THE IMPACT OF CONTEXT BASED ACTIVITIES ON THE CONCEPT OF CHEMICAL EQUILIBRIUM ON GRADE 11 STUDENTS' ACHIEVEMENT AND ATTITUDE: THE CASE OF BORENA PREPARATORY SCHOOL

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The Impact of Context Based Activities on the Concept of Chemical Equilibrium on Grade 11 Students' Achievement and Attitude: The Case of Borena Preparatory School

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I hereby certify that I have read and evaluated this thesis entitled (the Impact of Context Based Activities on the Concept of Chemical Equilibrium on Grade 11 Students' Achievement and Attitude: The Case of Borena Preparatory School) prepared under my guidance by Moges Ababu. I recommend that it will be submitted as fulfilling the requirement.

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STATEMENT OF THE AUTHOR

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DEDICATION

This thesis is dedicated to my wife Altayework Birhanu, for her endlessness support in my work.

ABBREVIATIONS AND ACRONYMS

ACs	Alternative Conceptions
BPS	Borena Preparatory School
CBA	Context Cased Activities
CEAT	Chemical Equilibrium Achievement Test
CE	Chemical equilibrium
WQ	Written Questionnaire
5E	Engagement, Exploration, Explanation, Elaboration, Evaluation
ICBA	Instructed Context Based Activities
TDCI	Traditional Design Chemistry Instruction
2TMC	Two Tier Multiple Choice
3TMC	Three Tier Multiple Choice

BIOGRAPHICAL SKETCH

The author was born on 1^{st} of March 1973E.C in South Wollo Zone, Borena Woreda in Amhara Regional State. He had attended and completed his primary and secondary education at Borena Junior Primary and Borena Senior Secondary school respectively, since 1980 to 1992 in E.C. Then he joined Dessie teacher training college in 1993E.C. and graduated with diploma in 1994E.C and had been worked in Borena woreda one of the primary school, then joined Wollo University in 2000E.C. and graduated with bachelor of education degree in chemistry in 2003E.C.

He has been working as chemistry teacher in Borena preparatory school since the year 2004 E.C and then he came to Haramaya University in 2007 E.C to pursue his study in chemistry for Master of Science.

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ABSTRACT

This study aimed to determine the impact of context-based activities in teaching Grade 11 students' achievement and attitude on the concept of chemical equilibrium as compared to the usual teaching approach. A quasi-experimental research design was used. The study group consisted of 91 students in eleventh grade at a public school (47 for the experimental and 44 for the control group). Chemical equilibrium achievement test (CEAT) and written questionnaire (WQ) were used for quantitative data collection (as a per- and post-test). The researcher used a convenience sampling technique to select sample students from the targeted school. Also, he employed systematic observation and interviews to collect insight data from the participants of the study about the approach. Both quantitative and qualitative data analysis techniques revealed that experimental group students have a positive attitude towards CBA instructional method and have good achievement. These showed that CBA provided genuine applications of chemistry topics, formed relations between chemistry and daily life, concretized chemistry concepts, made concepts highly memorable, and learning enjoyable in the courses. In summary and results showed that CBA, compared to traditional instruction, enabled students to learn chemical equilibrium concepts more effectively.

Keywords: Chemical equilibrium, context based activities, achievement test and alternative conception.

1. INTRODUCTION

1.1 Background of the Study

Chemical equilibrium is one of the basic topics in chemistry given to high school students and it is very important to understand basic chemistry concepts. Due to this Berquist and Hekkinen (1990) stated that "yet equilibrium is fundamental to students to understand other chemical topics such as acid and base, redox reactions, and solubility. Mastery of equilibrium facilitates the mastery of those other chemical concepts". The above literature indicated one important point to learn chemistry is the development of science, industry, and technology. Ceyhan (2008) stated that all-natural processes both within and outside human beings are governed by chemical reactions, people in the industrialized world enjoy not only the highest standard of living that is the material comforts which are measured by the goods, services, and luxuries available to an individual, but also quality life. Major concepts being looked at in chemical equilibrium are: open and closed system, reversible reactions, dynamic equilibrium, LeChatelier's principle with application to changes in concentration, pressure, and temperature, the effect of a catalyst on equilibrium, homogenous and heterogeneous equilibrium, the equilibrium constant, Kc (DoE, 2009).

In spite of the importance of chemical equilibrium to the improvement of life and technology, students showed a negative attitude to the concepts and this is associated with poor performance (Olajengbesi and Aluko, 2008). When chemical equilibrium has been connected in course of study, it is usually assumed that students understand this representational way. However, Johnston (2000) investigated a new approach for learning and teaching chemistry that needs to include three basic domains: (1) macro chemistry, chemistry which is experienced at the tangible, visible, and sensory level, (2) sub microchemistry, which explains macro-chemistry at the atomic and molecular level with the kinetic perspective and (3) representational chemistry this includes: symbols, equations, stoichiometry, and formulas. Researchers on the transition between submicroscopic to symbolic and symbolic to macroscopic improving educational equality require designing strategies which can be used to facilitate the teaching and learning of chemistry to make it more attractive to students and facilitating educational quality requires, at least, placing learners in active rather than passive roles (Moore, 1989). Researchers and science educators have been proposed several strategies to facilitate the learning and teaching of chemical equilibrium (Doymus, 2008). Some of them in teaching chemical equilibrium educators used: Conceptual change, T-in-ZPD, constructivist approach, and context-based activities were used.

The context-based activities approach aims to increase the interest and motivation of students in learning chemical equilibrium topics by presenting scientific concepts as daily issues (Barker and Millar, 1999; 2000). It emphasizes the creations of a need to know for students' understanding of scientific concepts in order to understand the features of a context about the subject matter (Pilot & Bulte, 2006). Therefore, this approach may help increase students' interest in learning. In context-based teaching, using context to increase students' need to know, creating everyday life situations, and doing in class activities play a great role in the learning process. The meaning of context designing context-based learning has extensively been discussed by (Gilbert, 2006). These discussions about context are appropriate to the context, learning simulation, frame for situated development, and application of knowledge and competencies. Villolino (2009) explained the term context-based activities learning as an educational strategy that focuses on enabling students to acquire meaningful learning in their education. This method help students connect knowing with doing (application). So, connecting the content with context has almost become a slogan for context-based which constructs the main framework for recent curriculum innovations (Ceyhan, 2008). The way to accomplish such learning can be done by using contexts aroused from daily life activities such as: analogies, puzzling, and simulation. The usage of natural and technical phenomena as context can be enriched with relevant questions and discussions which students engage in and hoped to be more motivated to deal with these activities. A great deal of research on CBA focused on the positive influence of context-based instruction on students' interest, motivation, attitude, problem-solving, understanding, and achievement (Millar, 2000). Therefore, the researcher suggested that context-based instruction has the possibility of enhancing students' achievement provided that an appropriate context was used.

1.2 Statement of the Problem

Many researchers indicated that Chemistry is one of the mainstays of science, technology, and industry. It contributes much to our quality of life. That is why it should be taught comprehensively and coherently. But during the teaching and learning process, students faced misconceptions about some chemistry topics. Especially, in chemical equilibrium, there were identified different alternative conceptions (Adesoji and Babatunde, 2008, Johnstone, 2000). Due to the presence of those misconceptions, educators do not have to normalize those misconceptions but their sources have to be identified and possible methods of intervention put in place in order not to normalize the abnormal that is not to justify the misconception. There is an extensive literature in science education about the incorrect scientific understanding of students which focus on their identification and classification of students' misconceptions (Villolino, 2009).

Moreover, researchers studied in which students' alternative conceptions are described over a wide range of chemistry subject areas and identified the key concepts in chemistry as being the "chemical substance" and the "chemical reaction"(Barker and Millar, Harrison and Treagust, Dias and Pedrosa, Taber and Watts, 2000; Taber, 2002). However, students were unable to provide correct reasons even if students have been found to provide correct answers to questions on chemical equilibrium. So, different researchers claimed that high school chemistry students' concepts of equilibrium reactions were influenced by their prior knowledge of reactions that comes to completion.

In Ethiopia University students' knowledge gaps in science courses specifically on year four chemistry students (Temechegn Engida, 2008). Moreover, Girma (2013) conducted research on the diagnosis of grade 12 students' alternative conceptions of chemical equilibrium using a four-tier diagnostic instrument, and the result accentuated that students have ACs: on the rate of forwarding reaction which increases with time until equilibrium is established and the reverse reaction rate is the same as the forward rate, on the relationship between the concentration of reactants and products such as [reactants] = [products] at equilibrium, and understanding dynamic nature of equilibrium.

Furthermore, based on his experience of teaching and personal observation in the target school, the researcher understood that the sample students did not understand chemical equilibrium concepts and were not active participants in the teaching and learning process. Equilibrium is seen as the firmly held concept of a static two-sided picture, students have difficulties in understanding the concentration of reactants and products, and students have difficulties in understanding the principle of Lechetilier's, have difficulties in distinguishing between reversibility and completion. A number of researchers in the field of chemistry education suggested different active learning strategies including CBA to minimize such gaps. Therefore, the aim of this research was to evaluate the impact of context-based activities in teaching the concept of chemical equilibrium in Grade 11 Students' achievement and attitude. The following questions have been raised to serve as guidelines in carrying out this study. These were:

- Does context based activities improve grade 11 students' achievement on the concepts of chemical equilibrium or not?
- What are the attitudes of students' towards this approach and chemical equilibrium concepts?

1.3. Objectives of the Study

1.3.1. General Objective

- The main objective of this study was to evaluate the impact of context based activities in teaching the concept of chemical equilibrium in Grade 11 Students' achievement and attitude.

1.3.2. Specific Objectives

The specific objectives of this study were:

- To evaluate whether context based activities in teaching the concept of chemical equilibrium improve grade 11 students' achievement or not.
- To assess students attitude towards this approach.

1.4. Significance of the Study

This study has the following purpose:

- It helps teachers to understand students' attitude towards chemistry.
- It contributes to educators use as literature in dealing with the assessment of students understanding about chemical equilibrium.
- It gives feedbacks for textbook editors and policy reviewers.
- It reduces the gaps in learning that may enhance the prevalence and strength of Students' alternative conceptions.

1.5. Scope of the Study

This research is delimited to study the impact of context based activities in learning the concept of chemical equilibrium in grade 11 students' achievement and attitude at Borena preparatory School; which is found at Mekaneselam Administrative Town, in South Wollo Zone of Amhara Regional State. It would be better if the research covers all governmental schools found in the town; however, the study is delimited to Borena preparatory School, grade 11 in particular. This is because the researcher observed the problems while his stays in the school. Other schools are not included and the finding of the study might not be applicable to the rest of the schools

1.6. Limitation of the Study

This study would have the following drawbacks

- ✓ Some of the students could not understand the activities. Due to this students would get some ACs.
- ✓ It would difficult to select adequate contexts for incorporating in students courses.
- ✓ It would too complicate for students to help them to make proper links with the concepts.
- ✓ There would have diffusion between the two groups.

1.7. Definitions of Terms

Activities: includes simulation, analogue and puzzling.

Simulation: imitation of the operation of a real world process or system over time: an object oriented model represents reality.

Analogue: relating to or using information represented by a continuously variable physical quantity.

Puzzling: causing one to be puzzled or perplexing.

Contextual: depending on or relating to the circumstances that form the setting for an event, statement, or idea and in terms of which it can be fully understood. This is in teaching Chemical Equilibrium using context (Apple fighting 'As Puzzling', pouring of Water, throwing of Coins and mixing of extra Sodium Chloride Salt in Saturated Salt Solutions)

2. REVIEW OF LITERATURE

2.1. Misconceptions

Misconception / alternative conception/ is the concept of students that is incompatible with the concepts of the expert (Clement, 1989).Misconception also called inconsistency in comprehension between students and experts Lonne, *et.al*. (2013). In addition, misconception (alternative) conception is an inconsistency in student's concept with scientific concept. As a result, long life alternative conceptions occur before instruction take place. Recently, science educators have focused their attention on how students learn and the factors which influence their learning. Learning is the interaction between what the student is taught and current ideas. Clark and Peterson (1986) stated that, "there is inverse relationship between teacher thought and teacher's performing. A teacher's thought includes teachers' theories and believes planning and interaction thoughts and decisions, while teacher action and its observable effect include teacher's classroom behavior and students' behavior and achievement.

Misconception can be classified in to two classes: experiential and instructional. The experiential ACs is also divided as alternative, intuitive, or native conceptions. Example, of experiential ACs occurs in connection with the phenomena: motion, energy, and gravity. Generally speaking, the possible source of students' misconceptions are (1) teachers' lack of interest in students understanding; (2) the use of everyday languages and metaphors; (3) different meanings between chemistry terminologies and everyday languages and (4) unclear and over simplicity representations in text books (Herron, 1996).

According to Heron (1996) some students, despite being perfect, kind and considerate, hardworking and anxious to learn do not learn and instead memorize. Learning the concept of chemistry may not be easy to comprehend students had considerate difficulty in solving conceptual problems and it appears that the experience gained in solving algorithmic problems is of limited help in solving conceptual problems (Niaz, and Chac'on, 2003). Furthermore, Temechegn (2008) pointed out that, if we consider that learning is enhanced when students are engaged in the processing of information, then teachers' responsibility is to find creative ways to design dynamic learning environments that involve students in doing and thinking about chemistry. In addition to this, all learners can learn more effectively when taught through experiences that engage multiple ways to remember their learning. For student one of the different skills that make his/her academically competent is his/her strategy in improving memory (Takele and Mekonen, 2008).chemical symbol and describe events seen in the laboratory. If teachers set up a problem involving moles, students get the answer but they do not understand what teacher is doing when teachers translate a chemical equation in to a mathematical statement because teachers introduce concepts, and subjects that are tied together in the students mind but fail to promote knowledge about how they are connected with each other (Steward, 1979). This encourages students to memorize words and use algorithms to solve numerical problems without completely understanding the underlying scientific concept. Why do students fail to learn what they are taught is they construct their own ideas about the natural world before they even go to school (Swell, 2002).

Some times their initial ideas are in line with the scientific community and what is taught in school. However, in many instance, there Is a big difference between the students' ideas and is scientifically accurate (Wood-Rubinson, 1999, Driver, Squire and Rush worth, 1994). Therefore these initial ideas play a significant role in learning. The teacher has to take such misconceptions in to account when they design lessons in order for meaningful learning to occur. Ausuble (1978), after he has made the very important distinction between traditional learning and meaningful learning, he stated that meaningful learning requires three conditions (1) the material to be learned must be conceptually clear and presented with language and examples which can be related to the learner's prior knowledge. (2) The learner must pass relevant prior knowledge (3) the learner must choose to learn meaningfully. A number of researchers have reported that students hold alternate conceptions concerning the particular nature of matter (PNM) (Abraham and Williamson, 1995). These alternate conceptions of the PNM conflict with the theoretical particulate explanations that are given by chemists for most experimental chemistry data.

Johnston (1993) described three components of chemistry: the macroscopic, submicroscopic, and symbolic levels. Conceptual understanding of chemistry often involves understanding particulate behavior; another body of research has identified a gap between students ability to respond to logarithmic versus conceptual question (Sanger, 2000). According to Johnston

(1993), our level of knowledge is dependent up on our ability to construct mental models from our conceptual frameworks, which we can use to reason. Jones & Simith (1999) described difference between the mental model of experts usually include both sensory, macroscopic data from the physical world and formal abstract dimensions of the phenomena, while novices usually have in complete or in accurate models. From the above explanation, Hebbal (2009) reported that, "It has now been realized that teaching is not telling, memorizing is not learning, and reproducing something in the examination is not an evidence of understanding." Many studies deal with students' conceptions different from those accepted as correct by expert. Scientists have given several names to these alternative views including "alternative framework" (Driver and Easley, 1978) and "misconception" (Griffiths and Preston, 1992). Researchers have been using the term misconceptions for most of those alternative conceptions that result from life experience, prior knowledge, and instructional misconceptions arrived at through the process of instruction. As a result, long life alternative conceptions occur before instruction take place. They result from a logical interaction of students sensory data, its inherit limitations. They are resistant to change. Students may acquire instructional alternative concepts through either formal or informal instruction. Studies related to misconceptions in chemistry have increased since 1980s. One of the most interesting result revealed from these studies is almost all students have similar misconceptions. Determination of student's misconception is very important to plan the teaching strategies and methods to be used by teacher.

2.2. Nature of Chemical Equilibrium as a School Topic

Chemical equilibrium is integrated with several other content topics in chemistry. Chemical equilibrium is a concept which is covered in different topics of chemistry at all level of education, secondary, college and university level. At the education band there are several topics in secondary education besides being indicated as topics (DOE, 2003). At grade 9&10 mention of the concept equilibrium is made whilst teaching these topics. Ochonogor (1999) indicated some of the topic involving chemical equilibrium concepts as dynamic equilibrium, variables factors affecting equilibrium. Different aspects are treated at different levels although without much detail being given. At times the elements of equilibrium do not come out clearly and no mention is made especially at grade 9&10. Quilez (2007) summarizes all concepts to chemical equilibrium in to: incomplete reaction, reversibility reaction, dynamics of reaction and equilibrium constant. This summary is short and comprehensive at it tried to cover the basic concepts included in the definition of chemical equilibrium. According to Jones (2007) and White (2008) in the learners' text book refer to equilibrium as covered through the basic concepts at grade 11: open and closed system, reversible reactions, changing conditions: LeCharteliers' principles, homogenous and heterogeneous equilibrium, equilibrium constant (k_c) and chemical equilibrium and industry. Also, electro chemical reactions and chemical system include concepts on chemical equilibrium. As guided by the curriculum requirements, almost all aspects are covered as illustrated by (Quilez, 2007). The main problems with most of the learners' text books in their failure to explain some basic chemistry concepts like 'a system' and its constituents, shift, constant, reaction quotient and many more yet these are very important when explaining equilibrium.

From them the key difficulty faced by students was "the incoherence and incompleteness of all chemistry curricula studied." They called for a "chemistry curriculum that will lead students on a quest for the hidden factors that determine chemical change and the creation of new substances." Nakhleh (1992) identified the central misconception of chemistry as being that matter is a continuous medium which is static and space filling. Thus, teaching chemistry should stress on developing habit of study throughout the life of a person. However, there are challenges from different angles in learning chemistry. Different findings related that in learning different topic of chemistry, learner face different conceptual understanding problems, one of these being chemical equilibrium (Sirhan, 2007).one of the most common problems related chemical equilibrium learning: (1) students approach chemical equilibrium from their experience with mechanical equilibrium; (2) traditional teaching uses physical analogies that may contribute to creating static idea of the equilbria; (3) the concept of reversibility with the physical movement induce to achieve equilibrium when everything is equal; and (4) the way to represent equilibrium with the double arrow separating the two sides of the equation may induce students to interprets the balance as two separate system that evolve one to another (Gacia and Moreira, 2014).

2.3. Basic Misconceptions of Chemical Equilibrium

Chemical equilibrium is a difficult concept to understand for both teachers and students partly because of its abstract nature (Quiliz-pordo and Solaz-portoles, 1995). Students may come to the classroom with some misconceptions towards the instructional subject to be taught. But, traditional text books and instructional tools are not important in removing these alternative conceptions because simply presenting materials, giving out problems and accepting answers back is not an efficient way of meaningful learning and teaching. The concept of “chemical equilibrium” includes a label that is known to students attending chemistry classes and for which they have preconception stem from the label “equilibrium” being used in physics as well as in some everyday life balancing situations such as circus acrobatic, bicycle riding, or weighing balance. The label “equilibrium” acquired attributes of equality in general, equality of two sides, stability and static nature become associated with the concept of equilibrium. However, these attributes of chemical equilibrium are the very ones that actually differentiate between physical and chemical equilibrium.

Phenomena that reach chemical equilibrium appear naturally and macroscopically as stable and static systems. On the other hand, on the microscopic level the system is dynamic not only because of molecular movement but also because the processes of breaking and creating bonds go on with the net result of zero. Attributing microscopic qualities to the microscopic level leads to misconceptions in the understanding of the concept. Example, “equilibrium” synonymously with the chemical meaning as static rather than dynamic.in the second case prior knowledge, language and cognitive development can be the cause of alternative conception related to strategic process. Student’s prior knowledge is the most important variable in success in learning chemistry. If learners’ prior knowledge is not enough to process new knowledge, they will become disturbed, reason inaccurately, and eventually form an alternative conception. Therefore teachers need to take in to account students prior knowledge before instruction takes place.

Another cause of alternative conceptions is instructional process in students’ cognitive development. If teacher’s use information which is already organized, they are attempting to transmit set of ideas. However, the students have not yet created an organization for themselves and can’t receive the information. So, different researchers claimed that, high school chemistry students’ concepts of equilibrium reactions were influenced by their prior knowledge of reactions that comes to completion.

Chemical equilibrium is listed under the most complicated concepts to learn, and the origin of this phenomenon is attributed to misconceptions, teaching related problems, and the use of in appropriate didactic approaches. To achieve meaningful learning, the students must have some relevant prior knowledge to which the new information can be related in a non-arbitrary manner; the student must consciously choose to non-arbitrarily in corporate this meaningful material in to his/ her existing knowledge; and the material to be learnt must be meaningful. However, the students have not yet created an organization for themselves and can’t receive the information intact. On this point, teachers need to consider students cognitive development and whether students have understood the concepts or not before doing many problem solving activities. Therefore, teachers ‘need to develop ways to promote students’ conceptual understanding and to facilitate learning rather than to control it. There are different methods available to identify students’ misconceptions. The most common instrument used to studies context based activities includes multiple choice, open ended question, and interview. Interview with pictorial or concrete models to elicit their preferred models, problem presented.

2.3.1. Two-Tier Multiple Choice Tests

The weakness in multiple choice questions was addressed by this test (2TMC) test (Treagust and Duit, 2008). This becomes the most popular members of the family of multiple choice questions in alternative conceptions studies (Heikkenen and Voska 2000). A two tier multiple choice (2TMC) item includes content based alternatives in the first item (answer tier or A-tier); and relevant principles justifying the A-tier responses in the second tier (reason tier or R-tier).

2.3.2. Three- Tier Diagnostic Instrument

Confidence rating or confidence judgment refers to the appraisal and judgments by an individual regarding the quality of his/her own performance (Dolph and Stankov, 2000).

since the 1930s confidence rating have been include interesting predominantly in the field of psychology, to enhance the amount of information that can be obtained from objective tests. Several studies have shown the confidence rating relative to academic performance (Crawford and Stankov, 1997).it was only in 1989 that confidence rating was utilized in science education research.

2.4. Remedy on Context Based Activities for Minimizing Students' Misconceptions of Chemical Equilibrium

According to different authors, dealing with misconception is one of the hardest tasks in teaching chemistry. These misconceptions are resistance to change by traditional teaching methods because most of recent traditional teaching is focused on the content of the curriculum and on knowledge and information transmission. These misconceptions must be removed as soon as possible, before they create deeper roots in to child's cognitive structure. The construction and reconstruction of meanings by learner that they actively seek to integrate new knowledge, with knowledge already in their cognitive structure. Therefore, teachers play a great role in how students understand and learn the concepts taught in the class. For the teaching process, it is therefore important to take students developmental stages in to account according to (Bhīma- Chand *et al.*2013) are: Students existing discrepancies with in their own explanations, Inconsistencies between pre-concept and scientific conception, Discrepancies between preliminary and correct explanations of experimental phenomena, Possibilities of removing misconceptions, Possibilities of constructing acceptable and skilled explanations. One concept in chemistry that has been posing conceptualization difficulties is chemical equilibrium.

The reason for these difficulties is the complexity of the concept, which demands understanding of a large number of subordinate concepts and also abstract in nature (Quilez, 2009). Students attempt to understand this concept has resulted in construction of faulty mental models. According to Johnston (1993), a new approach for learning and teaching chemistry needs to include three basic domains (1) macro chemistry, chemistry which is experienced at the tangible, visible and sensory level, (2) sub micro chemistry, which explains macro-chemistry at the atomic and molecular level with the kinetic perspective, and

(3) representational chemistry which includes symbols, equations, stoichiometry, and mathematics. These three domains chemistry were represented as a triangle of chemical understanding. Literature about how students make transitions with Johnston's triangle is limited and extensively focused on the transition from macroscopic to sub microscopic levels.

The construction and reconstruction of meanings by learner that they actively seek to integrate new knowledge, with knowledge already in their cognitive structure. Therefore, teachers play a great role in how students understand and learn the concepts taught in the class. For the teaching process, it is therefore important to take students developmental stages in to account according to research on the transition between sub microscopic to symbolic and symbolic macroscopic (Johnston, 1993). Learner experience everyday phenomena with their senses, but chemical concepts are usually explained at the symbolic level in the classroom. Improving educational equality requires designing strategies which can be used to facilitate the teaching and learning of chemistry to make it more attractive to students and facilitating educational quality requires, at least, placing learners in active rather than passive roles (Moore, 1989). Researchers and science educators have been proposed several strategies to facilitate the learning and teaching of chemical equilibrium (Doymus, 2008).

2.4.1. Background and Theory Pertaining to Context Based Activities

To help students understand chemistry, researchers have suggested a variety of instructional approaches, such as adapting teaching strategies based on conceptual change model Krajcik *et al.*, (1988), integrating laboratory activities in to class instruction Takele and Mekonnen (2008), and using concrete models (Copolo and HounsheiL, 1995). In chemistry education however, learning methods are an important as teaching strategies, used a lot among the learning methods is context based activities. On the same constructivism theory (Piaget, 1969; Vygotsky, 1979; Cobb and Yackel, 1998) whose main hypothesis in that knowledge does not exist in an objective reality and is actively constructed from within by the learner.

Constructivism theory

This theory proposed that we learn, not simply by memorizing new facts and concepts, rather by assimilating that information in to a pre-existing framework of knowledge (Ausubel, 1978). In constructivism, knowledge should be actively constructed by the learner and influenced by prior knowledge. Constructivism views about learning have gained acceptance among educators as a viable from work for understanding, learning and developing models of effective teaching.

Constructivism learning views have been documented by the different researchers and educators. For example; Bloom (1993) defined constructivism as a receptive act that involves the context of their current knowledge, previous experience, and social environment. Learning is a social act that can't occur in isolation from others, even if they are not physically present. Constructivist theory has implications for the ways in which educators view learners. It acknowledges that learners come from a variety of cultural backgrounds, and passes a range of interests and styles of learning. These are respected and form the basis of curriculum planning and practice. A constructivist approach also encourages children and young people to see that various perspectives and point of view underpin knowledge.

2.4.2. Conceptual Reconstruction in Zone of Proximal Development (ZPD)

What if ZPD is "proximal" is next. From this perspective Vygotsky (1979) saw learning and development as either a single process or as independent process. Central of constructivist theory is that biological and cultural developments do not occur in isolation (Driscoll, 1994).In explaining the concept of ZPD (Vygotsky, 1979) stated that "it is the distance between the actual development level as determined by independent solving and the level of potential development as determined though problem solving under adult guidance or in collaboration with more capable peers" or "distance between what we know and our potential for knowing'(Galloway, 2001).Using the zone of proximal development to chemistry "the degree to which the child masters everyday concepts shows higher actual level of development, and the degree to which he has acquired chemistry concepts shows the ZP D" (Hedegoard, 1990).

Johnston's trigonal approach

According to Johnston(2000)**,** one of the most important approaches in science education is trigonal approach this showing the nature of chemistry its anatomy he stated that "chemistry exists in three forms which can be thought of as No one form is superior to another, but each one complements the other. Furthermore, "on the macro level, chemistry is what you do in the laboratory or in the kitchen or the hobby club. Is everyday experience situation which we are accustomed? but to be more fully understand ,has to move to the submicroscopic situation where the behavior of substances is integrated in terms of the molecular and some representational language and notion."

Barke and Engida's structural oriented Approach

They further explained the "phenomena": Investigating phenomena in nature or in the laboratory, showing substance and their properties, conducting experiments to show chemical reactions. Offering students' their own experience by doing laboratory exercises. "Structural Imagination" Taking structural models to show the structure of substance involved before and after reactions, offering students the opportunity to build their own experiences. "Chemical symbols" Deriving formulas from demonstrated or self –built models in order to give students the idea that formulas are shorthand forms of structural models. From this point of view these researchers conducting empirical research on spatial ability in different cultures. Then they recommended that structural image, might be a mediator between the macro phenomena and chemical symbols.

Mahaffy's Tetrahedral Approach

Mahaffy (2006) come up with different anatomy re-hybridizing the triangular approach of Johnston with the human element and formulated a three dimensional tetrahedral chemistry education approach. This 3D-tetrahedral chemistry approach has four vertices: Macroscopic, Molecular, Representational and human elements. Tetrahedral chemistry education emphasizes case studies, laboratory work, and problem solving strategy and matching pedagogical strategies to the learning styles of students. One of the most innovations of the tetrahedral approach is the inclusion of context.

Yitbarek's tetrahedral inZPD (T-ZPD)

After critical reviewing the major approaches Yitbarek's (2011) forwards certain question. Then, he proposed a more refined approach these approaches re-hybridizes further (tetrahedral chemistry education and zone of proximal development (ZPD), and they named 'tetrahedral- in-ZPG chemistry education approach. Using these approaches researcher identified fundamental knowledge: Content knowledge, Pedagogical (teaching and learning process in the context of ZPD and knowledge using motivation, Contextual knowledge Gauge students learning and Knowledge of integrated four components of learning.

2.4.3. Context Based Activities as a Learning Strategy

According to Nail et al. (2016) indicated that from his results of students' opinion he could conclude that context based activities enabled students to learn chemistry concepts better than existing instruction did. Also he investigated that teachers play a great role in actualizing context based learning. Particularly, teachers must be well informed to perform activities revolving around the relationship between chemistry topic and daily life. New research evidence showed that ability to construct and use context based activities may affects conceptualization about chemical concept (Ceyhan, 2008). This study incorporated this new aspect to study general chemistry students' thinking process about chemical equilibrium and related concept.by employing puzzling, simulation and analogies method design, this study revealed relationships among students fundamental knowledge and thinking with context based activities influenced students learning about chemical equilibrium.

Thinking with context based activities

Contextual learning is the process of teaching and learning method that focuses on the importance of context for incorporation of concept. Ingam (2003) stated that, although studies indicated how students learning were put in order by contextual learning activities schools go on with contemplating on fragmented instruction which it is not suitable to connect real world issues. This approach to teach science started in early 1970s and has become increasingly popular in current research area. Bennett and Lubben (2007) point out usage of context at the beginning of construction of scientific understanding in context based activities as a major development in science education. These activities based methods are expected to overcome students' misconception; connection concepts to the real world they live, associating scientific knowledge to social issues. Pilot and Bulte (2006) explain the context based activities as focusing an inquiry and relating the science. In addition to this, context as rising questions in students and making students to see the motive for extending their knowledge. Also mention such an instructional framework should incorporate in a need-to-know principle thus constructs students learning instructionally meaningful. In this study, context based activities (CBA) is preferred to use rather than others.

2.4.4. Methods Used to Investigate Learners' Context Based Activities

The way to accomplish such learning were done by using contexts aroused from daily life activities such as, puzzling, analogue, and simulation. The usage of natural and technical phenomena as context could enriched with relevant questions and discussions which students engage in and hoped to be more motivated to deal with these activities. These activities based methods were done to overcome the difficulties of students' misconceptions; connection concepts to the real world they live, associating scientific knowledge to social issues. Pilot and Bulte (2006) explain the context based activities as focusing an inquiry and relating the science. In addition to this, context as rising questions in students and making students to see the motive for extending their knowledge. Science learning often requires realignment in thinking and construction of new ideas that may conflict with earlier ideas (Fellows, 1994). These conflicting conditions in students mind caused conceptual classroom to be more difficult. Therefore, it was essential to develop the ways of improving conceptual understanding in order to provide meaningful learning. So, students' misconceptions were minimized using different simulation and home analogue that was the chemical equilibrium show effect of concentration on reactants and products. As an introduction, it might be helpful to show melting eqiulibria with different ice- water mixtures or solubility eqiulibria with different amount of solids. $H_2o(s) \leftrightarrow H_2o$ (l) the melting equilibrium did not depend on the amount of ice or water, but it existed in each ice-water mixture. If one heated the mixture, then a part of the ice melted. When the mixture was still stirred, the temperature of 0^0c stayed constant. In addition to this, the misconception regarding the amount of solid material in equilibrium and the dynamic aspect were equally important in discussion.

If learners observed a saturated salt solution together with solid salt and added an additional portion of solid salt to the solution, this portion sinked down without dissolving. If one measures the density of the saturated solution before and after the addition of salt portions, one got the same measurement.so, the concentration of the saturated solution did not depend on how much solid residue was presented. In the other case one could not saw constant reactions from saturated salt solution to solid salt and back. Two similar measuring Jars are prepared, 100ml of water were placed in one of the Jar, and the other one remained empty. Using the two glass tubes of equal diameter to transport water back and forth, water was continuously transported between the two Jars; after a certain exchanges, 50ml of water remains in each of the Jar. The water level did not change despite carrying constant volume of water back and forth. If similar experiment was done using two Jar would perhaps have the volume of 30ml and the other would have 70ml "in equilibrium". Let us saw context based approach according to Villalino (2009) described context based activities adopted in science teaching where context and applications of science were used as the development of scientific idea.

Throwing coin Simulations Aspect

The researcher wanted to teach the selected students accordingly. In macroscopic representation teacher used to show students direct purposeful experience. At the beginning 24 coins are presented in a person A and gave for person B. That is: first nine coins, six coins and four coins gave respectively, immediately person B returned three, two, and two coins respectively. Done these certain times the coins that forward and back were equal that will 6, 4, 2 and 6, 4 and 2. Now the movements of coins were equal. But the number of coins that were presented in each person was not exactly equal. From this the movement of coin showed the rate of the reactions and the numbers of coin in each person was concentrations. When we throw the coin continuously the rate was determined by number of coins that was 12 for each. 12coins ↔ 12coins this showed the rate of forward was equal to reverse rate but the number of coin that moved was not be equal.

3. METHODOLOGY

3.1. Description of Research Area

This study was conducted in Mekaneselam Adiminstrative Town, in South Wollo Zone of Amhara Regional State. It serves both students of town and surrounding rural areas. All of them speak Amharic language; similarly they have been learning their first cycle education in Amharic language. The school was established in 1973 E.C with its former name Borena Senior Secondary School (grade 9-12).

Now, in Mekaneselam Adiminstration Town there are two Secondary Schools both of them are governmental. The researcher was used convenience sampling technique for the selection of sample students, because he has been teaching in the target school and has acquaintance with the school community. This creates opportunities to gather data from the target popolation. Moreover, based on his experience as a teacher in the school, he has personally noticed low students participation in the class room task and usually score low results in chemical eqiulibrium concepts particularly in grade 11.

3.2 Research Design

The research followed quasi-experimental research design. Both quantitative and qualitative data collection tools were used in the study. The study was carried out according to “qausi-experimental research design” none-equivalent groups’ pre-test-post-test experimental and control group design was used (appendix-III). In public high school in 2019/2020 fall semester context based activities in chemical equilibrium was performed in the class to the experimental group students. When this study was performed, the control group students were covered the course (chemical equilibrium) with usual or traditional teaching approach, which was more teacher centered (i.e taking notes, solving problems and lecture methods). The researcher applied the chemical eqiulibrium achievement test (CEAT) to both groups as per-test at most one weeks before the instruction.During instruction each student in the experimenal group was assigned on aseries of learning tasks that include submission of the first context based activity on chemical equilibrium topics which was covered at the end of fourth week was given teacher-constructed chemical equilibrium achievement test of this topic that was taught up to the end of the treatment. In the same way, students in the control group were provided the same lesson with the same allowed period and during the whole treatment weeks with the exception of instruction.

Table 1 Research Design of the Study

Group	Pre- test	Implementation	Post-test
Experimental group BPS 11D (N=51)	CEAT	Context based activities methods	CEAT* Questionnaire Interview
Control group BPS 11E (N=51)	CEAT	Traditional instruction methods	CEAT*

*Indicated that well-structured CEAT to determined context based activities on the concept of chemical equilibrium.

Time (4weeks 16 contact hours

3.3. Subject of the Study and the Sampling Procedure

3.3.1. Subject of the Study

The subjects for the study were grade 11students of 2019/2020 academic year at Borena Preparatory School in Mekaneselam Administrative Town which is far from Addis Ababa 581 Km to the north. Most of the learners were from both town and rural areas with similar background. For the selection of students' quasi- experimental sampling techniques especially regression discontinuity sampling techniques was applied to obtain a total of two section grade 11 students' participants in the described target study area. Why this sampling technique is preferred? The reason is that it involve the creation of a comparison were most often used when it is not possible to randomize individual or groups of treatment and control groups. This is always the case for ex-post impact evaluation designs. These made the results of the study free from bias. In addition 12 students from experimental group were selected for the interview by purposive sampling technique. Why purposive sampling? The reason is that the researcher believed in those who are learning in the selected section provided the required information for the study. Similarly, students were selected on their understanding (both Amharic and English) to participate the interview from the selected section by using extreme- case sampling techniques, the researcher were selected those who have different level of understanding learners.

3.3.2. Description of Sampling Procedure

According to the information obtained from the school principals in the target school, there were a total number of 4 section grade 11 students in the academic year of 2019/2020. The researcher believed that the target grade level students are equally important for the study, but it is difficult to collect the required data from a large number of populations and managed them. For this reason, the sample size for the study was determined based on the class the researcher was taught in the school and organizing the samples. From these sample of students,one section to experimental(11^{th} D) and other one as control group(11^{th} E) . Then, the researcher arranged independent tutorial classes for the two groups in addition to the regular class. The implementation took totally four weeks. In each week, students had two

Contact hours, that is, they had overall 16 hours to study the chemical equilibrium concepts The class is carried out in two days (in Tuesday and Thursday) in each week for 42 minutes. Students in experimental group were given the CBA approach which included the selected ACs related to chemical equilibrium concept. Simulation, analoge and puziling to activate these ACs evidences of incorrectness of these ACs and correct explanations of the concepts. Discussing the answers and establishing simulation,analogical and puzling thinking btween the real life examples and the unknown while new information and discarding ACs. While preparing demonstrative experiments based on CBA approach, it was necessary that students' ACs on the related concepts should be considered.

Students in the control group were instructed only with traditional approach using chemistry text that is, eleventh-grade chemistry textbook approved by Ministry of Education. During the classroom instruction,the teacher used lecture and discussion methodes together with problem solving in teaching chemical equilibrium concepts without considering students'ACs. Major concepts, equation and definitions were written on the black board by the teacher and students took notes. So, the instruction was teacher-centered. CEAT was applied to all groups as pretest at most one week before the instruction. After four weeks of instruction of chemical equilibrium concepts,similar CEAT was given as aposttest. Independent t-test was used to determine the difference between post-test mean scores of students who received CBA approach and those who received traditional approach with respect to the achievement test. Chemical equilibrium concepts were carefully examined (Adesoji and Babatunde, 2012). Each distracter of an item was prepared in such a way that it was confronted with students ACs.

3.4.Data Gathering Instruments

Different data was collected from the subject of study using multiple instruments listed below

3.4.1. Chemical Equilibrium Achievement Tests

In this study the researcher developed two-tier multiple choice questions in (CEAT) and considered the Alternative conceptions reported in the literature. There were ten 2tier-test multiple choice questions with one correct answer and three distractors. Each item was prepared in identifying students' performance in chemical equilibrium. CEAT methods was paralleled with Garnett and Hackling (1984) developed and applied a misconception identification test 30 ten grade chemistry students. Researcher used 2-tier multiple choices questions to identify the students' performance on chemical equilibrium concept and chemical equilibrium achievement test (CEAT) was used in the study. CEAT were developed by the researcher. It consists of ten 2tier multiple choice questions. During the preparation stage of the test, in the first case the instructional objectives were determined. Furthermore the literature related to students' misconceptions of chemical equilibrium was carefully examined (Adesoji and Babatunde, 2012)

Achievement test CEAT

Table 2 Item Type and Sample Items of the CEAT

Type	Sample items
2-tier multiple choice	Consider the gaseous reaction of hydrogen with iodine; $\mathbf{H_{2\,(g)} + I_{2\,(g)} \leftrightarrow 2HI_{(g)}}$. Suppose that we have a mixture of $H_{2\,(g)}$ and $I_{2\,(g)}$ at 700 K with the initial concentrations $[H_2]$ = 0.1 M and $[I_2]$ = 0.2 M. When the system reaches equilibrium, the numerical value of equilibrium constant equals, K_{eq} = 57.0.If the initial concentration is 0.3 M H_2 and 0. 3 M I_2, what would say the numerical value of K_{eq} when the system reaches equilibrium? A, Remain the same B, Increase C, Decrease D, unpredicted
Questionnarie	. Does learning chemical equilibrium by CBA make you feel not boring? A, yes B, No

A pre-test was used as an assessment of students' achievement by using chemical equilibrium achievement test (CEAT). Also it helps to identify the level of students' alternative conceptions on these concepts. Instruction of chemical equilibrium, the control group was instructed using traditional methods whereas the treatment group was taught using context based approach. The miss - understood students related to chemical equilibrium were motivated by using puzzle, simulations, concert analogies are example of activate these misconceptions. Evidence of in correctness of the misconception and correct explanation of the concepts were carried out.

Post-test Researcher was constructed chemical equilibrium achievement test. This makes comparison of information in simple reflective manner. The reliability of chemical equilibrium achievement test was checked using reliability test.

3.4.2. Observation toward Context Based Activities

To investigate students understanding about Concept, terminology and knowledge of the relationship of concepts and ability to communicate through context based activities the researcher observed students' construct context based activities three times in different time interval (15:00, 20, and 25mins in the first, second and last week of the observations. For this purpose some students were evaluated and included in the analysis to show students' ability towards connected chemistry with Girma Gebrekidan (2013).

3.4.3. Questionnaires

Questionnaires were used as tools to gather important information from the subject of the study. Therefore, the researcher adopted two set of questionnaires (five closed and four open) adopted from Quilez and Jones (2007) context based experienced questionnaire were prepared to collect data on: whether or not this method participate students, the effectiveness of students achievement and attitude in chemical equilibrium. The items in the questionnaire prepared for the experimental group students were divided into three parts, assuming to give back ground information, as well as to see differences in opinions of the students on each of context based activities tutorial classes and context based activities approach in teaching learning chemistry. The context based activities questionnaire were administered for experimental group students after completing the tutorial classes at the end of the fourth week period by the researcher himself clarifying all points that were not clear to the students. This was done to give the students opportunity for examining strong and weak point of the context based activities.

3.4.4. Interview

Interview is a commonly used method of gathering information. The researcher planned to use it to obtain responses that strengthen what has been done so far and to collect complex information. Therefore, to collect data from experimental group students semi structured and structured types of interview would be used. The reason why the researcher would use both types of interview is that to increase the similarity of the respondents' responses, to provide different required information from the experimental group students; in addition, to decrease the researcher's personal judgment. The interviews were conducted purposively selected 12 students from the observed classes. By using extreme-case sampling techniques, the researcher were selected those who have better extreme, lowest or average results. The focus of the interview was to obtain information that helps to triangulate the data gathered through other tools about the impact of context based activities on the concepts of CE on grade 11 students attitude, the extents of CBA the types of activities in experimental group understanding of what they discuss in tasks in each activities.

3.5. Data Collecting Procedure

In order to obtain adequate information from the subjects of the study, the researcher explained the purpose and importance of the research to the subjects of the study in brief. Then, tests, questionnaires, classroom observations, and interviews were conducted. During the classroom observation, each class was observed three times and a checklist was used every time. The researcher observed the two selected classrooms with one of the four periods with similar checklists to get adequate information from the observed classes. Finally, the overall activities in the classes were crosschecked by comparing the two lists in addition to the notes were taken by the researcher. Before distributing the questionnaires particularly to the students, clear explanation was given by the researcher himself, in both languages for all the participants. Then the questionnaires were distributed, and filled in the presence of the researcher. The need to distribute the questionnaire papers in the presence of the investigator was to avoid any ambiguity that might affect the study negatively. Before letting they fill the questionnaire, short explanation on how to fill the questionnaire were given by the researcher and finally, the questionnaire papers were submitted (collected back). Then, the data processing involved interpreting the responses of respondents, classifying, tabulating and editing. As far as the students' interview was concerned, the types of interview were conducted. Each of the selected students was interviewed in the Chemistry Department office at Borena Preparatory School. The participants in the interview were allowed to respond in Amharic so that they could speak freely what is on their mind. Each of the interviews was lasted for 15-20 minutes. During the interview, the students responded to three open-ended and two closed questions, which the researcher has prepared and he would encourage describing their attitudes towards CBA and whether they have positive or negative attitudes towards their achievements.

3.5.1. The pilot group

Before the actual data collection process, the pre-test and questionnaire of the study developed primary to meet the objectives of the study and the item were adopted from Quilez and Jones (2007). The adopted test was given one MSc in chemistry who have been teaching in Borena preparatory school to evaluate the items critically in terms of content validity, face validity, clarity of the items and if they fit to measure the objectives of the study. After revising the first draft of the test was piloted to the non- sample students of 18 students by using probable sampling, particularly lottery method with the intervention of checking the effectiveness of the tests and making improvements. Thus, the instruments were found to be reliable to collect data from the main study. Similarly, pilot study in questionnaire, interview and systematic classroom observation checklists were conducted to the same non-sample 18 students. Following the pilot study, improvements were made in tests, questionnaire, and interview and observation checklist. Double- barreled questions, ambiguous items, and unclear questions, instructions and inadequate scales were improved. For example, in test items no 4 and in questionnaire items no 7 were discarded since they had ambiguous. Participants involved in the pilot study were not included in the sample during the administration of the final form of the tests and questionnaire.

3.6. Quality Control Procedure

To insure the quality of this research, the following essentials procedures were used

3.6.1. Validity

It refers to the accuracy and precisions of the data which concerns appropriateness of the data in terms of the research question being investigated (Silverman, 2006). Based on his concept the researcher designed mixed method and four data collecting instruments in order to answer the research questions and its objectives. Then, the researcher collected appropriate quantitative and qualitative data through these instruments in order to get the valid findings of the study. He consulted experienced researchers about the research frameworks and contents. So he designed the instruments based on the research questions and objectives. The aim of using tests in this study is to find the data in a way which provides base for generalization of findings from the sample to the population. Thus, the study focused on representatives of students with the same homogeneous population.

3.6.2. Reliability

It refers to whether a research instrument is consistent across multiple occasions of its use for checking the consistency and stability of the finding, the research instrument would produce the same results on different occasions (Silverman, 2006). The researcher designed the same sense tests and questionnaires for students in order to make clear the response in quantitative data. Thus, the researcher used to pilot taking 10 for tests and 9 for questionnaires were improved for the consistency of the study by one MSc in chemistry who have been teaching in Borena preparatory school. Then, seven test items were modified and three questionnaires also modified. Based on the pilot study carried out, data collected from 18 non-sample students to the pre-test was analyzed. Then, re-examine and redistributed to the sampled students. The reliability of instruments tested through different reliability instrument. Among these the most common estimates are inter-rater, test-retest, split-half and internal consistency. The internal consistency (Cronbach's alpha) technique was used to measure the consistency of respondents' response to different items of instrument. According to the rule of Cronbach's alpha value equal or exceeding 0.8 have generally considered being acceptable, a Cronbach's alpha value equal or exceeding 0.8 but less than 0.9 have generally considered good and a Cronbach's alpha value equal or exceeding 0.9 have to be considered an excellent internal item consistency. Thus, as revealed in table below the current study indicated 0.83 which is good internal consistency.

Reliability Statistics

Cronbach's Alpha	N of Items
0.83	2

3.7. Variables

This study employed two types of variables which were dependent and independent variables as listed below

3.7.1. Independent Variables

In this study the independent variables were two different types of treatment; instruction based on context based activities and traditional designed chemistry instruction.

3.7.2. Dependent Variables

Variables affected by different instructions by (CEAT) and (TDCI) those were students' achievement and attitude.

3.8. Methods of Data Analysis

Since the purpose of the study is to investigate the impact of CBA on the concept of chemical equilibrium in grade 11 students achievement and attitude, an independent-samples t-test (compare means) methods were employed. Both qualitative and quantitative methods of data analysis were used for the reason that in conducting this study both were essential. The quantitative data was analyzed using various statistical methods and tools. i.e SPSS (statistical package for social science) was used analyzed purposive statistics to describe the data in terms of mean, standard deviation, average etc. The independent t-test determined the difference between two mean scores of the two groups were significance or not and also the degree and the nature of relationship between two variable A and B is answered by the use of correlation analysis. Quantitative data obtained from the CEAT and WQ were analyzed using purposive and predictive statistical methods by using SPSS 20 (Statistical Package for the Social Sciences). The significance level was 0.05. The difference between pre-test and posttest data of experimental and control groups were analyzed via independent samples t-test. Qualitative data were analyzed by content and descriptive analysis. The information obtained through these was summed up by reducing the relevant responses to the relevant meanings and clustering the key points.

3.9. Ethical consideration

Cohen, Man ion and Morrison (2001) defined ethics as one of the principles and guide lines of the research study that helps the researcher to up hold things to be valued. They also indicate, "One essential principle of research is that is under taken with an agreed frame work of ethics" (Cohen, Man ion and Morrison 2001). According to them researchers should be ethical in the collection of the data, in the process of analyzing of the data and in the dissemination of findings by respecting the rights and dignity of the research participants as well as by operating honestly and integrity. In accordance with the above ideas, there are practical reasons why researchers need to adopt an ethical approach to their investigations with the following principles:

- Participants should give informed consent that means they must be voluntary and must have sufficient information about the study (Buchanan, 2004). The researcher respected ethical norms by getting the informed consent of the participants whom the researcher is going to the interview, questions and observe in the study site.
- The interest of the participants should be protected. Researcher should safe guard the participants' interest in the investigation.
- The researcher should avoid misrepresentation and operate with honest as well as open manner.
- The researcher also kept the confidentiality and secrete of the participant of students by informing the purpose of the research and its possible benefits to the school.

4. RESULTS AND DISCUSSIONS

The results obtained from the experimental and control responses of the students collected by the pretest, posttest, questionnaire, interview and systematic classroom observations showed the performance and attitudes difference between experimental and control groups. The detail of the results is reported below

4.1. Analysis of Pretest Results of Students in Experimental and Control groups of the School

In this presentation, t-test was used to check the existence of significance different and source of variation at significance difference level of ὰ = 0.05 mean achievement scores of the students of the selected preparatory school.

Table 3 Comparison of Experimental and Control Groups According to the Pretest Results (Appendix Table-3)

Groups	N	Mean	Std. Deviation	T	P	Df
control groups	44	4.40	.901	.468	.08	92
experimental groups	47	4.32	.862	.468		91.8

Based on the analyzed descriptive data, students' knowledge about the topics was identified from the pretest, which was administered before program implementations. Independent t-test showed mean scores on the pretest, and it was interpreted. The mean scores were 4.32 (SD = .862) in the experimental groups, and 4.40 (SD = .910) in the control groups at (t = 0.5, $p > 0.05$ and df =92). This shows that the students had no prior knowledge difference on basic concepts in chemical equilibrium topics that were included in 11th grade chemistry text book.

Table 4 Data Analysis on Multiple Choice Tests of Pretests

No	Control group								Experimental groups							
	A	%	B	%	C	%	D	%	A	%	B	%	C	%	D	%
1	6	18.2	23	52.3	15*	34.1	-	0	7	14.9	25	53.2	15*	32	-	0
2	4	9.1	13*	29.5	24	54.5	3	6.8	5	10.6	14*	29.8	24	51.1	4	8.5
3	24	54.5	3	6.8	12*	27.3	5	11.4	26	55.3	6	12.8	13*	27.7	2	4.3
4	15*	34.1	23	52.3	6	18.2	-	0	17*	36.2	8	17	22	46.8	-	0
5	26	59.1	12*	27.3	4	9.1	2	4.5	25	53.2	12*	25.5	9	19.2	1	2.1
6	27	61.4	2	4.5	11*	25	4	9.1	29	61.7	4	8.5	11*	23.4	3	6.3
7	13*	29.5	20	45,5	7	15.9	4	9.1	13*	27.7	23	48.9	7	14.9	4	8.5
8	13*	29.5	8	18.2	23	52.3	-	0	14*	29.8	7	14.9	25	53.2	-	0
9	24	54.5	5	11.4	4	9.1	11*	25	24	51.1	7	14.9	3	6.3	13*	27.7
10	5	11.4	12*	27.3	5	11.4	22	50	6	12.8	12*	25.5	5	10.6	24	51.1

* Showed as the correct answered; # of control group = 44 & # of experimental group =47

Students' answered from pretest were given in the Table 4 showed that there were not individual difference between experimental and control groups of students. The table 4 indicated that the percentages of the students' answers to each item in the MCT (multiple choices test) of pretest. As seen in table, there was no meaningful difference between the answers of both groups of students in the pretest questions. As seen from the table 4 students in both groups had not individual difference about prior knowledge in chemical equilibrium topics and have ACs which was identified in the literature of appendix table 3.1 taxonomy of ACs in chemical equilibrium those were proposed by different scholars. Even if these were the fact that researcher focused on remediation of the ACs by applied CBA for experimental group students and traditional instructions for control group students.

Table 5 Comparison between Correctly Answered and Mostly Popular Acs in Both Experimental and Control Groups Respondent on Pretest Questions

No items	Control group				Experimental group			
	Correctly answer	%	Popular ACS	%	Correctly answer	%	Popular answer	%
1	15	34.1	23	52.3	15	32	25	53.2
2	13	29.5	24	54.5	14	29.8	24	51.1
3	12	27.3	24	54.5	13	27.7	26	55.3
4	15	34.1	23	52.3	17	36.2	22	46.8
5	12	27.3	26	59.1	12	25.5	25	52.3
6	11	25	27	61.4	11	23.4	29	61.7
7	13	29.5	20	45.5	13	27.7	23	48.9
8	13	29.5	23	52.3	14	29.8	25	53.2
9	11	25	24	54.5	13	27.7	24	51.1
10	12	27.3	22	50	12	25.5	24	51.1
average		28.9		54.1		28.5		52.6

4.1.2 Discussions on selected items of the pretests

The results of this study revealed, as the students responses suggested that misconceptions were held by these sample students. The forthcoming discussion deals with responses to individual pretest questions. Thus, each item below has been begun with the question as it was asked on the test and precedes by highlight the main focus of the question. Followed by analysis, interpretation and comparison of responses:

1. Which of the following statements describes a system that is at equilibrium? A, the rate constants for the forward and reverse reaction are equal B, the concentration of reactants and products are equal C, the reaction ceases D, the forward and reverse rate are equal

This question deals with the concept of rate of chemical equilibrium. Students tried to distinguish the nature of rate of reaction. The purpose is to identify students' prior knowledge that "rate of equilibrium". The determination is rate of the forward and reverse reaction. Students just memorized "adding of concentration of reactants affect the rate of equilibrium". Analysis of the responses of the question indicates those only 15 students (32%) of experimental group students and 15 students (34.1%) of control group students responded to the correct answer (D), implying that the forward and reverse rate are equal. The most popular incorrect response was choice (B) that the concentration of reactants equal to concentration of products. About 25 students (53.2%) of experimental group students and 23 students (52.3%) of control group students consider that the total concentration of reactants is always equal to the concentration of products at any instant. The rest 14.8% of experimental and 13.6% of control group students choose either (A) or (C).

2. Which of the following statements correctly describes a chemical reaction of equilibrium? A, the concentration of products and reactants are equal B, the change in concentration of the products and reactants is constant C, the rate of forward reaction is less than the rate of the reverse reaction D, the rate of the forward reaction is greater than the rate of reverse

   This question was used to address the ACs that the constancy of concentration when the reaction is at equilibrium. From the analysis of the responses of the two sample students, it was found those 14 students (29.8%) of experimental group students and 13 students (29.5%) of control group students provided the correct answer (B), which means the change in concentration of the products and reactants were constant. About 24 students (51.1%) of experimental sample students and 24 students (54.5%) of control group students responded to choice (D) the rate of the forward reaction is greater than the rate of the reverse as correct answer Since at the first time the concentration of reactants were greater until equilibrium established. Only 20% of experimental sample students and 16% of control group students responded choose either (A) or(C).

3. Which of the following factors does not affect the position of chemical equilibrium? A, temperature B, concentration C, pressure D, catalyst
   This question deals with the factors affecting the position of equilibrium. Students expected to identify the correct factors affecting position of chemical equilibrium. From the analysis of the responses of the students it was found that 13 students (27.7%) of experimental sample students and 12 students (27.3%) of control group students responded to the correct answer of choice (D) that temperature, concentration and pressure affects the position of equilibrium. 26 students (55.3%) of experimental group students and 24 students 54.5%) of control group students provided incorrect answered choice (C) had obviously developed ACs owning that they simply memorized the concentration and temperature as being factors affecting the

position of equilibrium. The rest of students that was 17% of experimental sample students and 18.2% of control sample students choose randomly choice (A) and (B).

4. At 295k, a 3.0L flask contains 7mol HI, 4mol H_2 and 0.6mol I_2 in equilibrium. What is the value of k at 295k: H_2 (g) + I_2 (g) ↔ 2HI (g). A, 10.2 B, 20.4 C, 30.4 D, 61.2

   The question deals equilibrium constant theory concepts of equilibrium. Here students were asked to identify the correct equation to calculate k value. In view of this, it was found that 17 students (36.2%) of experimental group students and 15 students (34.1%) of control group students were able to give the correct answer, that is, choice (B) these students identified the value of k and the correct equilibrium equation. Whereas 22 students (46.8%) of experimental group students and 23 students (52.3%) of control group students gave choice (A) as the correct answer. It is clear that students of respondents had definitely held ACs that the chemical equation is neither write the equation nor totally understand. The rest 17% of experimental students and 13.6% of control sample students answered either (C) or (D).

5. For specific reason, which of the following statement is true about k, equilibrium constant? A, it may be changed by the addition of a catalyst B, it increases if the concentration of one of the reactants increased C, it changes with change in temperature D, it increases if the concentration of one of the products increases

   This question deals with the concept of factors affecting equilibrium constant. Students were expected to identify the factors that affect the equilibrium constants. For the purpose of identification of possible students ACs (if any) and, whether or not these have any relation, coherences or differences with the theories. From the analysis of the responses of the samples it was found those 12 students (25.5%) of experimental sample students and 12 students (27.3%) of control group students' respondent to the correct response (C) that the equilibrium constant changes with change in temperature. Of these students who failed to give the correct answer, 53.2%, 19.2% and 2.1% of experimental sample students and 59.1%, 9.1% and 4,5% of control sample students were selected the wrong answers as responses (A), (C) and (D) respectively. Those students who responded (A) had developed ACs with regarded to equilibrium constant equation. It seems that they simply memorized the equation but faced the difficulty to apply them in this question most of them expect the formation of equilibrium equations.

6. Consider the equilibrium, H_2 (g) + CO_2 (g) ↔ H_2O (g) + CO (g) for which ΔH for the reaction = +41kJ. How is the amount of H_2 affected in the system when it is subjected to on external stress? A, addition of CO_2increases the amount of H_2 B, increase in temperature decreases the amount of H_2 C, addition of catalyst increases the amount of H_2 D, decrease in volume increases the amount of H_2

   This question deals with the concepts endothermic and exothermic reaction in the formation of forward or reverse reaction that was affected. From the analysis of the respondents of the samples were found that 11 students (23.4%) of experimental sample students and 11 students (25%) of control group students provided the correct answer (B), which was due to equal number of molecules of gaseous reaction pressure and volume have not effect on the amount of H_2.About 29 students (61.7%) 0f experimental group students and 27 students (61.4%) of control sample students answered the most popular incorrect responded (D) since compounds in gaseous phase affected by pressure. Only 14.9% of experimental sample responded choose either (A) or(C).

7. Consider the following equilibrium: N_2O_4 (g) ↔ 2NO (g). What happens if the total pressure is increased by adding nitrogen gas? A, k_c increases B, the equilibrium shifts to the left C, the equilibrium shifts to the right D, the position of equilibrium is not affected

   An interesting ambiguity comes up with the addition of inert gas in a solution. Analysis of the respondents' answer showed those only 12 students (25.5%) of experimental sample students and 13 students (29.5%) of control group students responded the correct answer, choice (C) that the equilibrium shifts to the right because addition of inert gas shifts the equilibrium to the larger number of molecules. About 23 students (48.9%) of experimental students and 20 students (45.5%) of control group students answered (D). due to the ambiguity of addition of catalysts which catalyzed could not affect position of equilibrium. The rest students selected randomly (A) and (B).

8. If we add a catalyst to a chemical reaction that is at equilibrium the catalyst increases the rate at which equilibrium is achieved. A, it does not change the composition of the equilibrium B, it will change the composition of the equilibrium C, will change the equilibrium in the

direction that produces heat D, will change the equilibrium in the direction that occupies a large volume

This question deals with the addition of catalyst in chemical reaction that is at equilibrium. Analysis of the respondents showed that 14 students (29.8%) of experimental sample students and13 students (29.5%) of control group students provided correct answer which is choice (A) that catalyst speed up both the rate of forward and reverse reaction without participating them self in the product. But 25 students (53.2%) of experimental sample students and 23 students (52.3%) of control group students responded (B) those students had ACs that catalyst participating in total chemical products. The rest selected choose either choice (C) or (D).

9. If the following reaction is at equilibrium, which one of the following changes will shift the equilibrium to the left: N_2 (g) + $3H_2$ (g) ↔ $2NH_3$ (g) +heat. A, increasing pressure B, decreasing temperature C, adding more $N_2$and H_2 D, increasing the volume of the reaction containers

   This reaction is often confused by students concentration refers to the number of moles of reactants or products. The responses analysis showed those only 11 students (25.5%) of control group students and 11 students (23.4%) of experimental students replied correctly which was response (D). On the other hand, 24 students (53.5%) of experimental sample students and 24students (54.2%) of control group students responded the most ACs was attributed to response (A) of these students assumed that increasing pressure affect the position of equilibrium by shifting to the left. The rest students choose either choice (B) or (C).

10. Which one of the following is correct about a dynamic equilibrium? A, is a form of static equilibrium B, occurs when the rate constant of the forward process is equal to the rate constant of the reverse process C, only occurs in chemical equilibrium D, exists when the rate of the forward reaction is equal to the rate of the reverse

    This question deals with the dynamic nature of equilibrium. Here students were asked to answer the correct properties of dynamic nature of reactions. In view of thus, it was found that only 10 students (21.3%) of experimental group students and 12 students (27.3%) of control sample students were able to give the correct answer which is (D). Whereas 24 students (51.1%) of experimental sample students and 22 students (50%) of control sample students respondents gave choice (A) as correct answer. It is clear that the groups of respondents had definitely held ACs that dynamic nature seems to static equilibrium. These students might have developed these wrong nations about dynamicity of equilibrium. The other students randomly selected either (B) or(C).

Table 6 Applications of Treatment to Eliminate or Reduce ACs of Chemical Equilibrium Topics

No of AC	Category of AC	Remediation activities for experimental groups
1and3	LCP(LeChatelier's principles)	The mixture table salt with water (saturated solution) Boiled water for reversibility reaction
2,4 and 5	Rate of reactions	Throwing of coin one person to other and return back Puzzling of man and boy in their garden Water poured in container until equilibrium was reached
6 and 7	Application of equilibrium constant (position of equilibriums	Mixture of ice with liquid water Reversible reaction for NH_4Cl when heated and cooled Saturated solutions(mixture of table salt with water
8	Dynamic nature of chemical equilibrium	Water steam for reversibility reaction Water poured in the container until equilibrium established

Procedure on Application of Treatment to Eliminate or Reduce ACs of Chemical Equilibrium Topics

It is not simply and convincingly possible to counter the cited common misconceptions, i.e. that chemical equilibrium show ‘‘equal concentrations of reactants and products’’. As an introduction, it might be helpful to show melting equilibria with different ice–water mixtures, or solubility equilibria with different amounts of the solid, Melting equilibrium. Different ice–water mixtures are produced, stirred for some time, and measured with the thermometer the temperatures are always 0^0C. The following melting equilibrium exists: ice (s, 0^0c _ water (l)) the melting equilibrium does not depend on the amount of ice or water, but it exists in each ice–water mixture. If one heats the mixture then a part of the ice melts. When the mixture is still stirred, the temperature of 0^0C stays constant: the energy is used to separate a special amount of water molecules from ice crystals to form water. Water molecules leave the liquid phase and enter into the gas phase (steam); in the same manner, other molecules move from the steam into the liquid phase. Even in this case, the amount of liquid does not make any difference. The above discussions indicated that, students easily understood equilibrium occurred when the reactions were at reversible and again in a closed the amount of reactants and products remain constant.

Solubility Equilibrium, the misconceptions regarding the amount of solid materials in equilibrium and the dynamic aspect are equally important in the discussion. If one observes a saturated sodium chloride solution together with solid sodium chloride, and adds an additional portion of solid sodium chloride to it, this portion sinks down without dissolving. If one measures the density of the saturated solution before and after the addition of salt portions,one gets the same measurements .The concentration of the saturated solution does not depend on how much solid residue is present; equilibrium sets in between the saturated solution and arbitrary amounts of solid residue. From the above experiment students fully understood solid material did not affect the position of equilibrium. Therefore, chemical equilibria are not static but rather dynamic: back and forth reactions are constantly happening at an equal rate. One can also observe the surface of salt crystals on the bottom of the saturated solution using by taking photographs over a long period: several crystals constantly increase in size, whereas others get smaller. A dynamic exchange of matter goes on between the solid residues and the saturated solution, forward and reverse reactions are constantly occurring: a dynamic equilibrium exists. One cannot see constant reactions from saturated salt solution to solid salt and back. Two similar measuring cylinders are prepared, 50 ml of water are placed in one of the cylinders, and the other one remains empty. Using two glass tubes of equal diameter to transport water back and forth, water is continuously transported between the two cylinders: after several such exchanges, 25 ml of water remains in each of the cylinders, the water level does not change despite carrying constant volumes of water back and forth. If a similar experiment is done using two glass tubes with different diameters, then one cylinder would perhaps have the volume of 10 ml and the other would have 40 ml ‘‘in equilibrium’’: the water level does not change although the same amount of water is continuously carried back and forth in the two different glass tubes.

An “apple fight” between an old man and the boy next door carries out a different model experiment on dynamic equilibrium. The boy is supposed to discard bad apples and just throws them into his neighbor’s garden. The neighbor reacts and throws them back-his own garden is already falling of apples (‘large concentration’). Whereas the boy has to really hurry in order to collect his bad apples (‘small concentration’), the old man effortlessly collects the same amount of apples, which he throws back. Finally, in balance, six apples are thrown in and six are returned despite different concentrations of apples on both sides.

Table 7 Comparison of Experimental and Control Groups According to the Post Test Results

	Groups	N	Mean	Std. Deviation	T	P	Df
Scores	control groups	44	5.77	.522	19	0.02	89
	experimental groups	47	8.19	.680			

Table 7 indicates that the impact of context based activities on students cognitive skills in some the concepts of chemical equilibrium, a post test was given to students of both groups, and their achievements were compared using t-test (Table 7). The results in table 7 shows a significant difference in knowledge between both experimental and control groups at $p<0.05$. The mean difference were 8.19(SD=.680) in the experimental groups, and 5.77 (SD=0.522) in control groups respectively. These differences are attributed to the application of CBA. Thus, there are significances between achievements of the students of control and experimental groups in the school. From the table above t=19 from 2.539 value showed us there were significances difference between the experimental and control groups. Generally CBA approaches had more effective than traditional approaches

4.1.2. Results of the post test

After the implementations’ of CBA, students’ responses to each of the items were discussed below. As the study investigated students’ understanding of chemical equilibrium concepts, the percentage of students’ correct responses to each items have been compared in table 8.

Table 8 Data Analysis from Two -Tier Multiple Choice Tests of Posttest Achievements

No items	Control group								Experimental groups							
	A	%	B	%	C	%	D	%	A	%	B	%	C	%	D	%
1	10	22.7	14	31.8	20*	45.5	0	0	12	25.5	3	6.4	32*	68.1	0	0
2	5	11.4	22*	50	13	29.5	4	9.1	4	8.5	30*	63.8	5	10.6	8	17.0
3	12	27.3	7	15.9	19*	43.2	6	13.6	3	6.4	3	6.4	31*	66	10	21.3
4	20*	45.5	13	29.5	11	25	0	0	32*	68.1	0	0	15	31.9	0	0
5	14	31.8	23*	52.3	4	9.1	3	6.8	2	4.2	34*	72.3	8	17.0	3	6.4
6	12	27.3	5	11.4	20*	45.5	10	22.7	4	8.5	6	12.8	29*	61.7	8	17.0
7	19*	43.2	11	25	8	18.2	9	20.5	30*	63.8	0	0	11	23.4	6	12.8
8	18*	40.9	12	27.3	14	31.8	0	0	31*	66	12	25.5	4	8.5	0	0
9	10	22.7	7	15.9	8	18.2	22*	50	5	10.6	8	17	3	6.4	31*	66
10	7	15.9	19*	43.2	6	13.6	12	27.3	9	19.1	28*	59.6	6	12.8	4	8.5

*showed the correct answered # of control group =44 &#of experimental group= 47

Table 9 Comparison of Experimental and Control Groups on Percentages Distribution of Both Pre and Posttests Results

No item	Control groups				Experimental groups			
	Pretests of correct answers	%	Posttests of correct answers	%	Pretests of correct answers	%	Posttests of correct answers	%
1	15	34.1	20	45.5	15	31.9	32	68.1
2	13	29.5	22	50	14	29.8	30	63.8
3	12	27.3	19	43.2	13	27.7	31	66
4	15	34.1	20	45.5	17	36.2	28	59.6
5	12	27.3	23	52.3	12	25.5	34	72.3
6	11	25	20	45.5	11	23.4	29	61.7
7	13	29.5	19	43.2	13	27.7	30	63.8
8	13	29.5	18	40.9	14	29.8	31	66
9	11	25	22	50	13	27.7	31	66
10	12	27.3	19	43.2	12	25.5	28	59.6

Analysis of responses to the posttests of the CEAT

Students' responses to the tenth items questions after instructions were implemented in Appendix Table 4 were discussed below.

Item 1: this item involved the effect of changing concentration of the products in any compounds at equilibrium at room temperature: $A_{(g)}$ $+B_{(g)} \leftrightarrow C_{(g)} + D_{(g)}$. Once equilibrium has been reached, the concentration of compound (C) is increased by the addition of more (C). Assume that the temperature remained constant. A total of 32 students (68.1%) of experimental group students and 20 students (45.5%) of the control group students correctly suggested that the equilibrium constant were not affected despite changes in concentration of products. Due to this high and low numbers of students correctly answered this item after the implementation of CBA (saturated solution of table salt with water and addition of ice with liquid water) to experimental group students correctly answered item1 question than control group students. On the other hand 3 students (6.4%) of experimental group students and 14 students (31.8%) of control group students held the most AC that the equilibrium constant increased as the concentration of the different species changed.

Item 2: this item involved the heterogeneous equilibrium of the decomposition of solid calcium carbonate in a closed container: $CaCO_{3(s)} \leftrightarrow CaO_{(g)} + CO_{2(g)}$. A total of 30 students (63.8%) of experimental group students and 22 students (50%) of control group students correctly suggested that the removal of some solid calcium carbonate did not disturb the equilibrium. However 4 students (8.5%) of experimental group students and 13 students (29.5%) of control group students incorrectly applied LeChatelier's principles to answer that more calcium carbonate was removed. Due to the implementation of experiment adding of more table salt in a saturated solution students analyzed solid salts did not affect the position of equilibrium. Most of experimental group students correctly answered item2 question than control group students.

Item 3: this item involved predicting the effect of adding a catalyst to the gaseous sulfur trioxide equilibrium system: $2SO_2\,(g) + O_2\,(g) \leftrightarrow 2SO_3\,(g)$, $\Delta H = -199.78$kJ/mol. Of the total 31 students (66%) of experimental students and 19(43.2%) of control group students correctly answered that addition of a catalyst had not effect on the rate of chemical equilibrium, but it lower the activation energy of both the forward and reverse reactions to the same extent. However, 3 students (6.4%) of experimental group students and 12 students (27.3) of control group students wrongly believed that the rate of the forward reaction rate increased. Although, the catalyst acts lowering the activation energy of both the forward and reverse reactions by the same amount. This is due to by applied of small sand to water before steam and after cooled most experimental students identified the purpose of adding catalyst and either it affect the rate of chemical equilibrium or not.

Item 4: students were required to predict the concentration of product when sulphur dioxide gas, oxygen gas and sulphur trioxide gas is as follow: $2SO_2$ (g) $+$ O_2 (g) ↔ $2SO_3$ (g). If the reaction starts with the concentration of 0.02M SO_2, 0.01M $O_2$and 0.00M SO_3, assuming that reaction reaches equilibrium at constant temperature. Almost 32 students (68.1%) of experimental group students correctly suggested. Due to the implementation of CBA (pouring of water in the same container or different size container and throwing coins between two relatives), showed that the concentration of the reactants were each less than the concentration of products because the reaction favor the forward reaction up to the reaction established stability (reaches equilibrium). But only 20 students (45.5%) of control group students correctly suggested that the concentration of reactants each less up to equilibrium reaches. Despite the relative high and low percentages of experimental and control group students, who answered this item incorrectly none of students (0%) of experimental group students and13 students (29.5%) of control group students held the highest AC that the amount of product is the same as amount of reactants before equilibrium in a closed container, the concentrations of all the reactants in the formation of SO_3 reaction mixture remain the same as that of SO_2 and O_2 because the concentration of all the species are equal.

Item 5: this item was required to predict the concentration of the products when 0.30 mol of PCl_5 reached equilibrium in a closed container at constant temperature in the equilibrium:

- $PCl_{5\,(g)}$ ↔ $PCl_{3\,(g)}$ + $Cl_{2\,(g)}$. Assuming that the container had a volume of 1000ml, of the total 34 students (72.3%) of experimental group students and 23 students (52.3%) of control group students correctly suggested that concentration of the products increased because the concentration of reactant had decomposed to established equilibrium. Despite the relative high percentages of experimental group students correctly answered and almost half percentages of control group students answered the question, only 2 students (4.3%) of experimental group students and 14students (31.8%) of control group students held the highest AC that when a certain amount of PCl_5(g) reaches equilibrium in a closed container, the concentration of all the products in the $PCl_{5\,(g)}$ ↔ $PCl_{3\,(g)}$ + $Cl_{2\,(g)}$, reaction mixture remain the same as that of the PCl_5(g) because the concentrations of all the species are equal at equilibrium. This is because, the implementation of experiment water poured in the container until equilibrium established most of the experimental group students answer item5 question more than control group students.

Item 6: this item showed the same idea and has the same behaviors and implementations to that of item5

Item 7 involved the effect of changing the concentrations of the reactants in the hydrogen iodide equilibrium: H_2 (g) + I_2(g) ↔ 2HI(g), in a closed container at constant temperature. A total 30 students (63.8%) of experimental group students and 19 students (43.2%) of control group students correctly answered that initial concentration could not affect equilibrium constant. This is due to the implementation of experiment most of experimental students understood whether initial concentration could not affect equilibrium constant. Of the remaining students none (0) of experimental group students and 11 students (25%) of the control group students held the most alternative conceptions that the equilibrium constant increased as the concentration of the different species changed.

Item 8: In predicting the effect of increasing the temperature on the ammonia equilibrium: N_2(g) + $3H_2$(g) ↔ $2NH_3$(g), keeping the pressure constant. A total of 31 students (66%) of experimental group students and 18 students (40.9%) of control group students correctly applied LeChatlier's principles to predict the effect of increasing temperature at constant pressure. But 4 students (8.5%) of experimental group students and 14 students(31.8%) of control group students held the most incorrect conceptions that the equilibrium shifts to the right when the temperature was increased favoring the formation of more ammonia. Because most of control group students did not identified the relationship between temperature and pressure but in the experimental group students could identified the reason because the position of equilibrium determined by number of mole in gas phase and factors affecting position of equilibrium.

Item 9: in predicting the rate of reaction in ethane (C_2H_6), hydrogen (H_2) and ethene (C_2H_4): C_2H_6 ↔ C_2H_4 + $H_{2,}$ keeping the system constant. Of these 31 students (66%) of experimental group students and 22 students (50%) of control group students correctly answered the rate law to predict increasing or decreasing of amount of reactants or products in the rate of reaction. Only 5 students (10.6%) of experimental group students and 10 students (22.7%) of control group students held the most alternative conceptions the idea that “the total amount of matter remains the same during a reaction” and “at the same time, the total of the amounts of reactants is equal to the sum of the amount of products”.

Item 10 involved the effect of changing the concentration of reactants or products in any compound at equilibrium affect the rate of reaction by increasing or decreasing the concentration: 2NO(g) + Cl2(g) ↔ 2NOCl(g) + heat, once equilibrium has been reached the rate of the reaction is increased or decreased by remaining NO. A total 28 students (59.6%) of experimental group students and 19 students (43.2%) of control group students correctly answered that the rate of reaction increases or decreases depending on the reaction. On the other hand 4 students (8.5%) of experimental group students and 12 students (27.3%) of control group students held the most ACs that the rate of reaction affected by increasing or decreasing of concentrations. An attempt was made to single out in which part of the post test questions (objectives) the experimental groups performed better. Table 8 indicates the results of objectives type questions.

Table 10 Paired t-Test Comparisons between Control and Experimental Group on Posttest Objectives Type Questions

Groups	Mean	N	Std. Deviation	T	P	Md
control groups	7.74	44	.685	2.321	0.05	0.147
experimental groups	8.08	47	.632			

Table 10, shows that no reasonable difference between control and treatment groups in BPS (ὰ = 0.05) this result goes in line with the study of Ceyhan (2008) in which reported that context based activities learning might not perform as well as multiple choices tests taught by traditional instruction. This can be attributed to that multiple choices do not need idea organization or complete description of the asked questions using higher order thinking and multiple- choices can also be achieved by selection methods rule of answering and also exposed to cheating from good performing students. To protect this condition the researcher used reasoning tier (R-tier) questions. The weakness in multiple choice questions was addressed by this test (2TMC) test. These become the most popular members of the family of multiple choice questions in alternative conceptions' studies (Heikenen and voska, 2000; Treagust and Duit, 2008). A two tier multiple choice (2TMC) items includes CBA in the first item (answer tier or A-tier; and relevant principles justified the A-tier responses in the second tier (reason tier or R-tier). Therefore, the results of this study also agreed with this.

Table 11 Paired t-Tests Comparison between Control and Experimental Groups on Posttest Reasoning Type Questions(R-Tier)

Group	N	Mean	SD	t-value	p- value	Mean difference
Control	44	4.93	.947	18.495	0.000	3.11
Experimental	47	8.04	.624	18.085	0.000	

*BPS= Borena Preparatory School

There is a significant mean difference between control and experimental groups of students at (ὰ= 0.05). The mean of treatment group is greater than that of control group. Similarly, this result is supported by Nail, et al. (2016). Whose report said that students who received CBA could have better used relevant information, in expressing and interpret their ideas. This difference may be due to reasoning, organizing and integrating ability of the knowledge of the chemical equilibrium topics. It is well known in lecture method learner which provided with a lot of information with less understanding in short period of time. The learner will not express or write their learning outcomes in a meaningful manner. It indicates that CBA more prepares learners to communicate their ideas through writing by connecting to familiarize things.

4.2. Discussion on Questionnaire Analysis Results

The questionnaires were administered to experimental groups before the completion instruction of the whole topics. The purpose of conducting the questionnaire was the learners' opinion about CBA effectiveness in learning chemical equilibrium through interests, motivations and cognitive to words the topics. Since most of the students in the school "yes" for stated questions, the researcher analyzed the results in one table as shown below.

Table 12 Questionnaires Analysis for Treatment Group of the School (#=47)

	Questionnaires	Interesting		Boring	
		#	%	#	%
1 1	Does learning chemical equilibrium by CBA make you feel not boring?	43	91.5	4	8.5
2	Does this method (CBA) relate your learning with your prior knowledge or real world practical situation?	38	82.97	9	19.15
3	Does this method have a power to make learners actively participate in learning?	41	87.2	6	12.8
4	Does CBA help you think critically?	43	91.5	4	8.5
5	Does learning chemical equilibrium by CBA help you improve your speaking English language than other methods?	38	80.85	9	19.15
6	Does CBA class allow you to discuss on your learning with your friends?	44	93.6	3	6.4
7	Does CBA class help you retain (not forget) your learning for long period of time?	43	91.5	4	8.5
8	Does CBA improve teacher – student interaction?	45	95.7	2	4.3
9	Does CBA enforce you to use (visit) library more frequently and use other information sources?	43	91.5	4	8.5

The questionnaires in Table 12 were asked before all portions of the chemical equilibrium topic were completed. That was used to assess learners' opinion about the effectiveness of CBA on learning the topic. As the results indicated, learners (91.5%) hoped that CBA class interesting. Most of the (82.97%) have got the chance to exercise working together in practice using different activities to express their ideas.one can also appreciate that CBA class has helped them relate their learning with what they knew already. About (87.2%) of the respondents did get that CBA enforces them to actively participate in every activities. It was ascertained that around (91.5%) of the respondents gave the opinion that CBA help remember concepts for longer time. It was found that CBA approach served how to minimize misconceptions and develop on self-confident. In survey questions number 8 all students gave individual opinion that it makes them interact more with the teacher. This result, agreed with the report of Bennett and Lubben (2007) in which all the students emphasized that the teacher's visitation and monitoring during the CBA process helped increase their communication with the teacher. This is because as the teacher and students doing the activities together and facilitate, they got the opportunities to ask their teacher freely. From the above table (91.5%) of the respondents answered that CBA helps them to develop interest in chemical equilibrium. This result was supported by the study Pilot and Bulte (2006) explained that context based activities as focusing on inquiry and relating the science. Learning in simulation, puzzling and analogy provided students with the opportunity to share their thoughts, check understanding, exchange ideas and communicate with one another freely. Thus it can also be concluded that CBA made them think critically on their learning through exploiting different available information source.

4.3. Systematic Classroom Observations

Systematic classroom behaviors observations were conducted using the checklist formats of Appendix -9 interest, motivation and cognitive skill behaviors observed in specific activities and discussed generally as on appendix table 6, 7 and 8 respectively. The observed behaviors for each check point were summarized for nine consecutive periods. Zero for (not observed) and one for observed behaviors was used to indicate the extent of presence of the checked behaviors under each column during learning. The observation techniques were indicated in (Appendix 8 and 9). The total frequency of the marked number was used in result and discussion as shown in the table4.5. Percentage representations of the extent of checklist points observed were also described as follows using modified checklist of (vamvakeros, Paulatou and Spyrellis 2010).

Exceeds expectation, excellent and very much = indicates above (40) 85% of the total students (47), in the class demonstrated the observed behavior. Meet expectations, very good and somewhat = indicates from (30) (65%) to (84%) of the total students (47) in the class demonstrated the observed behavior. Acceptable, good and minimally = indicates (19) (40%) to (64%) of the total students (47) in the class demonstrated the observed behavior. Not acceptable, unsatisfactory and not at all indicates below (19) 40% of the total students (47). Not observed did mean that the observed behavior was not demonstrated.

4.3.1. Interest Behavior of Learners Was Observed Using the Check Points

- Concerned towards cooperation in assisting one another to attain common goals learning.
- Eager to ask and answer questions using English as media.

- Enthusiasm for the subject matter and learning activities (appear to be observed and enjoying class room activities i.e ask questions freely, make suggestions and show willing to involve in class room activity.
- Willing to attend class at any time.

Table 13. Summarized Frequency Distribution of Systematic Class Room Observations of Interest Behavior on the School

Groups	Sum of total times of activities checked in three periods	V		S		M		N	
		F	%	F	%	F	%	F	%
Experimental	9	22	46.8	21	44.7	4	8.5	0	0
Control	9	0	0	25	56.8	13	29.5	6	13.6

V =very much, S =somewhat, M = minimally, N = not observed

f = total sum of frequency of each check points observed on the appendix table -9.

As can be seen form the Table, in experimental groups of the school, 46.8% out of the total observed times of the period under “very much” column indicates that above (40) 85% of the students demonstrated interest towards CBA learning. The control group of the school demonstrated none (0%) in column “very much” interest towards learning. This shows that CBA approach is enjoyable and can arouse most learners’ interest than that of traditional methods. Ceyhan (2008) also reported that CBA method was enriched chemical equilibrium under “somewhat” category 44.7% of the total times observed 65% to 84% of the class students in experimental groups of BPS showed interest in different activities. In the case of control groups of the school 56.8% of the total students showed interest for 65% to 84% and 25 of the total times checked. This implies that traditional instruction method can also catch learners’ interest to moderate extent. For about 4.3% of the class learners showed interest by the experimental groups of BPS towards learning. The control group of this school demonstrated interest by less number of students for more times of the period, under “minimally” category. This shows that less number of students in the control groups showed interest for more times than experimental groups. This showed interest for less time by less number of students. In addition, under column “not observed” 13.6% of the total times observed interest behavior were not observed by control groups of BPS. In regardless of the extent of interest, none (0%) of the total observed times, students of the experimental groups failed to show interest towards learning. Thus, one can conclude for CBA can create relatively much interest in students than traditional based method. This indicates the effectiveness of CBA in maintaining learners' interest. Further as stated by Lennon,et al.(2013) learners enjoy the applied aspect of learning chemical equilibrium. That will sustain their desire towards actively engaging those serves in learning activities. In life setting and storytelling nature of problems created their interest.

4.3.2. Motivation Behavior of Learners' Was Observed Using the Check Points

- Excite to actively participate in analogy, simulation and throwing coins and so on.
- Arouse to interact with classmate students.
- Inspire to interact with teacher during his facilitating.
- Stimulate to participate in dialogue debating between groups.

Table 14. Summarized Frequency Distribution of Systematic Classroom Observation of Motivated Behavior on the School

E = exceeds expectation, M = meet expectations, A = acceptable, N = not acceptable. BPS = Borena preparatory school, f = total sum of frequency of each check points observed

Groups	Sum of total times of activities checked in three periods	E		M		A		N	
		F	%	f	%	F	%	F	%
Experimental	9	23	48.9	21	44.7	3	6.4	0	0
Control	9	0	0	0	0	35	79.5	9	20.5

Table 14 indicates that 48.9% of the total times checked, above 85% of the total students in experimental groups of BPS motivated above expectations. To the contrary, none (0%) of the total times checked the control groups were not motivated above expectations. This indicates that CBA can motivate learners to great extent than traditional based instruction. Again under "met expectation" category, for 44.7% of the time observed, 65% to 84% of the total students in experimental groups were motivated for more times by more students than control group students, who were not motivated (0%) at all by 65% to 84% of the students of BPS. This is because the problems and the mood of learning were provoking towards the participation, in line with this, Donnel, *et al*. (2007) confirmed that in CBA class of chemistry participation engagement and improved class moral were observed. Under acceptable column (6.4%), by experimental groups and (79.5%) by control groups showed that 40% to 64% of BPS students motivated to an acceptable degree of motivation. This depicts that, for less number of periods, less number of students in experimental groups were motivated. To the opposite, for relatively high number of periods, the equivalent numbers of students of the control groups were motivated to an acceptable extent. From the total times checked, none (0%) of the times was observed under "not acceptable" category for experimental groups of the school. However, for significant percentage of the total times checked, students of control groups in the school demonstrated not acceptable motivation by less than 40% of the students (table 6). This indicates that CBA is effective in motivating students than traditional method. That is consistent with Ceyhan (2008) in which she reported that students in context based activities learning approach reported significantly higher levels motivation and satisfaction. Moreover, experimental groups in the school scored 0% under "not observed" category did mean that none of them failed to show motivation in all periods; whereas 20.5% of the total times checked, control groups were not motivated that means, for most periods learners in control groups were not motivated. Generally, the table indicates that most of the times learners were passive listeners in the traditional based instructions. And this was supported by the finding of Sirhan (2007), in which learners look note and listen to the teacher only in learning chemical equilibrium of grade 11^{th}. Thus, this could lead one conclude that CBA was effective to enhance learners' motivation than the traditional teaching method.

4.3.3. Cognitive Skill Behavior of Learners Was Observed Using the Check Points

- Organization of idea
- Retention of learned concepts

Table 15. Summarized Frequency Distribution Systematic Classroom Observation of Cognitive Skill Behavior in BPS

Groups	Sum of total times of activities checked in three periods	E		V		G		N	
		F	%	F	%	F	%	F	%
Experimental	9	24	51.6	19	40.4	4	8.5	0	0
Control	9	0	0	0	0	36	81.2	8	18.8

E = excellent, V = very good, G = good, N = not at all

From the Table 15 indicated that 51.6% of the total time checked above 85% of the total students in experimental groups of BPS excellent cognitive skill. Oppositely, for none (0%) of the total times checked, above 85% of control groups students did not show cognitive skills. The overall results on the “excellent” category shows that most learners perform cognitive skills for most periods by the experimental groups’ students than control groups. Under “very good” category most learners from 40.4% experimental groups demonstrated cognitive skills for more times than control groups. Bowell, et al. (1992) also discussed in their finding that CBA provides means for increases to sharpen their skills in oral and written communication and critical thinking. Under “good” 81.2% were recorded for control groups of the school. This shows that traditional based instruction is less effective in improving cognitive skills. Ceyhan (2008) reported that teaching chemistry using traditional based instruction is that students can not apply what they learn in class to the world in which they live. For effective behavioral change, lonnen *et al*. (2013) reported that students behavior improved well, when CBA, was used utilized.

4.4. Discussions of Post-Activity Answers to the Interview

In this section the experimental group students views about CBA are discussed detail. Interview was conducted as soon as CBA implementation was completed. The opinion of interview was to cross- check their attitude about CBA. The generalized reasoning opinion about CBA discussed as follows:

1. Do You Think That CBA Class Was Interesting or Boring

Almost above 92% of the 12 students answered interesting for (Appendix-table-10) and stating their reason as follow most of the teacher's role in this method is different from traditional method. In the lecture approach taught the topic himself / herself for almost 39 minutes. During this time they actively participate for the maximum of 15-20 minutes, after that they felt bored. In CBA, class most of the class time was completed by doing activities among learners and demonstrating practical activities. Because they said that the teacher asked questions continually and gave them time to discuss on it. Most students said that even when they insisted him /her for feedback. The interaction would give them only clues that provoking them for more work.

2. Do You Think That CBA Class of Chemical Equilibrium Life Activity Situation

Most of the students in the school (Appendix- table -10) reflected that problems given were mostly similar to the problems they encountered in real life situation, mostly important, in application of rate of chemical equilibrium and how much of the reactants remain unreacted they learned real life in CBA. In traditional method they were trying to solve quantitative problems and said that they finding was reported in number. In CBA, students were ordered individually to solve problems and looked for different information that helped them solve the given real problems. As the result they did understand the concept of chemical equilibrium better in this topic besides the memory lasts much longer than traditional methods.

3. Do You Think That CBA Class Was Democratic Significant Proportions of the Students in the School Answered "Interesting" for The Stated Question?

In lecture method the teacher asked questions. It was difficult to invite them for discussion. In CBA class students participated discussed widely and the class was democratic for everyone to do practical freely. In CBA approach they felt really closer to the teacher. Because, when he worked together during learning activities, they used this chance to interact as a friend; they extremely felt free and ask any questions Nail, et al. (2016) also reported that in CBA class, students got more open in discussions, asking questions to other group members and sharing their own ideas. Furthermore, it helps to build friend ship among students, experience of sharing ideas, knowledge and feelings.

4. Does CBA Help You Think Critically

Most of the students in the school (Appendix- table -10) reflected that problems given were mostly similar to the problems they encountered in critical thinking, mostly important, in application of rate of chemical equilibrium and how much of the reactants remain unreacted they learned through different activities in CBA. In traditional method they were trying to solve quantitative problems and said that they finding was reported in number. In CBA, students were ordered individually to solve problems and looked for different information that helped them solve the given real problems. As the result they did understand the concept of chemical equilibrium better in this topic besides the memory lasts much longer than traditional methods

5. What is your general opinion about CBA?

Learners gave comments that CBA, made most of them (Appendix table-10) like chemistry, think creatively and critically, feel responsibility to their learning. In traditional method, they always suffered of rote memorization and they were not confident in their knowledge mentation for a long period of times. In CBA, they learned by relating with real life conditions and the concepts were easily understood and rehearsed; thus the general concepts of chemical equilibrium could be remembered for longer period. Students used their natural techniques to solve the problems.

5. SUMMARY, CONCLUSION AND RECOMMENDATION

5.1. Summary

The purpose of this study was to investigate the impact of using CBA on the concept of chemical equilibrium on grade 11 students achievement and attitude. The study was conducted in Mekaneselam Town Administration Borena Preparatory School. Based on the general objectives, the specific objectives and leading questions were designed. To answer the research questions, the researcher employed four data collecting instruments. Grade 11 students of the targeted school were the subjects of the study. Convenience sampling techniques was used to select students for CEAT and questionnaires, whereas, students were selected using extreme-case sampling techniques for interview. 12 students were taken as participants of the interview in the study. The data gathered mainly through CEATs, questionnaires, observations and interview. The data collected via CEAT, was analyzed using T- tests statistical tools (mean, standard deviation and two tarried test) and questionnaires and observation checklist were analyzed using different kinds of statistical tools (frequency, percentage) which are processed through SPSS(statistical packages of social sciences) window 20 versions software. Besides the data scored via interview and open ended questionnaires were analyzed qualitatively.

5.2. Conclusion

In the study, the impacts of CBA on students' academic achievement were examined via CEAT and the result of the participants (experimental group and control group) compared with each other. The result of the study indicates that experimental group students who used CBA scored more than control group students. Therefore; CBA contributed more to students' success than existing/traditional instruction. Also the analyses of qualitative results indicate that students learned chemistry concepts better with CBA and concepts were highly memorable. It was clear that contexts used in CBA were more effective in retaining chemical equilibrium concepts than usual/existing instructional approach. Therefore, instead of directly offering concepts to students as currently done in traditional teaching, offering the chemical equilibrium with CBA approach is more important. We can say interjecting CBA approach on the concepts of chemical equilibrium whenever necessary is important

5.3. Recommendations

Based on the findings of the study, the researcher would like to forward the following recommendations for developing students' achievement and attitudes towards chemical equilibrium concepts

- Teachers should aware of students' prior knowledge and ACs since students construct knowledge by the help of already existing conceptions.
- Teachers should understand the importance of context based activities method so that they can plan future instructional activities in a way that promote meaningful learning.
- Furthermore, teachers should realize that it is difficult to remediate misconception by traditional instruction since it is not enough to simply present the important concepts. Because research studies presented that ACs are highly resistant to change.
- Teachers should be encouraged to use context based activities.
- The teachers and students should get more time in the classroom of the government school. So that they can discuss the learning materials in depth and there by develop different skill such as interaction skills.
- Teachers should use genuine applications of chemistry topics association with between chemistry and daily life.

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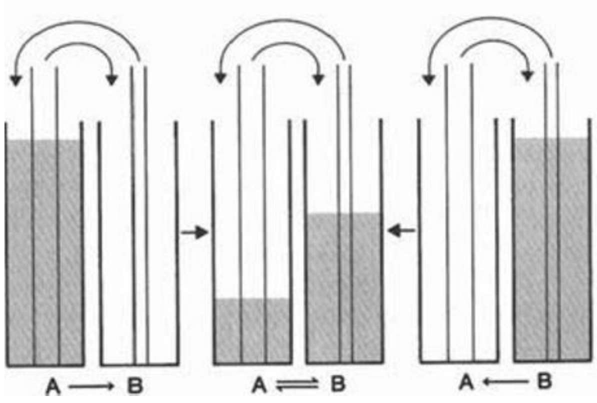
7. APPENDICES

Appendix I

Appendix table 1 taxonomy of misconception in chemical equilibrium those were proposed by different scholars

1	Students can not alter the amount of a solid in an equilibrium mixture
2	Large value of equilibrium constant imply a very fast reaction
3	The lechatelier's principle could be used to predict the equilibrium constant, when the reaction established at equilibrium
4	The rate of the forward reaction increases with time from the mixing of the reactants until equilibrium established
5	The appearance and disappearance of material by assuming concentrations fluctuate as equilibrium established
6	Confusion over the meaning of k by describing in as varying in value while at constant temperature.
7	Confusion adding of inert gas while the reaction reach at equilibrium
8	A reaction is reversible yet goes to completion; that the forward reaction must be completed before the reverse one starts.



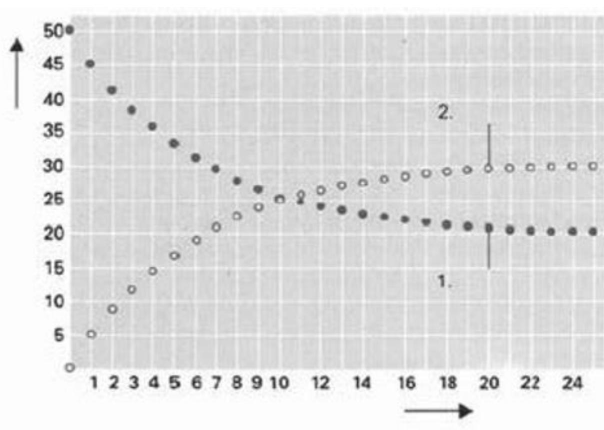


Figure 1 water simulation in dynamic nature aspects (Barke H.D., 2009)

Contains 24 coins(9,6,and 4 coins)

- Forward reactions

Returns(3,2,and 2 coins)

- Reverse reactions

and again15(6 coins)

- for ward

it has 9+(3 coins)

- reverse

Figure 2 throwing coin simulations aspect

Appendix II

Appendix table 2 Data collected from pre and posttests of both control and experimental group students

No of students	Control group students section (D)		No of students	Experimental group students	
	Pretest	Posttest		Pretest	posttest
1	6	7	1	4	9
2	4	6	2	4	8
3	5	6	3	5	7
4	-	-	4	4	8
5	5	6	5	5	9
6	4	5	6	4	8
7	4	6	7	5	7
8	4	5	8	4	7
9	6	7	9	5	8
10	6	6	10	4	7
11	6	6	11	6	9
12	-	-	12	4	7
13	4	6	13	4	8
14	6	5	14	3	8
15	5	6	15	4	7
16	6	7	16	6	8
17	5	5	17	4	8
18	5	6	18	4	7
19	4	7	19	5	7
20	6	5	20	5	8
21	5	5	21	4	8
22	6	6	22	3	7
23	-	-	23	4	9
24	6	6	24	4	8
25	4	7	25	6	8
26	5	6	26	-	-
27	4	5	27	4	7
28	4	6	28	4	7
29	-	-	29	4	8
30	4	5	30	6	7
31	4	5	31	3	7
32	4	6	32	5	7
33	5	5	33	4	7
34	-	-	34	4	7
35	3	6	35	5	8
36	4	6	36	-	-
37	4	5	37	6	9

38	6	7	38	5	8
39	-	-	39	-	-
40	4	5	40	6	9
41	6	6	41	6	7
42	4	7	42	5	8
43	3	6	43	3	9
44	3	5	44	6	9
45	4	5	45	-	-
46	-	-	46	4	6
47	6	6	47	5	7
48	4	5	48	4	9
49	4	6	49	5	9
50	5	7	50	4	6
51	4	7	51	4	8

Appendix III

Appendix table 3 Questionnaires data analysis techniques for treatment group of the school (#=47)

No	Questionnaires	Interesting		Boring	
		#	%	#	%
1	Does learning chemical equilibrium by CBA make you feel not boring?	43	91.5	4	8.5
2	Does this method (CBA) relate your learning with your prior knowledge or real world practical situation?	38	80.85	9	19.15
3	Does this method have a power to make learners actively participate in learning?	41	87.2	6	12.8
4	Does CBA help you think critically?	43	91.5	4	8.5
5	Does learning chemical equilibrium by CBA help you improve your speaking English language than other methods?	38	80.85	9	19.15
6	Does CBA class allow you to discuss on your learning with your friends?	44	93.6	3	6.4
7	Does CBA class help you retain (not forget) your learning for long period of time?	43	91.5	4	8.5
8	Does CBA improve teacher – student interaction?	45	95.7	2	4.3
9	Does CBA enforce you to use (visit) library more frequently and use other information sources?	43	91.5	4	8.5

Appendix IV

Appendix table 4 Data collected from questionnaires in experimental groups

No.	Questionnaire	
	interesting	Boring
	yes	No
1	1	
2	1	
3	1	
4	1	
5		0
6	1	
7	1	
8		0
9	1	
10	1	
11	1	
12	1	
13		0
14		0
15	1	
16	1	
17	1	
18		0
19	1	
20	1	
21	1	
22	1	
23	1	
24		0
25		0
26	-	
27	1	
28	1	
29		0
30		0

31	**1**	
32	**1**	
33	**1**	
34	**1**	
35	**1**	
36	**-**	
37	**1**	
38	**1**	
39	**-**	
40	**1**	
41	1	
42		0
43		0
44	**1**	
45	**-**	
46	**1**	
47	**1**	
48	**1**	
49	**1**	
50	**1**	
51	**1**	

1 = yes 0 = no

Appendix V

Appendix table 5 Systematic classroom observation techniques of motivational and result for BPS

	SN	Check list point:-	E		M		A		N	
motivation		To what extent did the learner demonstrate the following behavior	f_E	f_C	f_E	f_C	f_E	f_C	f_E	f_C
	1	. Excite to actively participate in simulation, throwing coins and analogue	22	0	21	25	4	13	0	6
observed behavior	2	Arouse to interact with classmate students	21	0	23	26	3	14	0	6
	3	Inspire to interact with teacher during his facilitating	23	0	22	25	2	13		7
	4	Simulate to participate during simulation	22	0	21	25	4	13	0	6
		Total summed	88	0	87	101	13	53	0	25

Appendix-VI

Appendix table 6 Data collected from systematic observation in control groups

No.	Questions													
	Interest					**Motivate**								
	1	**2**	**3**	**4**	**to**	**1**	**2**	**3**	**4**	**To**	**1**	**2**	**3**	**4**
1	**1**	**2**	**3**	**3**		**2**	**2**	**3**	**2**		**2**	**1**	**3**	**2**
2	**3**	**2**	**2**	**3**		**3**	**2**	**3**	**2**		**2**	**2**	**3**	**2**
3	**2**	**1**	**3**	**2**		**2**	**3**	**2**	**3**		**3**	**3**	**2**	**3**
4														
5	**2**	**2**	**3**	**3**		**2**	**2**	**2**	**3**		**2**	**2**	**3**	**2**
6	**3**	**3**	**3**	**2**		**3**	**3**	**2**	**3**		**3**	**1**	**2**	**3**
7	**2**	**3**	**2**	**3**		**3**	**2**	**1**	**3**		**3**	**3**	**3**	**3**
8	**3**	**3**	**1**	**2**		**3**	**3**	**3**	**3**		**2**	**3**	**3**	**2**
9	**3**	**2**	**3**	**3**		**3**	**2**	**2**	**2**		**2**	**3**	**3**	**3**
10	**2**	**3**	**3**	**3**		**2**	**3**	**3**	**3**		**3**	**3**	**1**	**2**
11	**3**	**3**	**1**	**2**		**3**	**3**	**3**	**2**		**1**	**2**	**3**	**3**
12														
13	**1**	**3**	**3**	**3**		**2**	**3**	**2**	**2**		**2**	**3**	**2**	**3**
14	**3**	**2**	**3**	**2**		**3**	**2**	**3**	**3**		**2**	**2**	**3**	**2**
15	**2**	**3**	**2**	**1**		**3**	**3**	**3**	**3**		**2**	**3**	**2**	**3**
16	**3**	**1**	**3**	**2**		**2**	**2**	**3**	**3**		**2**	**2**	**2**	**3**
17	**1**	**3**	**3**	**3**		**3**	**2**	**2**	**2**		**3**	**3**	**3**	**2**
18	**2**	**2**	**2**	**3**		**3**	**2**	**3**	**2**		**3**	**3**	**3**	**3**
19	**3**	**3**	**3**	**2**		**2**	**2**	**3**	**3**		**2**	**2**	**3**	**2**
20	**3**	**3**	**3**	**2**		**2**	**2**	**3**	**3**		**2**	**2**	**3**	**2**
21	**3**	**3**	**2**	**2**		**3**	**3**	**2**	**2**		**3**	**1**	**2**	**3**
22	**2**	**3**	**2**	**3**		**2**	**2**	**2**	**2**		**3**	**3**	**3**	**3**
23														
24	**3**	**2**	**1**	**2**		**3**	**2**	**3**	**3**		**2**	**3**	**3**	**3**
25	**3**	**3**	**3**	**3**		**3**	**2**	**2**	**3**		**2**	**2**	**2**	**3**
26	**2**	**3**	**2**	**3**		**2**	**2**	**3**	**3**		**3**	**3**	**3**	**2**
27	**2**	**2**	**3**	**3**		**3**	**2**	**3**	**2**		**1**	**3**	**1**	**2**
28	**3**	**2**	**3**	**3**		**2**	**2**	**3**	**3**		**3**	**2**	**3**	**1**
29														
30	**3**	**2**	**2**	**3**		**2**	**2**	**2**	**2**		**1**	**3**	**2**	**2**

31	**3**	**1**	**2**	**3**		**3**	**3**	**2**	**3**		**3**	**2**	**2**	**3**
32	**2**	**3**	**2**	**2**		**1**	**3**	**3**	**3**		**2**	**3**	**3**	**3**
33	**3**	**3**	**2**	**3**		**3**	**3**	**1**	**2**		**3**	**3**	**1**	**2**
34														
35	**3**	**1**	**3**	**2**		**3**	**3**	**3**	**2**		**2**	**3**	**3**	**2**
36	**2**	**3**	**3**	**2**		**2**	**3**	**2**	**2**		**1**	**2**	**2**	**3**
37	**3**	**2**	**2**	**3**		**3**	**2**	**3**	**3**		**3**	**3**	**2**	**3**
38	**2**	**3**	**3**	**2**		**3**	**3**	**2**	**2**		**3**	**3**	**2**	**2**
39														
40	**2**	**3**	**3**	**2**		**1**	**2**	**3**	**2**		**2**	**2**	**3**	**1**
41	**1**	**2**	**2**	**3**		**3**	**1**	**2**	**3**		**3**	**2**	**1**	**3**
42	**3**	**2**	**3**	**3**		**2**	**3**	**3**	**2**		**3**	**3**	**3**	**2**
43	**2**	**3**	**2**	**3**		**2**	**3**	**3**	**1**		**2**	**3**	**3**	**2**
44	**3**	**2**	**3**	**2**		**3**	**2**	**2**	**3**		**2**	**2**	**2**	**1**
45	**3**	**3**	**3**	**3**		**3**	**3**	**3**	**3**		**3**	**3**	**3**	**3**
46														
47	**3**	**3**	**3**	**3**		**3**	**3**	**3**	**3**		**1**	**2**	**3**	**1**
48	**2**	**1**	**1**	**1**		**1**	**2**	**2**	**1**		**2**	**2**	**3**	**3**
49	**3**	**3**	**2**	**3**		**3**	**3**	**3**	**2**		**1**	**3**	**2**	**2**
50	**2**	**3**	**3**	**3**		**2**	**2**	**3**	**3**		**3**	**3**	**3**	**3**
51	**3**	**3**	**2**	**2**		**3**	**3**	**2**	**2**		**2**	**2**	**1**	**3**

4 = exceeds expectations, excellent, or very much

3 = meet expectation, very good or some what

2 = acceptable, good or minimally

1 = not observed, not acceptable or not at all

Appendix-VII

Appendix table 7 Data collected from questionnaire in experimental groups (#times)

01= yes, and 0=no

No.	Questions								
	1	2	3	4	5	6	7	8	9
1	1	1	0	1	1	0	1	1	1
2	1	1	1	1	0	1	1	0	1
3	0	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	1
5	1	1	1	1	1	1	0	1	1
6	1	1	1	0	1	1	1	1	1
7	1	1	1	1	1	1	1	1	0
8	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1
10	0	0	1	1	0	1	1	1	1
11	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1	1	1
14	1	1	0	1	1	1	1	1	1
15	1	1	1	1	1	1	1	1	1
16	1	1	1	1	1	1	1	1	1
17	1	1	1	1	1	1	1	1	1
18	1	1	1	1	1	1	1	1	1
19	1	1	1	1	1	1	1	1	1
20	1	1	1	0	1	1	0	1	1
21	1	1	1	1	1	1	1	1	0
22	1	0	1	1	1	0	1	1	1
23	1	1	1	1	1	1	1	1	1
24	0	1	0	1	0	1	1	0	1
25	1	1	1	1	1	1	1	1	1
26									
27	1	1	1	1	1	1	1	1	1
28	1	1	1	1	1	1	1	1	1

29	1	1	1	1	1	1	1	1	1
30	1	1	1	1	1	1	1	1	1
31	1	1	1	1	1	1	1	1	1
32	1	1	1	1	1	1	1	1	1
33	1	1	1	1	1	1	1	1	1
34	1	1	1	1	1	1	1	1	1
35	1	1	1	0	1	1	1	1	1
36									
37	1	1	1	1	0	0	0	0	0
38	0	0	0	0	1	1	1	1	1
39									
40	1	1	1	1	1	1	1	1	1
41	1	1	1	1	1	1	1	1	1
42	1	1	1	1	1	1	1	1	1
43	1	1	1	1	1	1	1	1	1
44	1	1	1	1	1	1	1	1	1
45									
46	1	1	1	1	1	1	1	1	1
47	1	1	1	1	1	1	1	1	1
48	1	1	1	1	1	1	1	1	1
49	1	1	1	1	1	1	1	1	1
50	1	1	1	1	1	1	1	1	1
51	1	1	1	1	1	1	1	1	1

Appendix-VIII

Appendix table 8 Data collected from systematic classroom in the experimental groups

No.	Questions														
	Interest					Motivate					cognitive				
	1	2	3	4	tot	1	2	3	4	tot	1	2	3	4	total
1	3	4	3	2		3	3	2	4		4	3	3	4	
2	4	3	3	4		4	4	3	4		4	4	2	4	
3	1	3	3	2		4	2	3	4		2	3	4	4	
4	3	4	4	4		3	4	3	3		1	4	3	3	
5	3	2	3	1		3	3	3	3		3	4	3	4	
6	4	4	3	3		4	4	4	4		4	1	4	4	
7	3	4	3	4		2	1	4	4		4	3	1	4	
8	2	3	3	4		3	4	3	3		3	2	3	1	
9	3	2	4	3		1	3	3	2		3	4	3	4	
10	4	4	3	4		3	4	4	1		3	3	3	3	
11	3	2	4	3		4	3	3	3		4	3	3	3	
12	3	3	3	4		1	4	4	3		1	4	4	3	
13	2	4	3	4		4	3	4	4		3	3	4	4	
14	3	3	3	4		3	4	3	3		2	4	3	4	
15	1	3	4	3		4	4	3	4		4	3	4	4	
16	3	2	1	1		3	4	3	3		3	3	3	3	
17	3	4	3	4		1	2	4	3		2	4	4	4	
18	3	4	3	3		3	4	3	4		4	3	3	3	
19	3	3	3	3		3	3	4	4		3	3	3	3	
20	4	4	3	4		3	2	3	3		4	2	2	4	
21	3	4	4	4		4	4	3	4		3	3	4	4	
22	3	3	3	4		4	4	3	4		1	4	3	4	
23	4	3	3	2		4	3	4	4		4	2	3	4	
24	3	4	3	4		3	3	4	4		3	4	4	4	
25	4	3	3	3		4	3	3	4		4	3	4	4	
26															
27	3	4	4	4		3	4	3	4		4	2	3	3	
28	3	3	3	4		4	4	3	4		3	3	3	1	
29	4	4	3	2		4	3	3	4		2	4	1	4	
30	4	3	4	4		3	4	3	3		4	1	3	2	

31	3	4	4	4		4	3	3	4			2	3	3	3	
32	3	4	4	4		3	4	4	4			4	4	3	4	
33	4	4	3	3		4	3	3	3			3	3	3	3	
34	4	3	3	3		3	3	4	3			4	4	3	4	
35	3	4	3	4		4	4	4	3			3	3	3	4	
36																
37	3	4	4	4		3	3	3	3			3	2	4	4	
38	4	4	3	4		3	4	4	4			4	4	3	3	
39																
40	2	1	3	2		4	3	3	3			4	3	3	4	
41	3	4	4	4		4	4	4	3			4	3	3	3	
42	3	3	3	3		2	2	2	1			1	2	4	4	
43	4	4	3	4		4	3	2	3			3	4	3	3	
44	3	4	3	4		4	4	4	4			3	2	4	4	
45																
46	4	3	4	4		3	4	3	3			4	4	4	4	
47	4	3	3	3		3	4	4	4			3	2	3	4	
48	3	4	3	4		4	4	3	4			1	2	3	3	
49	3	4	3	4		4	3	4	3			3	4	4	4	
50	4	4	3	3		3	4	3	2			4	3	3	3	
51	3	3	4	4		4	2	3	3			3	4	3	4	

4 = exceeds expectations, excellent, or very much

3 = meet expectation, very good or some what

2 = acceptable, good or minimally

1 = not observed, not acceptable or not at all

Appendix table 9 Data collected techniques from interview in experimental groups (#=12)

No	Interview questions	yes		No	
		#	%	#	%
1	Do you think that CBA class was interesting or boring	11	92	1	8
2	Do you think that CBA class of chemical equilibrium related your learning to your daily life activity situation?	10	83	2	17
3	Do you think that CBA class was democratic?	12	100	0	0
4	What is your general opinion about CBA	10	83	2	17
5	Does CBA class help you retain (not forgot) your learning for long period of time	11	92	1	8

Appendix -X

HARAMAYA UNIVERSITY

POSTGRAGUATE PROGRAM DIRECTORATE

ITEMS HAVE BEEN USED FOR PRETEST IN CHEMICAL EQUILIBRIUM ACHIEVEMENT TEST

DIRECTION CHOOSE THE BEST ANSWER FROM THE GIVEN ALTERNATIVE AND ENCIRCLE YOUR OWN CHOICE

1. Which of the following statements describes a system that is at equilibrium? A, the rate constants for the forward and reverse reaction are equal B, the concentration of reactants and products are equal C, the reaction ceases D, the forward and reverse rate are equal
2. Which of the following statements correctly describes a chemical reaction of equilibrium? A, the concentration of products and reactants are equal B, the change in concentration of the products and reactants is constant C, the rate of forward reaction is less than the rate of the reverse reaction D, the rate of the forward reaction is greater than the rate of reverse
3. Which of the following factors does not affect the position of chemical equilibrium? A, temperature B, concentration C, pressure D, catalyst
4. At 295k, a 3.0L flask contains 7mol HI, 4mol H_2 and 0.6mol I_2 in equilibrium. What is the value of k at 295k: H_2 (g) + I_2 (g) ↔ 2HI (g). A, 10.2 B, 20.4 C, 30.4 D, 61.2
5. For specific reason, which of the following statement is true about k, equilibrium constant? A, it may be changed by the addition of a catalyst B, it increases if the concentration of one of the reactants increased C, it changes with change in temperature D, it increases if the concentration of one of the products increases
6. Consider the equilibrium, H_2 (g) + CO_2 (g) ↔ H_2O (g) + CO (g) for which ΔH for the reaction = +41kJ. How is the amount of H_2 affected in the system when it is subjected to on external stress? A, addition of CO_2increases the amount of H_2 B, increase in temperature decreases the amount of H_2 C, addition of catalyst increases the amount of H_2 D, decrease in volume increases the amount of H_2

7. Consider the following equilibrium: N_2O_4 (g) ↔ 2NO (g). What happens if the total pressure is increased by adding nitrogen gas? A, k_c increases B, the equilibrium shifts to the left C, the equilibrium shifts to the right D, the position of equilibrium is not affected
8. If we add a catalyst to a chemical reaction that is at equilibrium the catalyst increases the rate at which equilibrium is achieved. A, it does not change the composition of the equilibrium B, it will change the composition of the equilibrium C, will change the equilibrium in the direction that produces heat D, will change the equilibrium in the direction that occupies a large volume
9. If the following reaction is at equilibrium, which one of the following changes will shift the equilibrium to the left: N_2 (g) + $3H_2$ (g) ↔ $2NH_3$ (g) +heat. A, increasing pressure B, decreasing temperature C, adding more $N_2$and H_2 D, increasing the volume of the reaction containers
10. Which one of the following is correct about a dynamic equilibrium? A, is a form of static equilibrium B, occurs when the rate constant of the forward process is equal to the rate constant of the reverse process C, only occurs in chemical equilibrium D, exists when the rate of the forward reaction is equal to the rate of the reverse

Appendix- XI

HARAMAYA UNIVERSITY

POSTGRAGUATE PROGRAM DIRECTORATE

ITEMS HAVE BEEN USED FOR POSTTEST IN CHEMICAL EQUILIBRIUM ACHIEVEMENT TEST

DIRECTIONS CHOOSE THE BEST ANSWER FROM THE GIVEN ALTERNATIVE AND ENCIRCLE YOUR OWN CHOICE. AND PLEASE GIVE REASON FOR YOUR CHOICE

1. The following hypothetical reaction reaches equilibrium at 25ºC: $\mathbf{A_{(g)} + B_{(g)} \leftrightarrow C_{(g)} + D_{(g)}}$ once equilibrium has been reached, the concentration of C is increased by the addition of more C. Assume that the temperature remains constant. Which of the following can be said about the numerical value of the equilibrium constant? A, Decreases B, Increases C, Remain constant

Please give brief reason for your choice.

____

____

2. Limestone decomposes to form quicklime and carbon dioxide as follow: $\mathbf{CaCO_{3(s)} \leftrightarrow CaO_{(s)} + CO_{2(g)}}$. What can we say about any equilibrium shift after removing some solid $CaCO_3$ from the equilibrium mixture? A, shifts to the reactants' side B, will not shift the equilibrium C, will not be predictable D, shift to the products' side

Please give brief reason for your choice.____

____

3. Sulphur dioxide and oxygen react to form sulphur trioxide in the following reaction:

$2SO_{2\,(g)}$ + $O_{2\,(g)}$ ↔ $2SO_3$ (g). ΔH = - 197.78 kJ/mole. What can you say about the forward reaction rate compared with the reverse reaction rate if a catalyst is added to system? A, lower B, higher C, the same D, not predicted

Please give brief reason for your choice.____

____

____

4. The equilibrium between sulphur dioxide gas, oxygen gas and sulphur trioxide gas is as follows: **$2SO_{2\,(g)}$ +$O_{2\,(g)}$ ↔ $2SO_{3\,(g)}$.** If the reaction starts with the concentration of 0.02 M SO_2, 0.01 M O_2 and 0.00 M SO_3, and reaches equilibrium at a constant temperature, what can you say about the equilibrium concentrations of SO_2 gas and O_2 gas? A, Decreases B, The same

C, Increases

Please give brief reason for your choice.____

____

____

5. Suppose that 0.30mol PCI_5 is placed in a reaction vessel of volume 1000 mL and allowed to reach equilibrium with its decomposition products: phosphorus tri-chloride and chlorine at 250ºC, when K_{eq} = 1.8 for **$PCI_{5\,(g)}$ ↔ $PCI_{3(g)}$ + $CI_{2(g)}$.** What can we say about the concentration of the PCI_3 gas and CI_2 gas at equilibrium? A, higher than 0.30 M B, lower than 0.30 M C, equals to 0.30 M D, higher than 0.50 M

Please give brief reason for your choice.____

____

____

6. Carbon monoxide reacts with oxygen to form carbon dioxide in accordance with following reaction. **$2CO_{(g)}$ + $O_{2\,(g)}$ ↔ $2CO_{2\,(g)}$, ΔH** = - 566 kJ/mole. Suppose that you have a reaction

vessel containing an equilibrium mixture of [CO] = 0.30 M, [O_2] = 0.20 M and [CO_2] = 0.25 M. What will happen to the concentration of CO_2 if a catalyst is added to the equilibrium mixture?

A, will be higher than 0.25 B, will be lower than 0.25 C, will be equal to 0.25 D, is equal to 0.55

Please give brief reason for your choice.____

____

____

7. Consider the gaseous reaction of hydrogen with iodine; $\mathbf{H_{2\,(g)} + I_{2\,(g)} \leftrightarrow 2HI_{(g)}}$. Suppose that we have a mixture of $H_{2\,(g)}$ and $I_{2\,(g)}$ at 700 K with the initial concentrations [H_2] = 0.1 M and [I_2] = 0.2 M. When the system reaches equilibrium, the numerical value of equilibrium constant equals, K_{eq} = 57.0.If the initial concentration is 0.3 M H_2 and 0. 3 M I_2, what would say the numerical value of K_{eq} when the system reaches equilibrium?

A, Remain the same B, Increase C, Decrease D, unpredicted

Please give brief reason for your choice.____

____

____

8. Consider the following reversible reaction that is in a state of equilibrium. $\mathbf{N_{2\,(g)} + 3H_{2\,(g)} \leftrightarrow 2NH_{3\,(g)}}$, ΔH = - 92.4 kJ/mole. If the temperature of the system is increased, the equilibrium positions will A, Shift to the left B, Shift to the right C, Remain the same

Please give brief reason for your choice.____

____

____

9. In a closed system, the following equilibrium can develop between the compounds ethane (C_2H_6), hydrogen (H_2) and ethene (C_2H_4): $C_2H_6 \leftrightarrow C_2H^4$ + H2. At the beginning of the

reaction 8 mol C_2H_6 are present, at this time C_2H_4 and H_2 have not yet been formed. At equilibrium, 3 mol C_2H_4 are formed. How many mol of C_2H_6 and H_2 exist at equilibrium?

a) 2 mol C_2H_6 and 3 mol H_2 b) 3 mol C_2H_6 and 3 mol H_2

c) 4 mol C_2H_6 and 1 mol H_2 d) 5 mol C_2H_6 and 3 mol H_2

Please give brief reason for your choice.____

____

10. Consider the following reversible reaction that is in a state of equilibrium. $2No(g) + Cl_2(g) \leftrightarrow 2NoCl(g) + heat$. When the reaction approaching to equilibrium, the decreasing in concentration of No is A, increasing the concentration of product B, favour the rate of reverse reaction C, increasing the concentration of Cl_2 D, remain the same

Please give brief reason for your choice.____

____

____

____

Appendix -XII

HARAMAYA UNIVERSIT

POSTGRAGUATE PROGRAM DIRECTORATE

Title: The Impact of Using Context Based Activities on the Concept of Chemical Equilibrium on Grade 11 Students' Achievement and Attitude: The Case of Borena Preparatory School

Instruction: the following are questionnaires prepared for grade 11th students of 2019/2020 Academic Year in south wollo zone Borena woreda in Borena preparatory school to study Impact of Using Context Based Activities on the Concept of Chemical Equilibrium on Grade 11 Students' Achievement and Attitude.

Dear respondents

Since the reliability of this quasi experimental study depends on the objectivity of your response, you are kindly requested to offer your response based on factual and genuine information. Thank you for your cooperation.

Objectives: the objective of this questionnaire is to gather relevant information on the Impact of context Based Activities.

Directions

1. Don't write your name

2. Encircle your choice

3. If you are interested please try to reason out your answer

4. Respond all questions precisely and genuinely

Questionnaires

1. Does learning chemical equilibrium by CBA make you feel not boring?

A, yes B, No. If your answer is 'yes' please write your reason briefly

____

____

____

2. Does this method (CBA) relate your learning with your prior knowledge or real world practical situation? A, yes B, No If your answer is 'yes' please write your reason

briefly.____

____

3. Does this method have a power to make learners actively participate in learning?

A, yes B, No If your answer is 'No' please writing your reason briefly.____

____

4. Does CBA help you think critically? A, yes B, No. If your answer is 'yes' please list somereasons.____

____

____

5. Does learning chemical equilibrium by CBA help you improve your speaking English language than other methods? A, yes B, no. If your answer is 'yes' please list some reasons.____

____

6. Does CBA class allow you to discuss on your learning with your friends? A, yes B, no

If your answer is 'yes' please list some reasons.____

____

____

7. Does CBA class help you retain (not forget) your learning for long period of time? A, yes B, no

If your answer is 'yes' please list some reasons.____

____

8. Does CBA improve teacher – student interaction? A, yes B, no

If your answer is 'yes' please list some reasons.____

____

9. Does CBA enforce you to use (visit) library more frequently and use other information sources? A, yes B

ሀረማያ ዩኒቨርሲቲ

የቀመርና ተፈጥሮ ሳይንስ ትምህርት ክፍል

በቦረና መሰናዶ ት/ቤት ተማሪዎች የሚሞላ ቃለ-መጠይቅ

መመሪያ: ከዚህ በታች የተለያዩ ጥያቄዎች ቀርበዋል፡፡ ጥያቄዎቹን በጥንቃቄ አንብብ/ቢ/፡፡ እያንዳንዱን ጥያቄ በፍጥነት በማንበብ ትክክለኛ መልስ በታማኝነት ስጥ(ጭ)፡፡ትክክለኛ መልስ የሚባለዉ አንተ ወይም አንች ራስህ(ሽ)ን በመገምገም ባህሪዬን ይመስላል የምትለዉ(ይዉ) ነዉ፡፡ መልስህ(ሽ) በሚስትር ይያዛል፡፡ ስም >በመጻፍ ወይም በሳጥኖች ዉስጥ የ<X> ምልክት በማድርግ መልስ(ሽ)፡፡

1. ጾታ ■ ወንድ■ ሴት

2. የክፍል ደረጃ ■ 9 ■ 10 ■ 11 ■ 12

ክፍል ሁለት፣ ከዚህ በታች ለተዘረዘሩት ዐረፍተ ነገሮች ከእያንዳንዱ ዐረፍተ ነገር ፊት ለፊት <አዎ> እና <አይደለም> የሚሉ አማራጮች ተሰጥተዋል፡፡ አረፍተ ነገሩ የያዘዉ ሃሳብ ከሃሳብህ(ሽ) ጋር የሚስማማ ከሆነ <አዎ> የማይስማማ ከሆነ <አይደለም> ከሚለዉ አማራጭ ፊት ለሚገኘዉ የ<X> ምልክት በማድረግ መልስ(ሽ)

1. በአዉዳዊ የማስተማር ዘዴ ኬሚካል ኢኩሊብርዬምን እንዳትሰለች ረድቶሀል(ሻል)? ሀ. አዎ ለ. አይደለም

   መልስህ(ሽ) <አዎ> ከሆነ፣ ምክንያትህን(ሽን) በግልጽፃፍ(ፊ)

2. አዉዳዊ የመማር ስነ-ዘዴዉ ከአንተ(ቺ) የእዉቀት ዳራ ጋር ወይም ከአለም አቀፍ ተጨባጭ ሁኔታ ጋር የተገናኘ ነበር? ሀ. አዎ ለ. አይደለም

   መልስህ(ሽ) <አዎ> ከሆነ፣ ምክንያትህን(ሽን) በግልጽፃፍ(ፊ)

3. በአዉዳዊ የማስተማር ዘዴዉ ተማሪዎችን በንቃት እንድሳተፉ የማድረግ ሀይል ነበረዉ? ሀ. አዎ ለ. አይደለም

   መልስህ(ሽ) <አይደለም> ከሆነ፣ ምክንያትህን(ሽን) በግልጽፃፍ(ፊ)

4. በአዉዳዊ የማስተማር ዘዴዎች በጥልቀት እንድታስብ(ቢ) እረድቶሀል(ሻል)? ሀ. አዎ ለ. አይደለም

   መልስህ(ሽ) <አዎ> ከሆነ፣ ምክንያትህን(ሽን) በግልጽፃፍ(ፊ)

5. ኬሚካል ኢኩሊብሪምን በአዉዳዊ የማስተማር ዘዴ መማርህ(ሽ) በእንግሊዘኛ ቋንቋ የመናገር ችሎታህን (ሽን) ከሌሎች በበለጠ አግዞሃል(ሻል)? ሀ. አዎ ለ. አይደለም

መልስህ(ሽ) <አዎ> ከሆነ፣ ምክንያትህን(ሽን) ዘርዝር(ሪ)

6. በአዉዳዊ የማስተማር ዘዴዎች ከጓደኞችህ(ሽ) ጋር እንድትወያይ እድል ፈጥሮልሀል(ሻል)?

   ሀ. አዎ   ለ. አይደለም

   መልስህ(ሽ) <አዎ> ከሆነ፣ ምክንያትህን(ሽን) በግልጽፃፍ(ፊ)

7. በአዉዳዊ የማስተማር ዘዴዉ የተማርከዉን (ሽዉን) ይዘት ለረጅም ጊዜ እንድታስታዉስ(ሽዉ) ረድቶሀል(ሻል)? ሀ. አዎ   ለ. አይደለም

   መልስህ(ሽ) <አዎ> ከሆነ፣ ምክንያትህን(ሽን) በግልጽፃፍ(ፊ)

8. በአዉዳዊ የማስተማር ዘዴዉ የመምህሩንና የተማሪዎችን መስተጋብር አሻሽሏል? ሀ. አዎ ለ. አይደለም

   መልስህ(ሽ) <አዎ> ከሆነ፣ ምክንያትህን(ሽን) በግልጽፃፍ(ፊ)

9. አዉዳዊ የማስተማር ተግባር ወዴ ቤተ-መፃህፍት ወይም አጋዥ ፅሁፎች በተደጋጋሚ እንድታነብ (ቢ) ይገፋፋል? ሀ. አዎ   ለ. አይደለም

   መልስህ(ሽ) <አዎ> ከሆነ፣ ምክንያትህን(ሽን) በግልጽፃፍ(ፊ)

INTERVIEW QUESTIONS

Good morning/ afternoon dear, student my name is ___________ I come from Haramaya University Natural and Computational science college department of chemistry to investigate the impact of CBA on the concept of chemical equilibrium on grade 11 students' Achievement and Attitude. Then, I would like to stay with me some minutes and give your genuine responses to my interview questions.

1. Do you think that CBA class was interesting or boring? A, interesting B, boring

   If your answer is interesting please give your reason briefly.

   ____

   ____

2. Do you think that CBA class of chemical equilibrium related your learning to your daily life activity situation? A, yes B, no

   If your answer is 'No' please write your reason.________________________________

   ____

3. Do you think that CBA class was democratic?

   If your answer is democrat please give your reason.______________________________

   ____

   ____

4. What is your general opinion about CBA?

   Please write your suggestion.____

   ____

   ____

   ____

5. Does CBA class help you retain (not forgot) your learning for long period of time?

   A, yes B, no

   If your answer is 'yes' please give your reason._____________________________

   ____

   ____

   ____

ሀረማያ ዩኒቨርሲቲ

የቀመርና ተፈጥሮ ሳይንስ ትምህርት ክፍል

ለቦረና መሰናዶ ት/ቤት ተማሪዎች የሚሞላ ቃለ-መጠይቅ

መመሪያ፡ ከዚህ በታች የተለያዩ ጥያቄዎች ቀርበዋል፡፡ ጥያቄዎቹን በጥንቃቄ ካዳመጣችሁ በ ሗላ ለእያንዳንዱን ጥያቄ በታማኝነት፣እኔ ብሆን ብለዉ የሚያስቡትን መልስ በመስጠት ስለተባበርሽን/ከኝ አመሰግናለሁ፡፡

1. በመማር ማስተማር ሂዴት ጊዜ አዉዳዊ የማሰተማር ዘዴዉ አነቃቂ ወይስ አሰልች ነበር?
   ሀ.አነቃቂ ለ. አሰልች
   መልስህ(መለስሽ) አነቃቂ ከሆነ ምክንያተዎን ያብራሩ

2. አዎዳዊ የመማር ማስተማር ሂደቱ በተለያዩ ተግባራት መደገፉ ኬሚካል ኢኩሊብሪዬም የሚለዉን ርእሰ ጉዳይ ከዕለት የዕለት የአኗኗር ዘደህ (ሽ) ጋር ይገናኛል ሀ.አዎ ለ. አይደለም
   መልስሽ(ህ) አይደለም ከሆነ ምክንያቱን ያስቀምጡ

3. አዉዳዊ የመማር ማስተማር ስነዘደዎ የተማርከዉን (ሽዉን) አይረሴ ለማድረግ ረድቶሀል(ሻል) ሀ. አዎ ለ. አይደለም
   መልስህ(ሽ) “አዎ” የሚል ከሆነ ምክንያቱን ይግለፁ

4. አዉዳዊ የመማር ማስተማር ዘዴዉ ሁሉን አካታች ነበር? አስተያየተዎን ይግለፁ፡

5. ስለአዉዳዊ የመማር ማስተማር ስነዜዴዉ ምን አስተያየት አለዎት

Appendix XIII

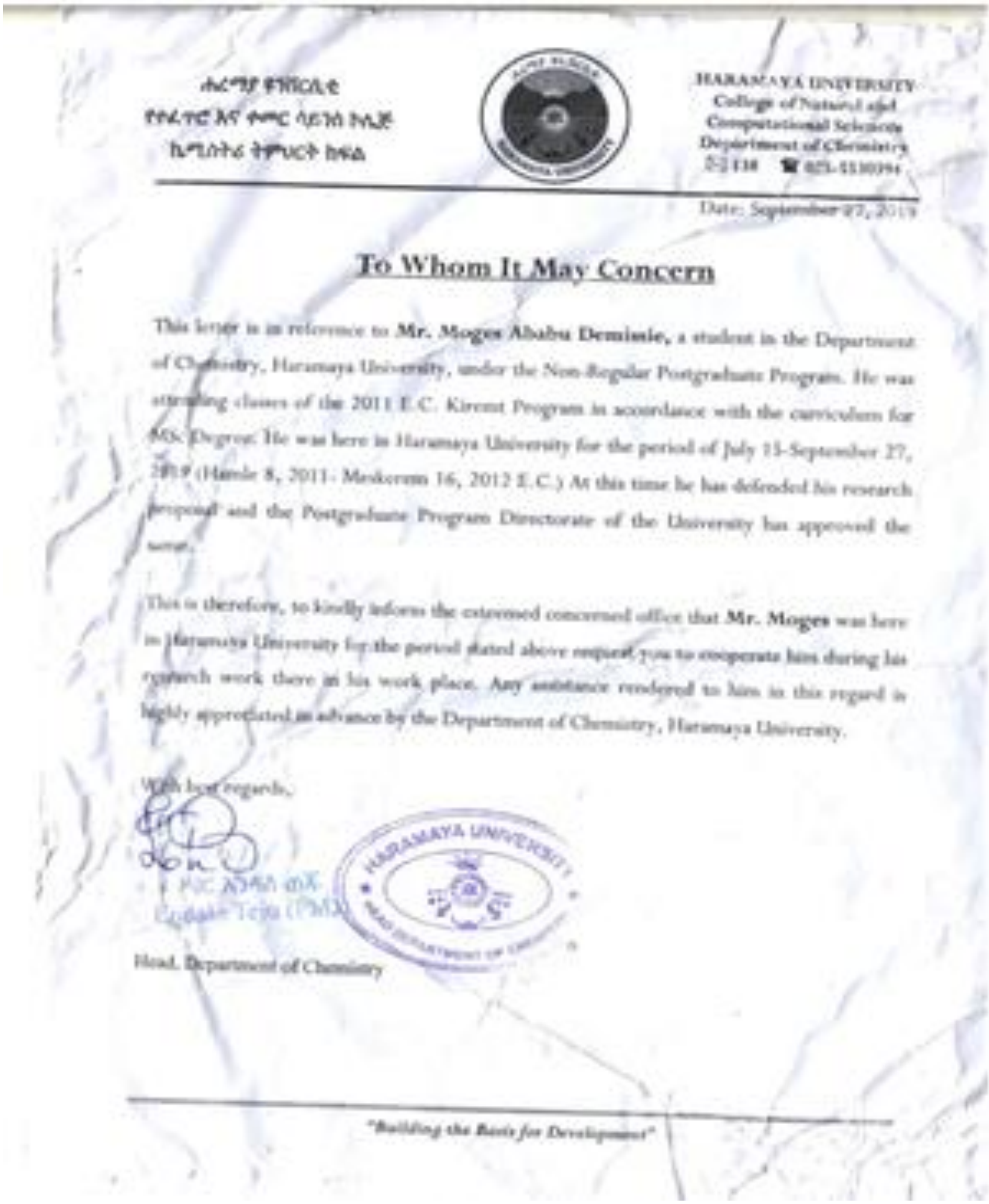
Systematic Class Room Behaviors Observations Using the Checklist Formats of Interest, Motivation and Cognitive Skill Observed on Specific Activities.

A, Interest Behavior of Learner: 4 =very much, 3 =somewhat, 2 =minimally, 1 =not observed for each criteria

No		Systematic class room behaviors observations checklists			
A	**Interest Behavior of Learner**	Very much	Some what	minimally	Not observed
1	Concerned towards cooperation in assisting one another to attain common goal learning				
2	Eager to ask and answer questions using English media				
3	Enjoyment for the subject matter and learning activities				
4	Willing to attend class at any time				
B	**. Motivations Behaviors of Learner**	Exceeds expectation	meets expectation	acceptable	Not acceptable
1	Excite to actively participate in simulation, throwing coins and analogue				
2	Arouse to interact with classmate students				
3	Inspire to interact with teacher during his facilitating				
4	Simulate to participate during simulation				
C	**Cognitive Skill Behavior of Learner**	Excellent	Very good	good	Satisfactory
1	Organization of ideas				
2	Retention of learned concepts				
3	Recalling terminologies				
4	Doing activities practically				

Appendix XIV

Department Letter for Targeted School.



HARAMAYA UNIVERSITY
College of Natural and Computational Sciences
Department of Chemistry
☏ 138

Date: September 27, 2019

To Whom It May Concern

This letter is in reference to **Mr. Moges Ababu Demissie,** a student in the Department of Chemistry, Haramaya University, under the Non-Regular Postgraduate Program. He was attending classes of the 2011 E.C. Kiremt Program in accordance with the curriculum for MSc Degree. He was here in Haramaya University for the period of July 15-September 27, 2019 (Hamle 8, 2011- Meskerem 16, 2012 E.C.) At this time he has defended his research proposal and the Postgraduate Program Directorate of the University has approved the same.

This is therefore, to kindly inform the esteemed concerned office that **Mr. Moges** was here in Haramaya University for the period stated above request you to cooperate him during his research work there in his work place. Any assistance rendered to him in this regard is highly appreciated in advance by the Department of Chemistry, Haramaya University.

With best regards,

Endale Teju (PhD)

Head, Department of Chemistry

"Building the Basis for Development"

Appendix XV

ANRS Education Bureau South Wollo Zone Education Dep't Borena Woreda Borena General Higher Education Preparatory and Secondary School

Role/BPS/901703/s-50/12

Date: September, 25/ 2020

To Whom It May Concern

This letter is in reference to Mr. Moges Abahu Demissie, he made the study by the title of 'The Impact of context based activities on the concept of chemical equilibrium on grade 11 students' achievement and attitude' in postgraduate program.

According to this title, Haramaya University Department of chemistry ordered us to help him with any evidence related to his research. He was here in Borena Preparatory School 10/10/2019_30/1/2020, as a result the School and his department confederated him by giving any thing that he may concern.

With best regards,

Natnael Bogale

Vice Director