

The Impact of a Teaching-Learning Program Based on a Brain-Based Learning on the Achievement of the Female Students of 9th Grade in Chemistry

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Abstract

This study aimed at recognizing the impact of teaching-learning program based on a brain-based learning on the achievement of female students of 9th grade in chemistry, to accomplish the goal of this study the researchers designed instruments of: instructional plans, pre achievement and past achievement exams to use them for the study-validity and reliability of these instruments were tested and found appropriate for the study purpose. The instruments were applied on a sample of 64 female students in the 9th grade at the EIN ALBEDAH secondary school in TAFILAH. The researchers applied T-test for independent sample means, standard deviations and ANOVA. The results indicated statistically significant differences at the level ($\alpha \leq 0.05$) in contemporary and instructional achievement or the experimental group. The researchers recommended applying the approaches of instructional methods which are based on brain-based learning in chemistry and science.

Keywords: teaching-learning program, brain-based learning, instructional achievement

1. Introduction and Theoretical Background

The world witnesses information revolution that is represented by cognitive inflation and technological advance.

This status imposes the educational institutions to review the teaching process a whole in order to help learners to apply these advancements and to Passover the learning process to a state of how to learn. Many theories called for concentrating on the efficient learning which helps learner to employ the knowledge and develops his/her thinking abilities. One of these theories in the theory of brain-based learning which emerged in the last decade of 20th century which was described as the decade of brain, where the neurologists were able to explore and discover many secret of the brain. The educators and psychologists used these result in the improvement of teaching-learning process, so the neuro-cognitive concept was established to pave the road to the emergence of brain-based learning (Assalti, 2004). Some of the secrets of the brain-based learning theory are Abdulbari (2011) and Ayasrah (2013).

1) the human brain work depends the separated (discrete) longitudinal waves called alpha-this wave is dedicated for the state of relaxed attention, and is considered the best for learning new information.

The second is beta the wide wave which is applied more in redundancy of frequent information known to the learners like the languages speaking.

2) the brain of the learner consist of a hundred millions of neural cells, of which there are active cells that grow by a rate of twenty tree-branches, and used for storing the information, besides cells that support the active cells.

3) cerebellar cortex consist of two sides: the creative brain on the right and the academic brain on the left side. The more the use of both sides simultaneously the more capability to learn easily.

Therefore, the brain grows if it finds a suitable environment that enhances its work and capability to store information this can be done through stimulating both sides of brain.

Components and functions of brain:

Hashash (2008); Abdulmawla (2008) and Najafi (2013) suggest that brain is divided into three main components. The forebrain which consists of the following.

1.1 Thalamus

This part contributes to organizing the external appearances of emotions because it is responsible for the selective attention. It has two parts, the right one helps in focusing the attention to the central image while the left part steers the attention to the things and phenomena that can be transformed into words.

1.2 Hypothalamus

This part helps in regulating the body heat and other bio simulators like thirst, hunger.

1.3 Peripheral

This part processes the emotional experiences.

1.4 Cerebrum

It is the largest part in the brain and contains neural centers related to the sensual, kinetic and major operations like memory and thinking-on the surface of the brain there are curvatures (flexions) called convolutions. Between the convolutions of the brain there are seams that divide each cerebral hemisphere into lobes known as the bones of the skull which cover it.

These lobes are the temporal lobe which contains the functional spots such as the auditory cortex; the parietal lobe which is responsible for the sensual interpretation, compatibility among different senses; and the frontal lobe which is responsible for vision functions.

2. Midbrain

This component is responsible for the basic processes for activation, attention and control of the cerebral reflexes like eye blink and sudden movement of head. Therefore many understanding problems and learning difficulties relate to the disorders of midbrain in relation to the cortex.

3. Hindbrain

This component consists of three parts.

3.1 Cerebellum

This part is located behind the arch and medulla oblongata, and receives the incoming information related to the status of body joints and limbs. It receives the information of brain about the desired status of these limbs, coordinates information and sends it to the spinal cord. This process affects the skeletal muscles to contract and diastole. The damage of cerebellum causes a constriction reflex of muscles and uncontrolled movements of the voluntary muscles besides loss of balance.

3.2 Arch

This part contains centers that collaborate with the medulla oblongata centers to control the rate and depth of respiration.

3.3 Medulla Oblongata

This part contains the centers that control the blood circulation, respiration, which its damage leads to death.

The brain consists of two kinds of cells: the neural cells that compose 10% of total brain cells. These cells affect the role of brain in learning and thinking. The second type of brain cells is the glial cells which compose 90% of brain cells. The glial cells play a role in getting rid of the dead cells, regulating the functions of the immune system as well as offering a structural support to improve the protection of the brain, transfer the nutritional elements and formation of the blood barrier of brain.

Figure 1 shows the components of the brain.

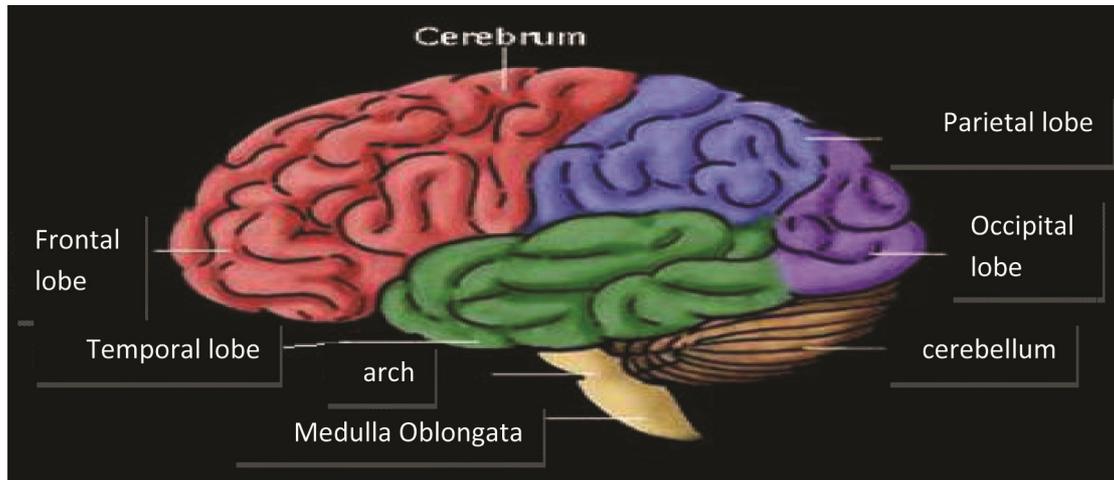


Figure1. Brain components

The brain-based learning several principles as mentioned by Tenssen (2012) as follow:

1) Learning outcomes

The brain prepares initial draft of the new instructional materials, since brain seldom gets the learning from the first trial. By the time the brain updates the drafts to improve the meaning. When the brain is oriented to a good it comprehends in a way better than the random learning.

2) Flexible memory

This memory enhances the learners memory through practicing and repetition under different conditions. Memories are subject to forget fullness by the time due to external conditions, since memories that are not encoded and encrypted will be lost quickly.

Abu Alssaheed (2005) and Caine R. and Caine G. (2000). These principles can generate teaching strategies used in teaching situations as follows:

1) The brain is social

It is influenced by the social interaction as for example the development and listening to other people. The suitable strategies are the collaborative learning, work in groups in the class, debates among students either individuals or groups as well as the collective contests.

2) Looking for the meaning in instinctive

It is an interpretation of our feelings, which change by age and respond to our new stimuli. The applied strategies for this principle are use a video film to develop the stored experiences in the brain, the predefined preparation of topic to provide students with a general and illustrative framework, and spare some time for thinking and meditation.

3) Emotions are important for learning

The scientists in the past ignored emotions and did not recognize the relationship between thinking and emotion-each experiences is associated with an emotion. The adopted strategies: provide opportunities to express the feelings and emotions, role playing, report writing, training of relaxed awareness and the formal regulator.

4) Human being has two types of memory

A static and dynamic memory. The static memory show us why do we learn separate facts, while the dynamic memory determines our place and registers the events we make.

The adopted strategies memorization aids, change of environment (hall, session, ...), field trips, use of computer and internet, transparency and abstracts, make projects and change the volume and pitch of the voice.

5) Developmental learning

Despite that the brain is a complicated structure, but it is very flexible change able and learn able.

The brain grows through the vital experiences which lead to neural links and chemical secretions. The physical structure of brain does not grow only by the protection and nutrition but also through the live experiments which lead to new links. The teaching strategies adopted this principle are: concepts charts, classification, and brain storing.

6) The brain learns in a unique method

There are no brains similar in the neural links, so each learners acquires experiences and learns in a way that suits his/her brain through the social and cultured environment.

The adopted strategies here are: self assessment, make research upon the choice of the student and diversification.

The brain-based learning theory had generate some teaching strategies like:

1) f=Formal or perceptive regulator

It is the organizing of concepts in the form of interrelated networks. This organization helps the learner to arrange his/her idea, summaries, and discover the details and lost information.

2) Brain storming strategy

This strategy is based on generation of ideas about atopic, where the student is allowed to think freely without intervention by the teacher .this strategy is applied with a small group or the class in a whole .

3) Strategies of kwl

These abbreviations denote to know wanted learning. These strategies are applied in the beginning and end of each learning module, and are consistent with the brain (Assalti, 2004; Addasouqi, 2013; Abdulbari, 2011).

The Brain-Based Learning (BBL) theory had influenced all elements of teaching-learning process as follow:

1) curriculum

The curriculum is all experiences acquired by the student under the supervision of the school. The researchers suggest that principles of BBL should be taken into account, which were indicated by Jensen; cain and cain. These principles include the implication of curriculum with attractive stimulate in presenting the concepts, organizing the knowledge as networks and charts, enrichment the classroom, and providing the safe psychological environment.

2) Teaching

It is a human process conducted by the teacher through providing a model teaching environment to help learners to achieve the educational different goals. The BBL theory distinkted between two types of learning:

(a) Brain-Harmonized learning

Such learning is facilitating and joyful, with the absence of threat, besides providing the possibility for moving and sitting upon the **define** of learner, as well as increase relaxation, reduce or eliminate the fear and anxiety of learner when encountered by the strong challenges in the environment, in addition to establishing a learning environment that encourage the learner to indulge in the learning experiments.

(b) Anti-Brain learning

This type threats the learner and teacher alike through using the punishment and negative expressions.

It is used for tests accompanied by tension and ends by the finish of exams. It applies the lectures in a large extent and emphasizes the content (Alkhataibih, 2007; Assalti, 2004; Almorabit, 2013).

(c) Assessment

It is the judgment of achieving the goals teaching-learning process, besides proposing the suitable mean to avoid the obstacles and enhancement the control of teaching-learning process. In this learning type we should apply the self assessment strategy, student record and cumulative file.

Alamiri (2002) indicates three teaching techniques related to BBL strategies as follow:

a) Indulgement

It means creation an environment that encourage learner to get involved in the teaching situations.

b) Relaxation

It is an attempt to eliminate the fear and hesitation o learners when encountering challenges.

c) Active processing

It is the permission to learner to processing the information and supporting it with another information.

During teaching the topics of electrochemical cells, acids interactions with bases, the researchers applied some of the teaching strategies emerged from BBL theory as the formal (perceptive) regulator, concept charts through organizing concepts from general to specific and clarification of its interrelations.

Others strategies used were brain storming which permit the learner free thinking and let him/her encounter challenges situations, besides the review of previous topic before continuing to the next topic.

The researchers also applied the strategies of feedback assessment, collaborative learning through groups, role playing, debate and discussions, summaries, besides providing the safe psychological classroom environment through free movement and sitting upon the define of the student as well as allowing drinking water.

Alsati (2004) and marji (2010) indicated that BBL has several stages as follows:

1) Preparation stage

This stage consists of briefing about the topic to let the learner from mind perception on the topic, hence representing the new information and processing and prepare the brain of learner with interrelated topics.

2) Acquisition and directed indirect learning

This stage emphasizes on the importance of forming neural relations directly or indirectly such as: lecture, visual tools, the environmental stimulate and the contests.

3) Eelaboration stage

This stage is required by teachers to integrate the learner in the class activities for the deep comprehension and exploring the interrelation among topics through implicit and explicit learning strategies like the brain storming and summarization.

4) Memory formation stage

This stage aims at enhancing the learning where the brain of learner will encode what he/she learned.

There are factors help to retrieve information like good nutrition, the adequate rest and link age to the prior learning.

5) Functional integration stage

This is the last stage of learning in which learning is used foe enhancement and expansion through encouraging learners to questioning about the importance of achieving the goals of learning content, besides clarification the concepts and principles in the content.

The researchers adopted these stages during the planning of teaching situations, and implementation of teaching topics of electrochemical cells and acids-bases interactions.

Due to the importance of BBL in teaching chemistry, a vital curriculum that has a great role in the modern life, which implies concepts, principles, laws and theories that explain many phenomena in life and nature, we should apply efficient teaching techniques and approaches that help learners to build up the knowledge in a meaningful function besides developing the mental capabilities of students.

The ministry of education in Jordan approved four textbooks in chemistry, physics, geology and biology since 1989, in order to provide students with more attention to the concepts of each topic.

The educational and teaching institutions apply the measurement of changes by learners through the achievement exams. The development of achievement of learner is considered one of important objectives that educators seek to obtain, because it is the criterion by which teachers success and progress, throughout the study stages, can be measured (Alfilimbani, 2014).

Measurement of achievement was defined by Sa'adah and Ibrahim as a procedure through which the behavior of learner can be observed and accomplishment of the learning objectives.

There are many factors that affect achievement such as (Alfilimbani, 2014):

1) Learner elements

His/her mental capabilities, motivity, interests, ability for learning, and capability for comprehending the information.

2) Family

The family provides the social and psychological security and prepare the conditions and atmosphere that fit learning process.

3) Teachers

The teachers approach of treating the learner, his/her technique in presenting topics have a great influence in the teaching outcomes.

4) School

The school provides the physical environment like classroom, labs, play yards, and safe environment.

5) Curriculum

The curriculum should comply with the developmental characteristics of learner and take into account the individual differences of learners besides taking into account the horizontal and vertical integration of lessons and topics.

6) Teaching methods

By using efficient teaching methods that focus on the learner and provide him/her the chance for self learning.

In our study we used a teaching method emerged from BBL to investigate its impact on achievements, with considering (Jensen, 2012) indication in that the research on the functions and processes of the brain do not claim that the current models and teaching methods are wrong, but they are not harmonized with the brain despite that learning is based on brain in a form or another.

Dhull (2011) indicates that educational and teaching research showed that using methods from BBL besides the preparation of suitable environment for learning process are considered an affecting factor in improving the achievement of learner. This conclusion comply with the attitudes of education university which focus on the learner as the center of attention.

The ministry conducted the educational development in 1987 which the king called for to match the technological and scientific advancement. The educational development focused on three fields:

Developing the scientific thinking, taking into account the individual differences and link knowledge to life, followed later by the skills of knowledge economics (Moe, 2012).

(a) Problem and questions of the study

One of teaching problems that encounter the educational institution the low achievement by learners in the curricula especially in science (chemistry).

The situation of science teaching in Jordan indicates a low achievements in learning science despite the efforts made. Such situation was indicated by several studies such as the study by National Center For Developing Human Resources (NCDHR) (2010), in analyzing the results of 8th grade students in science according to TIMSS exams.

The results of national exam conducted by the ministry of education for the courses indicated a low level of achievement by learners in science (MNOE, 2013).

Aziz (2007) indicated that teaching approaches are still concentrating on memorizing and prompting; and make the learner as a receiver of information sent by the teacher without any critics, understanding or relation to his/her interests-these approaches transform the student from a learner with imagination and active thinking to a machine loaded by information without understanding or independent thinking.

For these reasons our study investigated the impact of a teaching method emerged from BBL on achievement. The problem of the study was identified in answering the main question:

“What is the impact of using a teaching-learning program based on brain-based learning on achievement of chemistry by the females students in the 9th grade?”

(b) Goal of the study

The study aims at exploring the impact of a teaching-learning program based on a brain-based learning on the academic achievement of the 9th grade female students in chemistry.

(c) Importance of the study

The importance of this study stems from matching the results of research and advanced studies of brain and its impact on learning and teaching besides encouraging teachers to use teaching models and strategies based on

modern educational theories. Its importance stems from the fact that the results may serve decision makers in ministry of education to adopt these strategies during preparation of academic curricula.

(d) Procedural definitions

Brain-based teaching-learning program:

It is the group of activities that are based on the research on brain. It consists objectives, tools and strategies based on the principle of brain-based learning during the sessions of learning in the topics of electrochemical cell bases-acids and minerals in chemistry course.

Academic achievement:

It is the sum of acquired knowledge, skills and experiences. It is measured by the score achieved in the exam prepared for chemistry.

Traditional method:

It is a teaching method where learner is the center of teaching process, with limited role bounded by receiving the information with less discussion and debate. This method depends on textbook, boards and teaching aids.

(e) Boundaries and limitations of study

- 1) the place limits: the 9th grade female students at Ain Albaidha female secondary school in Tafila city.
- 2) the time limits: the study was conducted in the academic year 2014/2015 in the second semester.
- 3) topic limits: the study included only the topics of electrochemical cell, acids, bases, of chemistry text book dedicated for the 9th grade by the ministry of education in academic year 2012 by decision of education board no 2007 and the plans and tools developed for this study .

4. Literature Review

The topic of brain based leaning a new and growing topic. The researchers reviewed the previous studies which discussed the subject and concluded different results.

Altiti (2014) study aimed at exploring the impact of brain based teaching program on the achievement of the 5th grade students in the science curriculum in Jordan.

The study sample consisted of 128 students, the results showed an impact of brain based teaching program on improving the achievement in sciences. There were differences with statistical significance among the means of achievement scores off the students for the favor of experimental group that applied the program. The study didn't show any differences with statistical significances attributed to the gender or interaction between gender and teaching method.

Saleh (2012) study aimed at estimating the effectiveness of brain based learning in enhancing the understanding and comprehension of Newton laws in physics. The sample consisted of 100 secondary stage students in northern Malaysia. The results showed effectiveness of this method in enhancing the understanding and comprehension of Newton laws.

Ozeden and gultleen (2008) study aimed at recognizing the impact of using the brain based learning on the achievement and sustain of impact in science curriculum.

The sample consisted of 22 students of the 5th grade in turkey-the experimental group learned by the Traditional method. The results showed on effectiveness of brain based learning on achievement and sustain of impact.

Khattab (2013) study aimed at recognizing the impact o brain based learning theory in teaching mathematics on developing the skills of mathematical communication and mind arithmetic by the primary stage students. The sample consisted of 63 students of 3rd grade in Alfayoom, Egypt. The result indicated no statistically significant differences between the means of experimental group scores, who have the dominating side. for the exam of mathematical communication and mind arithmetic, and the means of control group, who have the dominating side for the exam of mathematical communication and mind arithmetic.

Alfilimbani (2014) study aimed at preparing a training program based on brain based learning and preparing an instrument to measure the motivity for mastering and a test of the impact of a training program on developing some characteristics of brain. The sample consisted of 68 students of cairo university who were selected randomly. The result concluded that there was an impact of the training program on academic achievement and motivity for mastering.

Duman (2010) study aimed at recognizing the impact of using the brain-based learning on the achievement of students with different patterns of learning. The sample consisted of some students of social sciences at mugla university-turkey. The results indicated on a efficient brain-based learning, while there were no statistically significant differences among the learning patterns.

A general comment on literature review:

We note that the result of the previous studies indicated the efficiency of brain based learning in the teaching outcomes, different curricula and different stages of school.

Our study has benefited from these studies in preparing the theoretical framework and designing the teaching situations. Upon the knowledge of the researches this study distinkted in introducing the variable of chemistry achievement.

5. Methodology and Procedures

This section includes the procedures adopted by the researchers to fulfill the study as follows:

5.1 Population

The population of this study consisted of all female students of the 9th grade in Tafila city by 702 students.

5.2 Sample

A sample of the students of 9th grade in Ain Albaidha school was selected on purpose, due to easy access and two classrooms. The researchers assigned one classroom as an experimental group while the other one was the control group. The total of number of sample was 64 students.

5.3 Instruments of the Study

The researchers used the study plans for the teaching-learning program and the test of academic achievement.

5.3.1 The Brain-Based Learning of Teaching-Learning Program

The researchers prepared the teaching-learning program which consisted of 14 study plans that covered the topics of electrochemical cells, acids, bases and minerals. These plans were built according the brain based learning theory and its fire stages, beside preparing the topic plans to be taught experimentally.

The confidence of these plans and its validity were verified by experts and academics in terms of:

- 1) Lesson objectives.
- 2) Language structure.
- 3) The five stages of BBL.
- 4) The applied teaching strategies.
- 5) Scientific accuracy in preparing activities.
- 6) Experimental tests.

5.3.2 The Achievement Exam

The achievement exam for chemistry modules was prepared in 30 items upon multiple choice selection.

The stages of preparing the exam were:

- 1) Content analysis for the chemistry topics.
- 2) Identify the topics of electrochemical cells, acids, bases and minerals and its interactions.
- 3) Determine the topics goals and classifications.
- 4) Writing items on the basis of multiple choice with a key for answer.

5.4 Confidence of Achievement Exam

The achievement exam was verified by experts and academics for confidence and validity. These experts included 9 chemistry teachers and academics in tafila university and Alhussein university. All reviews and suggestions of judges were taken into consideration by the researchers.

5.5 Stability of Exam

The exam was applied on exploratory sample o 25 students o 9th grade at khawla bint alazwar school. According to the processing, the coefficient of stability was calculated by testing and retesting method by a gap of 21 days. The stability coefficient was 0.86, which indicated the validity of the achievement for the study purposes. The

researchers conducted an achievement exam for both group to assure their equivalency. The exam data was analyzed according T test where the researchers found no differences between the means of both groups.

5.6 Procedures of Applying the Study

To obtain accurate results, the researchers adopted the following procedures:

- Identify the population and sample of the study.
- Tafila university communicated with the researchers of education to facilitate the mission of researchers.
- Develop a teaching-learning program that consists of chemistry curriculum for the 9th grade according to BBL.
- The experimental processing and control group were applied on the sample during the period from March 23-May 24, 2015, by two classes each week for each group.
- Develop the exam for the modules of electrochemical cell, acid, bases and mineral in chemistry curriculum for the 9th grade. The exam confidence to assure its confidence and stability.
- The exam of achievement was applied on both experimental and control group of the sample.
- Data was entered and processed by SPSS to obtain and explain results and recommendation.

5.7 Statistical Analysis

The researchers applied the arithmetic means, standard deviation, and two independent samples test to compare equivalency of both groups. The researchers also applied ANCOVA to discover any differences among the arithmetic means of the students scores in both groups, besides applying the posterior test where the researchers calculated the effect size M^2 as an additional measure.

6. Results

6.1 Results Related to the Main Question

“Who is the impact of applying a teaching-learning program based on brain-based learning on the academic achievement of the 9th grade students in chemistry syllabus?”

To answer this question the arithmetic means, standard deviations, for the students' scores in both groups, were calculated as shown in Table 1.

Table 1. Arithmetic means and standard deviations of the students performance in the exam of achievement (prior and posterior)

Group	No	Prior exam appl		Posterior	Appical
		Arith.mean	Std.dev	Arith .mean	Std.dev
experimental	32	13.16	2.529	21.62	3.563
control	32	14.12	1.773	13.91	3.971

Table 1 shows different among the arithmetic means and standard deviations for the students' scores in the prior and posterior exam application. To test the statistical significance of these different the researchers applied ANCOVA to control the impact of prior application of exam. Table 2 shows the results of ANCOVA.

Table 2. Analysis of ANCOVA for exam scores according to the method of teaching

Source of variance	Sum of squares	Freedom degrees	Average of squares	Calculated f	Significant degree
Prior exam	3.739	1	3.739	33.226	0.612
Method of teach	932.986	1	932.986	64.785	0.00*
Error	878.480	61	14.401	-	-
Total	1815.205	63	-	-	-

*significant at $\alpha \leq 0.05$.

The result of ANCOVA analysis in Table 3 indicates a statistically significant impact of teaching method in the academic achievement for the favor of experimental group. This result enhances the impact of teaching-learning program using the brain-based learning. The researchers applied the effect size by using Eta square which was equal to 0,80, so the teaching method based on BBL explained about 80% of variance in academic achievement of the students, while 20% of variance was attributed to other factors. In the light of the above mentioned results, researchers found that level of achievement has been improved by using BBL with the experimental group better than the control group. The researchers attributed this result to the benefits of using the BBL method and principles that were summarized by caine and caine (1997) and Jensen (2012). The strategies harmonized with principles, such as work in groups, encourage cooperation among students, indicate that teaching process will be more efficient when it is conducted within a teaching environment that provides students with chances to exchange experiences within collaboration groups.

The use of concept charts (maps) which leads to link the major and minor themes together, and organize the knowledge hierarchically makes learners more capable to use, retain the knowledge easily.

The note writing (taking notes) help in memorizing the written material. Marshall (2002) and obeidat and abu alsamsed (2005) emphasize that taking notes helps knowledge memorization, retrieving, developing, enhancing with more information.

It also establish new relations between previous and new knowledge. The use of brain storming helps in generating creative ideas through encountering new situation and problem by the students. The review of pervious lesson is found to be complementary to these strategies whether work in groups, concept charts, notes taking and brain storming activate the previous information in the brain.

Jensen (2010) discovered that information is not static so it needs frequent review and repetition, else it will be lost or leaked. These skills need more time to apply.

The application of several strategies has appositive impact on increasing the interaction of students to the class situations. In this context, Aljorani (2008) indicates that enrichment of teaching program, with the varied activities and techniques, can meet the needs and interests of students and take into account the individual differences, this enrichment also can develop positive attitudes and increase the learner self confidence which in turn will help students involve in the activities of teaching situations it also helps more relaxation, active processing and improve achievement.

The providing safe and suitable psycho-educational environment like joy, water drinking, collaborative learning, pre preparing the topic, use of science and computer labs, light and colors are vital factors that help controlling the learning method, and increase the students capabilities of academic achievement. In addition, the use of Know What Learn (KWL) strategy will help teacher to be sure of what learner knows and what she want and what she learned. This strategy helps linking the previous and later knowledge together.

The measure of effect size is an additional measure to determine the efficiency of independent variable (teaching method) in the dependent variable (academic achievement). The value of effect size was 80% and positive for teaching method.

The result of this study agreed with the study of Ozedn Gultken (2008) and differed than the study of Alsalti (2002).

7. Recommendation

- 1) Apply BBL based models due to its importance for achievement.
- 2) It is necessary to organize the syllabus and content of the textbook, besides using the principles of learning based on brain.
- 3) It is necessary to conduct workshops for teachers in the filed of BBL and apply it in the classroom.
- 4) Use of BBL method in teaching chemistry and science.

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