimental activities done in laboratories, availability of reference books, method of instruction, language of instruction, representation of materials in textbooks, or after-school support programs [7]. The effect of conducting experimental activities and teaching and learning methods used by teachers in developing positive attitude in learning chemistry is also confirmed [8]. Practical work needs essentially to be about thinking that is trying to understand the relation between evidence and theory to stimulate challenge students [9]. Low laboratory practices in secondary schools are the leading causes that bring negative impact on academic achievements in chemistry [10]. Students who learn by inquiry approaches are responsible for developing their own answers to questions rather than exclusively relying on the teacher and/or textbooks [11].

The preceding arguments suggest that a lesson presentation that is consistent with active learning is characterized by activities in which students fully engage their higher order thinking mental capacities like concepts, procedures, predicting and justifying with each other [12]. Teachers should cultivate work environments in which they are able to watch students at work and

listen to them explaining learning strategies that could be used in the presentation. Create opportunities to use problem solving, games, puzzles, and small group work [13].

Giving responsibility and leadership in scientific activities, keeping the students informed of their progress in chemistry, providing opportunity for students demonstration, arranging for students cooperative enterprise in science, organizing field trips, science clubs and science fairs, creating a sense of healthy competition among the students [14]. The learners should be actively involved in the learning experience. The teacher does not take center stage in the classroom but should be a facilitator and listener [15]. The teacher should design activities that focus on allowing students support, refine or refute their theories about a particular event [16]. Lack of competence in English language by both teachers and learners affect the teaching and learning chemistry and the immediate consequences of students' performance in school subjects including chemistry. Students are unable to communicate fluently in English and find it difficult to take part in class discussions. Examinations remain a critical factor in influencing the learning of chemistry. Teachers tend to focus on those aspects which gain examination grades rather than on important outcomes such as practical skills and generally relevant attitudes and values [17].

As mentioned the above chemistry curriculum arranged for preparatory schools by the Federal Ministry of Education of Ethiopia (Grades 11 and 12) consists a wide spectrum of concepts related to organic, inorganic and physical chemistry that are to be learnt and mastered by the students in a 2-year period. The most common ones are chemical bonding, chemical kinetics, equilibrium, solutions, acid base equilibrium etc. In addition, high levels of skills and attitudes are expected to be acquired by learning preparatory school chemistry [18]. However, the document analysis in the past four years shown in Table 1 and 2 from the finding parts only 38.98 % and 35.48 % of the students in our school scored pass mark in chemistry in model examination prepared

at school level and university entrance examination administered at national level respectively. The result of the document analysis indicated us there is a huge gap between what is intended in the national curriculum in terms of students' learning in chemistry, what actually happens in the classroom where students learning chemistry and shows students experience common difficulties in learning chemistry. The purpose of this study was therefore to investigate the nature and causes of learning difficulties students experience in chemistry in Preparatory School of Ebinat.

Objectives of the Study

1. To identify the nature of common difficulties experienced by grade twelve students in learning chemistry in Ebinat Preparatory School.
2. To determine the causes of these difficulties grade twelve students experience in learning chemistry in Ebinat Preparatory School.
3. To establish what can be done to minimize these difficulties in learning chemistry in Ebinat Preparatory School.

Basic Questions

1. What common difficulties do students experience in learning chemistry in Ebinat Preparatory School?
2. Why do students experience these difficulties in learning chemistry in Ebinat Preparatory School?
3. How can these difficulties be minimized in learning chemistry in Ebinat Preparatory School?

METHODOLOGY

Research Design, Samples and Research Instruments

A qualitative method was used for collecting data from chemistry teachers and grade twelve natural science students selected for the study. Data was collected through open ended questionnaire and semi structured interview from respondents.

The study population was 284(144 males and 140 females) grade twelve natural science students and 4 (3 males and one female) chemistry teachers of Ebinat preparatory school of 2015 G.C. The researcher choose only grade twelve natural science students because they have covered most of the syllabus of chemistry in preparatory school and could be able to provide information about the common difficulties they experience during their stay in the school.

Study participants were selected using purposive sampling technique. This technique was used to select 30 (15 males and 15 females) of the students out of 284 grade twelve natural science students who took model examination of 2015 G.C. and four (three male and one female) chemistry teachers.

The research instruments used for data collection included interview and questionnaires. The interview and questionnaire were meant to collect data on common difficulties experienced by grade twelve students when learning chemistry, their causes and how they could be minimized.

The collected data were analyzed using the qualitative content analysis approach. This involved identifying, categorizing and listing responses according to themes. These responses were coded and grouped by establishing the emerging themes.

FINDINGS OF THE STUDY

Grade 12th Students' Results in the past four consecutive years are given the following table.

Table 1: Ebinat preparatory School Grade 12th Students Model Examination Results from 2012 to 2015.

Year	Reg. candidates			Passed candidates in Exam.				Failed candidates in Exam.			
	M	F	Tot	M	F	Tot	In %	M	F	Tot	In %
2012	69	67	136	30	27	57	41.90	39	40	79	58.10
2013	128	119	247	48	44	92	37.24	80	75	155	62.76
2014	135	131	266	52	52	104	39.10	83	79	162	60.90
2015	140	144	284	53	54	107	37.67	87	90	177	62.32
Total	472	461	933	183	177	360	38.98	289	284	573	61.02

Source: school record section

As can be seen from table one the pass percentage of students in the four years went 38.98%. It is clear from table one that a large percentage of candidates in the four years given just failed school model examinations. Again in 2012, 79 (58.10%) out of 136, in 2013, 155 (62.76%) out of 247, in 2014, 162(60.90%) out of 247 finally in 2015,177 (62.32%) out of 284 students are failed from total registered candidates respectively.

Table 2: Ebinat preparatory School Grade 12th Students university Entrance examination Results from 2012 to 2015

Year	Reg. candidates			Passed candidates in Exam.				Failed candidates in Exam.			
	M	F	Tot	M	F	Tot	In %	M	F	Tot	In %
2012	69	67	136	26	24	50	36.76	46	40	86	63.24
2013	128	119	247	35	38	73	29.55	80	94	174	70.45
2014	135	131	266	58	61	119	38.72	92	55	147	61.28
2015	140	144	284	43	46	89	31.33	97	98	195	68.67
Total	472	461	933	162	169	331	35.48	315	287	602	54.52

Source: school record section

As can be seen from table two the pass percentage of students in the four years went 35.48%. It is clear from table two that a large percentage of candidates in the four years given just failed chemistry university entrance examinations. Again in 2012, 86 (63.24%), out of 136, in 2013, 174 (70.45%) out of 247, in 2014, 147 (61.28%) out of 266 finally in 2015, 195 (68.67%)

out of 284 students are failed from total registered candidates respectively. The result of the students was not considered the university enrolment of but who scored less than fifty percents. This document analysis is in line with the finding of the study which showed the teaching-learning process of science education in Ethiopian schools failed to meet the requirements of policy expectation. Generally, the results of students in the four years of school model and university entrance examinations are underachievement. These scores are less than the expected average score (50%) by the Education and Training Policy of Ethiopia [19]. They have significant different from this expected value and are decreasing too. Hence, it needs to assess the common difficulties experienced by students in learning chemistry.

Interview questions and Questionnaires for Grade Twelve Students and chemistry teachers

1 Which topics do you find more difficult to learn in grade 11and 12 Chemistry texts? List them?
2 What difficulties do you experience when learning Chemistry?
3 What do you think causes of learning difficulties you have mentioned?
4 What measures do you think should be employed to minimize the learning difficulties which you experience chemistry?

These questions and their responses were discussed in the following cases.

1. Question 1 and 2: Which topics do you find more difficult to learn in grade 11 and 12 Chemistry texts? List them? What difficulties do you experience when learning Chemistry?

Most of the student and teacher respondents who completed these questions the researcher prepared confirmed that they failed to understand the concepts of chemical equilibrium, chemical bonding, chemical kinetics, thermodynamics and colligative properties respectively.

Chemical Equilibrium

According to the finding most of respondents said that learning equilibrium is difficult and they cited that teaching student's chemical bonding is difficult. On the researcher teacher's respondent, most students assumed that learning about chemical equilibrium is difficult. Because they usually consider reaction quotient and equilibrium constant are the same. However, reaction

quotient can be gained at any point in the reaction but equilibrium constant can obtained at equilibrium point only where the rate of forward and backward reaction are balanced. Due to these misconceptions in equilibrium students failed not only calculate equilibrium constant but also memories the formula. One teacher said that about calculations, students are unable to calculate and understand them therefore they always do poorly when answering questions on reaction quotient (Q_C) and equilibrium constant (Kc). Hence they failed their examinations. One teacher also wrote that students have difficulties in identifying the forward and the backward reactions. They assume that at equilibrium the forward reaction is greater than the backward reaction.

Chemical Bonding

Most of the student respondents confirmed that most of the terms related to chemical bonding is abstract to understand. As nine of the respondent students confirmed they are unable to differentiate metallic, covalent and ionic bonding. They also failed to differentiate between intramolecular (metallic, covalent and ionic bonding) and intermolecular forces like hydrogen bond, dipole-dipole and dispersion forces. Three of the teacher's respondent cited that students have poor knowledge in the concept of hybridization orbital like SP^1, Sp^2, and Sp^3 which are the bases of chemical bonding. They do not recognize the importance of sp1, Sp2 and Sp3 in determining single, double and triple bonds respectively. The other teacher confirmed that students failed to understand the concepts of chemical bonding because they do have poor knowledge in valence electrons and how atoms share electrons.

Chemical Kinetics

Ten of the interviewed students responded that they found learning chemical kinetics be the most difficult topic among chemistry lessons. According to these students response they develop no interest in learning these lesson because of the complex nature of calculating chemical kinetics. Both on researcher own personal experience and two of the respondent teachers, most of students assumed that learning about chemical kinetics is difficult. Because they usually consider rate constant is the same in all orders of reactions like zero, first, second, and third order of reactions. Due to these reasons students failed not only calculate rate constant but also rate of forward and backward reaction. As indicated by one teacher respondent reaction mechanisms are the most difficult topic for students because of the fact that they do not understand the nature of reaction factors such as concentrations, temperature and pressure.

Thermodynamics

When students are asked to state how they could understand the concepts of thermodynamics, eight of them responded that they failed to understand the concept of thermodynamics starting the definitions of terms like work, heat, specific heat, specific heat capacity, system, state and path function, surrounding etc. According to them these words are very difficult to differentiate them. One teacher observed that students had difficulty in understanding and differentiating chemistry terms such as heat with work, specific heat with heat capacity and on the system with by the system.

Colligative Properties

Most of respondents of students put the difficulties of calculation about colligative properties. They said that it is very difficult to remember and differentiate the formula of colligative properties with concentration parameters like mole fractions, molalities and molarities. On this topic one teacher said that students do not write the formula of vapor pressure lowering, boiling point elevation, freezing point depression and osmotic pressure during examination questions.

2. Question 3 what do you think causes of learning difficulties you have mentioned?

Most of respondent students and teachers are mentioned and expressed the following causes' in learning chemistry.

Absences of Laboratory Work

All the students participated in the study were cited about the absence of laboratory when learning chemistry. They said that chemistry topics need experiments to understand them, when we are taught without experimenting or putting in practice. Most of students revealed that absence of experiment made some topics difficult to learn. This factor was also supported by three teachers who said that practical activities were not often conducted due to the absence of laboratory class, apparatus and chemicals in our school. They said that the major cause of common difficulties in learning chemistry among others are practical activities which are not conducted often due to the fact that absence of laboratory class, chemicals, apparatus and laboratory technician in the school.

Lack of Remedial Actions by teachers

Three respondent students said that we usually fail examinations due to inappropriate flow instructions. These gaps will continue without being corrected because the teachers did not take any remedial actions to fill the gaps of slow learner students. According them, most teachers are dominated by few fast learner students leaving the slow and middle learners aside. This idea is admitted by two of the respondent teachers. The other two teachers responded that we created a chance for students to help one another in their group.

Inadequate Explanations from the Teachers

Four students revealed that some teachers did not explain fully and they thought roughly difficult chemistry contents. Chemistry is a difficult subject which requires specific chemistry trained teachers. Because chemistry subject needs more explanations about concepts of facts, laws and rules. They usually spend most of their chemistry periods telling stories, giving guidelines to students instead of teaching these concepts.

Wide Chemistry Syllabus

All the respondent teachers admitted that they do not properly cover the intended syllabus since the period allotted for the course and the intended topics to be covered do not match.

Lack of Motivation and Language Skills

Most of students were reported to be lacking motivation to read on their own and described by two teachers as having language problems, and also they failed in examinations. One teacher said that the most serious thing is instruction of English, because most of students when we speak them don't understand. Two teachers exposed that English language made them feel uncomfortable and that they failed to express themselves in language clearly and could not participate fully in a class. This factor was also supported by one teacher who stated that most students have poor English background.

Lack of Teaching and Learning Aids

Lack of textbooks and other materials was a common complain among the students who were interviewed. Two of students also complained that even one textbook is shared among five students due to inappropriate ratio of students and text books in the school. Five of the student's interviewed also complained only few and outdated supportive books are available in the school. Unfortunately, the school was failing due to big student numbers. Three students wrote that common difficulties in learning chemistry were due to lack of proper learning materials in school.

Two students wrote that students had negative attitude towards chemistry. They failed to understand questions because they were not well prepared as a result students found them difficult to answer questions.

Lack of Mathematical Skills

Most of students expressed experiencing problems with calculations on colligative properties (vapor pressure lowering, boiling point elevation, freezing point depression and osmotic pressure) and rate law. They said that our teacher does not teach us how to calculate problems; as a result we failed calculation examinations.

Heavy Teaching Loads

Two teachers cited heavy teaching loads is a contributing factor of learning difficulties. They wrote that heavy teaching loads are tedious and prevents us from working harder like organizing special lessons for slow learners and offering individual help to those in need and in big and overcrowded classes, supervision during lessons and tests becomes very difficult.

3. Question 4 what measures do you think should be employed to minimize learning difficulties which you experience chemistry?

Participants cited a number of measures which they thought could help improve students' learning in chemistry as follows.

Teaching and Learning Aids

Most of students indicated that books must be made available in school; they put it as we must be provided with adequate books because chemistry is a very wide subject that requires us to use our time studying something that we haven't covered with our teachers. One cited that the government should to provide more learning materials and he put it as the school together with the government must provide more learning materials especially books. This suggestion was also provided by two teachers who said that in order to overcome common difficulties of learning chemistry, we must make sure that learners at any level are able to acquire good chemistry background by improving learning facilities and providing all the necessary learning materials and equipment to enhance learning.

Provision of Experimental Work

Three students observed that learning of chemistry could be improved by showing students how to carry out experiments because they usually appear during the final examination and teachers should find time to go through some chemistry terms and concepts. Students should emphasis to put on observation and conclusion, for example on conductivity and non- conductivity to be emphasized as well as their interpretations in respective practical work. Four students observed that students should also be serious and they should love the subject as well as the teachers and they should do experimental activities on their own. One teacher advised that chemicals should be made from locally available materials by teachers and students and should be bought in amounts that will be adequate in order to enable students carry out practical works.

Improvement in Assessment

Most of students advised that tests should be given at the end of each topic and those students should have read different books. The test should have practical activities at each end of the term tests, because we become ignore on answering practical activities during examination questions. Students should at least be told the topics that they are going to cover the coming term in order to prepare and research adequately on those topics. One teacher wanted students to be motivated when learning chemistry; he put it as students need to be encouraged and motivated when learning chemistry. In order to encourage learners to do their homework and assignments, teachers should mark the homework or the assignment regularly and talk to parents to encourage their children to do their work.

Teaching of Challenging Topic

Most of students wanted teachers to concentrate on teaching topics perceived to be difficult, they put it as advocate the teachers to teach on vital topics that are mainly brought in the examinations. We should be given a task at every chemistry period to make us revise. Teachers to give encouragement to the students concerning the subject and they advise students to study chemistry subject widely.

Use of Proper English Language by Teachers

Most of students wrote that teachers should use simple English when preparing questions so that students could understand clearly. They added that if possible they should be teaching us in our local languages. One teacher on the use of English language wrote that it is not only the obligation of the English language teachers to teach English to learners, the other teachers have

equally the same duties to explain the meaning of the wordings in their respective subjects as words could have different meaning in each subject.

Avoid Hiding Information

Seven students held the same view that teachers should avoid hiding information when teaching chemical bonding and chemical equilibrium that they must be teaching more materials from past examination papers. Three students suggested that teachers should be positive and encouraging when teaching chemistry. One teacher emphasized the need to consider fast and slow learners he put it as passing of lessons should take into account the different rates at which students learn, i.e. fast or slow. The teacher should also use appropriate teaching strategies matching with the outcome students intend to attain. The teacher should use teaching aids when dealing with abstract concepts. Two teachers admitted that more time should be allocated to topics perceived to be difficult.

Provision of Qualified Teachers

As ten students cited that, chemistry teachers in the school must be increased to provide for all the students in school and also improve the interaction between teachers and students. The number of periods allocated each week should be increased as it is very difficult to finish the syllabus at our school.

DISCUSSIONS

The study set out to investigate the nature and causes of common difficulties experienced by abstract nature of chemistry concepts. This is line with [19]. Some of chemistry concepts complained by both students and teachers were chemical bonding, chemical kinetics, chemical equilibrium, colligative properties and thermodynamics. The abstract nature of chemical bonding was also supported by previous studies [20]. However, both students and teachers confirmed that students in our school has problems in understanding the concept of valence electrons, atomic models, hybridization orbital's which are the bases for understanding chemical bonding. It is confirmed that our students hate chemical equilibrium because they consider equilibrium constant and reaction quotient are similar. This is supported by [21]. Our students were unable to differentiate the basic terms of thermodynamics like heat, specific heat, specific heat capacity. The difficulty of thermodynamics due to the physical and mathematical nature instead of chemistry nature was complained by the students and teachers. This is linked with [22].

Based on participants (students and teachers) the common causes of learning difficulties in learning chemistry faced by our students include: absence of laboratory works that support the theoretical lesson, absence of teaching and learning resources, poor teaching and learning strategies, large class size, over loaded teachers, wide chemistry syllabus, poor English and Mathematical skills. Because most respondent teachers and students said that teachers' capacity, ineffective teaching methods, scarcity of human and material resources are the causes of learning difficulties in chemistry lessons and achievement of students. This is similar with [23]. Similarly lack of experimental works, reference books, representation of materials in textbooks, are the other causes of learning chemistry.

In general, when we consider the teaching and learning process in chemistry in our school, is dominated by teachers. Teachers are considered as the only dispenser of knowledge which is in contrary to the education and training policy [24]. However, due to wide chemistry syllabus which cannot be covered on time, lack of text books, poor English and mathematical skills developed by our students most of the teaching and learning process in chemistry is largely dependent on the teachers. Though the instructional language of preparatory school chemistry is English, most teachers and students use Amharic but examinations are prepared in English. Poor mathematical skills to drive chemical formulas and absence of after-school support program slow learner students is also the other teaching learning process that bring difficulty in learning chemistry. Large class size and overloaded teachers were also complained to bring difficulty in learning chemistry in our school. This idea is supported with [25].

Lack of motivation by teachers and lack of willingness by students to be fully engaged in chemistry lessons are also reported to negatively affect teaching and learning in chemistry. This is in part due to large class size and student's poor background in chemistry, most of our students and teachers perceived that common difficulties tend to exhibit a performance orientation to teaching and learning process, where by learners are viewed as need of motivation in order to learn and instead of viewing the teaching and learning process as a motivational strategy itself. In this area questions such as efficiency of administrative support, the type and influence of leadership, class size and the teacher student ratio and the administrative structure of the chemistry department needs to be considered. It is advisable that in order that different factors work in agreement to bring about maximum learning, there must be a good organization of staff, students, finances etc.

CONCLUSIONS AND RECOMMENDATIONS

Through the assessment of student's responses on common difficulties they experience in learning chemistry and the views of chemistry teachers on these difficulties, the following were the major findings from the survey conducted.

- ❖ The study revealed that some chemistry concepts like chemical equilibrium, chemical bonding, chemical kinetics, thermodynamics and colligative properties are difficult.
- ❖ Most of chemistry teachers are unable to briefly explain the difficult concepts of chemistry because of inadequate knowledge of the subject matter and shortage of time to cover the syllabus.
- ❖ The main factors that are contributed for the learning difficulties in chemistry faced by our students include: absence of equipped laboratories and practical work that support the theoretical lesson, absence of teaching and learning resources, poor teaching and learning strategies etc.
- ❖ There is a need to equip the school laboratories with appropriate chemicals, equipment and there is a need to support the theoretical lessons with practical activities.

Based on the findings of the present study the following recommendations were made:

- Chemistry teachers should give more emphasis on difficult topics and assess whether students have understood laws, principles, and facts of chemistry lessons.
- They should use visual aids like models, locally available materials and power-point presentations.
- The school administrators should create a chance of experience sharing among teachers in the school for example chemistry teachers with mathematics and English teachers so that they could have better Mathematical and English skills which are tools for chemistry lessons.
- The department head of chemistry should develop a means of experience sharing among chemistry teachers so that they could have similar understanding of the difficult topics of chemistry indicated above and devise better common teaching and learning strategies for these lessons.
- The Education offices at the district level and other stakeholders should try their best laboratories with appropriate chemicals, apparatuses and human resources.
- There is also a need to capacitate chemistry teachers using additional on-job and long trainings.

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APPENDIXES

A. Interview questions for Grade Twelve Students

1 Which topics do you find difficult to learn in grade 11and 12 Chemistry texts? List them?
2 What difficulties do you experience when learning Chemistry?
3 What do you think causes of learning difficulties you have mentioned?
4 What measures do you think should be employed to minimize the learning difficulties which you experience chemistry?

B. Questionnaire for Grade Twelve Students

1. Which topics do you find difficult to learn in grade 11and 12 Chemistry texts? List them?
2. What common difficulties do you experience when learning Chemistry? ----------
3. What do you think has caused these common difficulties in Chemistry? ----------
4. What do you think should be done to overcome these difficulties? ----------

C. Interview questions for Chemistry Teachers

1. What do you think are the difficulties your students experience in learning Chemistry?
2. What common difficulties do you experience when teaching Chemistry?
3. What do you think causes learning difficulties which your students experience in Chemistry?
4. What do you think should be done to minimize the learning difficulties your students experience in chemistry?

D. Questionnaire for Chemistry Teachers

1. What do you consider to be your students learning difficulties in Chemistry? ----------
2. What do you think causes these learning difficulties? ----------
3. What do you think should be done to overcome these learning difficulties? ----------