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Effectiveness of a proposed brain-based learning program in developing metacognitive skills in laboratory investigation in Chemistry for Preparatory year students

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Abstract

The present study aimed to identify the effectiveness of a proposed program based on brain-based learning in development of metacognitive skills in laboratory investigation in Chemistry. This study used experimental design based on one experimental group, the sample of the study was randomly selected from 38 students of health track students, Deanship of preparatory year and supporting studies at Imam Abdul Rahman bin Faisal University in Saudi Arabia.

The results of the study showed that:

- There are statistically significant differences at the level 0.01 between the mean of the pre and post application scores, in the metacognition skills scale in laboratory investigation in chemistry in favor of the post application.

-There are no statistically significant differences at the level 0.05 in the metacognitive skills in the laboratory investigation in chemistry due to the style of thinking and education according to the pattern of brain control right hemisphere learner - left hemisphere learner - learner in both halves.

In light of the study results, the researcher introduced some recommendations, including: the need to pay attention to the organization of the knowledge structure of students in the laboratory investigation, as well as the need to teach students the procedures of obtaining information.

Keywords*: Program, Brain-Based Learning Theory, Laboratory Investigation, Metacognitive Skills.*

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I. INTRODUCTION:

Global interest in the subject of thinking increased significantly in the second half of the twentieth century and this is evident in the vast amount of psychological and educational research that is interested in thinking and learning its skills, where thinking is a key factor in guiding life and an essential element in the progress of peoples.

Sanchez,2017, 238, believes that metacognitive skills are necessary for the teacher and his preparation, as they contribute to the development of higher thinking skills. Learn about the views of primary science teachers about the beliefs of the epistemological and beyond knowledge.

Studies that have focused on metacognitive in laboratory science and its various chemistry-physics-biological sciences include introducing a proposed Efklides (2008) study approach, or using teaching strategies and portals such as (Kam Li, & Billy Wong. 2017), (Spada & Marino, 2017) & (Davidowitz & Rollnick, 2003)

The Goli & Momeni study, 2014, aimed to measure the activities metacognitive in the activities of the student's physics laboratory at the university level, which may help in teaching and learning in the physics laboratory, and has used a tool called. The government has also been able to make research that has focused on knowledge in laboratory investigation s is important, but few and still need further study, as indicated by (Goli & Momeni, 2014) (Etkina & Heuvelen, 2007)

The interest of the metacognitive is due to the crystallization of the cognitive trend and the emergence of the structural theory, which emphasizes the importance of the knowledge structure of the individual and that it is this knowledge structure that mediates the thinking metacognitive and the living external reality of the individual. (Samia Al-Ansari, Helmi El Fil, 2009, 82)

It is expected that the near future will reveal accurate and sophisticated technology that helps to reveal the secrets of the brain, and despite the importance of the case for taking care of the results of brain research, we find that interest in applying this theory in education, especially in Arab countries.(Nasser al-Din Abu Hammad, 2017.150-156)

The theory of brain-based learning is one of the modern theories that can contribute to the teaching of science and emerging from cognitive neuroscience, which emerged as a result of recent brain research, which had an impact in several areas leading to cooperation and overlap between several areas including neuroscience, physiology, biochemistry, medicine, psychology and knowledge science, and this integration was the beginning of the birth Brain Based Learning BBL Brain-Based Learning Theory (Zaid Al-Adwan, Majid Al-Khawla,2011)

The Study Problem:

The researcher carried out a pilot study on a sample of 81 students from the health track student in the preparatory year and support studies at Imam Abdul Rahman bin Faisal University, by applying the Scale of Schraw & Dennision(1994) which was designed for the application in the

university stage translated by Mr. Mohammed Abu Hashim, and Dina Al-Flemish to measure metacognitive where he found that the average score 314 While the overall score of the scale is 240, which means that some of the metacognitive skills of these students are deficient, therefore the development of those skills should be taken care of and used in the laboratory investigation in science as indicated by the studies of (Kam Li, & Billy Wong, 2017.& Davidowitz & Rollnick, 2003) which may reflect on the student's performance professionally and academically. (Muslim Al-Tayati,2014.156-181)

The problem of the current study is determined by the lack of some metacognitive skills of the student of the health track in the course of the preparatory year and support studies at Imam Abdul Rahman bin Faisal University, and the need to pay attention to the development of those skills and use them qualitatively in the laboratory investigation in chemistry.

The Study Hypotheses:

The study aims to test the validity of the following two assumptions:

1. There are statistically significant differences at the level of 0.01 between the averages of pre application grades and the distance application grades in the metacognitive skills scale in laboratory in chemistry in favor of the dimensional application.
2. There are statistically significant differences at the level of 0.05 in the skills metacognitive in the laboratory in chemistry due to the methods of thinking and learning according to the pattern of brain control learned in the right hemisphere - learning in the left hemisphere - learning in both halves

The Study Terms:

Through what has been done in the theoretical framework and previous studies the researcher identifies the following procedural terms:

1.The proposed program:

This study is intended for a range of educational experiences that reflect the theory of brain-based learning, through which it is possible to develop metacognitive skills in laboratory intake of the health track student in the preparatory year.

2.Brain-Based Learning Program

It is one of the modern theories of learning emanating from cognitive neuroscience that is concerned with learning according to the way the brain broke to learn normally and which is based on twelve principles.

3.Metacognitive Skills in chemistry laboratory:

A set of skills that help the student to be aware of the tasks they perform when performing laboratory in chemistry, before, during and after the experiment, including knowledge about the

knowledge of the report - conditional - procedural and organization metacognitive planning, observation or control, meditation or presentation in the post, measured by the measure of skills metacognitive in laboratory reliability in chemistry.

4.The Preparatory Year:

It is found in most Saudi universities, which is the academic year in which the student attends the university after the completion of his studies to the secondary level, and precedes his involvement in a specialty, and enrolled in a certain college, where he studies a set of subjects that qualify him to succeed in the required specialization according to the course to which he belongs: healthy, engineering, scientific, human.

II. Theoretical framework, previous studies

Introduction:

The theoretical framework deals with independent and dependent variables respectively where it presents brain-based learning, and metacognitive in laboratory in chemistry, with the presentation and employment of previous studies and research thesis in the context of presenting these variables.

First Brain-based learning theory: BBL

The brain-based learning theory emerged as a result of cognitive neuro

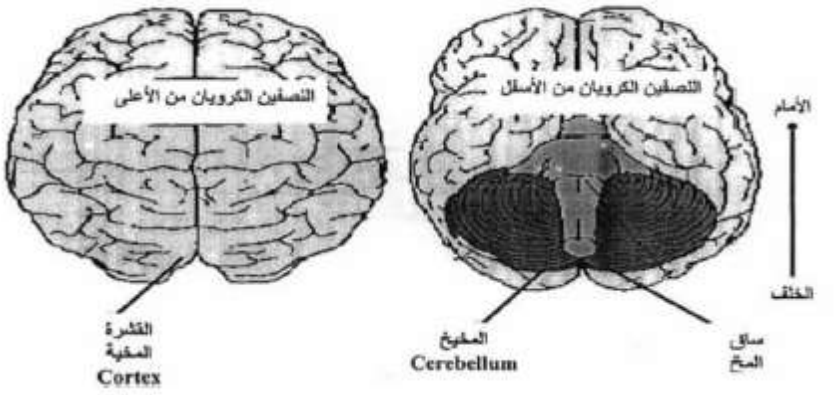
Science research that explains how the brain is learning as a learning organ, as well as working to integrate neuroscience, biochemistry and psychology, and the use of medical techniques in the study of the brain such as nuclear magnetic resonance and positron release, through which electronic activity is measured. For neurons. (Prinz, 2012) (Davidowitz & Rollnick, 2003)

The theory of brain-based learning confirms that the spherical hemispheres are different, and they control two different types of thinking and knowledge and each of us uses one of them better, and each part has an important significance in the teaching and learning (Firas Saliti ,2008,170,7,6) The theory of learning based on the brain, that learning patterns are learned in the right hemisphere, and educated in the left hemisphere, and thus It is interested in identifying the student's learning patterns through this aspect and emphasizes the importance of integrating them.(Rose & Abi-Rached,2013.68) (Erkan & Ozlem,2013.117)

Fathallah Muhammad, Eid Abdulaziz, and explains the form of 1 the composition of the two hemispheres in man. (Haghighi ,2013, 510). (Rached, Erkan, Erkan, ‘Haghighi,2013, 510.)

Brain-based learning and two hemispheres in learning:

Figure (1) Structuring of the Two Hemispheres



- The majority of Arab and foreign studies have agreed that each side of the brain has special ways of processing information Jehan Musa, 2009, and Saleh, Saleh, that the two hemispheres reflect the pattern of learning of each individual and his way of organizing information and that the concept of the spherical halves Hemispheroid reflects the nervous employment of the cerebral cortex, Sousa emphasizes, the need for teachers to pay attention to the activities of the hemispheres, and should be used efficiently in Learning.(Stetsenko, 2016.439)

The current research is interested in identifying student learning patterns, follows the control of the brain and is educated in the right hemisphere, educated in the left hemisphere, and educated in both halves.

Second: Metacognitive in laboratory in chemistry:

The current study defines metacognitive in laboratory intake as:

A set of skills that help the student to be aware of the tasks they perform when doing laboratory in chemistry, before, during and after the experiment, measured by the measure of skills metacognitive in the teacher's establishment in chemistry.

Julie's study, & Etkina", 2008 showed that metacognitive skills in laboratory intake are evident in controlling the variables associated with practical experiments.

Laboratory in chemistry is performed during chemical experiments, which include analyzing the constraints between variables, forming results, and writing the report at the end of the experiment.

Sanchez points out that the skills metacognitive in laboratory investigation are before, during and after the investigation, which is carried out through the third basic stages:

1. Planning: thinking ahead
2. Observation: thinking while thinking while
3. Reflection: Reflection on what has already been rethought

Measuring the skills metacognitive in laboratory investigation in chemistry:

There are two methods of measuring metacognitive in laboratory investigation in chemistry:

- The analysis of protocols, Use of discretionary metrics. (Samia Al-Ansari and Helmy el-Fil, 2009, 87) and the method of analysis of protocols is one of the most common ways to measure the skills metacognitive in laboratory investigation in chemistry, whether It was verbal or written.

- Studies that have been concerned with the development of skills metacognitive in laboratory investigation in science: they can be presented Through table(1)

Through these studies it is clear:

- Interest in studies metacognitive laboratory investigation in different branches of science Spada & Marino, 2017, concerned metacognitive in laboratory investigation in biological sciences, and the study of: Efklides Study,2008, Goli &Momeni, 2014 I addressed it in the field of physics, and the study of (R Ollnick, & Davidowitz, 2003) (Kam Li, & Billy Wong, 2017). I've had it in the field.

Science.

- Metacognitive skills may be before or in the implementation of the laboratory investigation, such as the studies of Kam Li, & Billy Wong, 2017., Rollnick, 2003 Davidowitz or after completing it as a study. Efklides,2008 - Studies have used different tools in measuring metacognitive such as verbal protocols as in the Sanger & Dorjee study, 2016, written as in the Study of Kam Li, &Billy Wong , 2017.

and interviews as in study of Rollnik & Davidowitz ,2003

. The current study has benefited from these studies in determining the skill of laboratory investigation in chemistry and how to develop it, and how it is measured in qualitative ways and analysis and interpretation of data.

The Study procedures

First, to determine the list of skills metacognitive in the laboratory investigation in chemistry: the list of skills is determined as follows:

1-Target selection of the list: The list aimed to identify the skills metacognitive in the laboratory investigation in chemistry suitable for the health track student in the preparatory year.

2- Arbitration of the list of skills: The list was presented in its initial form to the 7 judges specializing in educational psychology, curricula and methods of teaching sciences, and in the light of the opinions of the judges were modified some of the skills included in the list and after the completion of the modifications the list of skills became in its final form, where those skills included two processes Two fundamentals metacognitive are knowledge about knowledge, knowledge, procedural knowledge, conditional knowledge, organization metacognitive planning, control or control, meditation or presentation, distributed in the third basic stages of the investigation , which is before the investigation , during the investigation , and after the E from the investigation included in Thirty one skills.

Secondly, prepare the student's book in the selected chemistry experiments according to the proposed program:

The student's book was prepared in some laboratory investigation s in chemistry according to the modified ISLE model, which reflects the philosophy of brain-based learning.

Thirdly, preparing the teacher's guide to teaching according to the proposed program: The teacher's guide included:

1.Introduction: Included the objective of the teacher's guide and the teaching strategy used.

1. General instructions for the teacher: it refer to a set of guidelines and guidelines that should be observed when teaching
2. Proposed time plan for teaching: Included a statement of the number of trials proposed during which the investigation was taught, which amounted to six sessions and one session lasted two hours over a period of six weeks.
3. Teaching strategy and appropriate teaching methods: The teaching strategy focused on the modified ISLE model of brain-based learning.
4. Evaluation: The interim evaluation was carried out during teaching and provided feedback, as well as the final evaluation after each investigation.
5. Educational means: It should be suitable for the student, which consisted of presentations using computers for each investigation.
6. Laboratory investigation s in chemistry: Laboratory investigation s were presented with a description of how to move from another stage in order to develop skills metacognitive with a focus on the role of the student at every step.
7. References that can be used: The teacher's guide includes a list of some scientific references that the rich teacher can use the scientific material about the investigation s submitted.

Third, the preparation of measuring tools under the current study: the following measurement tools were used:

- A Metacognitive Measure in laboratory investigation in chemistry. Prepared by the Researcher
- Torrance Test to determine brain control pattern: prepared by Torrance et al. translated by Anwar Riad, Ahmed Abada, Fatima al-Khalifa,

Here is how to prepare and use each tool as follows:

1 Measure the metacognitive in laboratory investigation in chemistry:

- The goal of the scale:

The scale aims to measure the skills metacognitive in laboratory investigation in chemistry.

- Scale description:

The 35-single scale consists of measuring the dimensions beyond knowledge, namely knowledge about knowledge, and the organization of knowledge in laboratory investigation in chemistry over the stages of the third investigation before - during - after the investigation.

- The investigation of the scale:

The investigation of the scale was conducted on a group of 42 students of the health track in the preparatory year for the academic year 2018- 2012, in order to calculate the honesty and consistency of the scale as follows:

Validity of the scale:

It was presented to a group of arbitrators in the preparatory year specializing in chemistry, as well as arbitrators specializing in the curricula and methods of teaching science, where they emphasized the appropriateness of the scale to measure the skills metacognitive in the laboratory investigation in chemistry in the preparatory year.

Reliability of the scale:

The reliability of the scale has been verified in two ways: Alpha Cronbach, Spearman and Brown, as shown in the table 3:

From table 3 it is clear that the value of the reliability coefficient of the two skills included in the scale as well as the scale as a whole ranges from4, 8 0-2,90, and therefore it can be said that the reliability requirement of the measure metacognitive in the laboratory investigation in chemistry is achieved.

Thus, the scale in its final form is applicable to the study group, consisting of 35 individuals to measure the dimensions beyond knowledge, namely knowledge about knowledge, and the organization of knowledge in the laboratory investigation in chemistry over the stages of the third investigation before - during - after the investigation .Table 4 Describes the metacognition scale in the investigation

2 Torrance tests to determine the control pattern

A-style thinking and learning

Prepared by Tawarns et al. Translated by "Anwar Riyadh, Ahmed Obada, 9861" Fatima Al-Khalifa, 3013, 322-432, There are many tests that use the anti-cerebral method, the Hermann instrument test, and McCarthy test

The Torrance test is one of the most tested and codified tests on different samples in the Arab environment. Torrance and colleagues prepared it in the light of the results of many research and studies in the neurological and surgical field on human models and therefore were chosen for use in the current research. There are three pictures for the test A, B and C and the picture A was used because it was prepared for adults, which is appropriate for the current research sample.

Aim of the test:

The test aims to determine the thinking and learning style or patterns of cerebral dominance prevalent in individuals who are educated in the right hemisphere - educated in the left hemisphere - educated in both halves.

Test description:

The test in Picture A consists of 36 paragraphs for each third paragraph of alternatives, which are phrases that refer to a method derived from the functions of the right hemisphere and symbolized by the letter R in the correction guide, and other indicating a style derived from the functions of the left hemisphere and symbolized by the letter L, and a third phrase indicating a derivative method Of the functions of each of the two hemispheres symbolized by the letter Sousa, 2011, 211. I

Investigation study:

The investigation study was conducted on a group of 42 students from the Health Track student at the Preparatory Year Deanship of Abdul Rahman bin Faisal University in Saudi Arabia for the academic year 2011-2018-2001, to calculate the honesty and consistency of the test as follows:

Validity test:

In its construction, the test was based on the results of many previous research and studies in the field of determining the functions of the spherical hemispheres of the brain, and therefore the scale has what is called logical truth Fatima Al-Khalifa, 2013, 224

test reliability : the use of the scale of learning and thinking patterns in many Arab and foreign studies, and its reliability was calculated in different ways, and those values showed reliability coefficients ranging from acceptable to good, in Torrance et al. study 1978 The reliability of the scale was verified by the image-parity method, and good reliability coefficients ranged between 83, 0-1,90 Fatima al-Khalifa, 2020, 322-432.

Study group selection:

The study group, a division of the health track people of the Preparatory Year Deanship of Abdul Rahman bin Faisal University in Saudi Arabia, was chosen. The number of the sample population was 36 students, representing one student of the people, which was randomly selected.

Experimental design of the study:

The present study is based on experimental design based on a single experimental group where the program included laboratory investigations in a manner consistent with the development of metacognitive skills in the laboratory investigation of chemistry.

Pre applying for tools.

The tools were previously applied to the study group, the sample of the experimental group, in order to determine the student's level before applying the program.

Adjust parameters:

The researcher tried to control the variables that could affect the results of the experiment, and among these variables are the study tools: All study tools were applied under one conditions, and each time the tools instructions were explained, the researcher also tried to adhere to the accuracy and objectivity in the application until the results are representative of the student's actual performance .

Executing the research experiment and its procedures:

Laboratory investigations were taught in chemistry through a colleague * after training in the use of this model in teaching, according to what is contained in the teacher's guide, and an introductory session was made to introduce the student to the philosophy of brain based learning and what research seeks to achieve is the development of metacognitive skills in their laboratory investigation . The application took 12 sessions and was distributed as Table 5.

Introductory sessions to introduce the program, its philosophy and objectives

The application of laboratory investigations in chemistry

Post-application study tools

Given the nature of the dependent variable that the current research seeks to study and develop, which is metacognitive in the laboratory investigation , which calls for the need to work in the real contexts of learning, this has imposed the need for laboratory investigation s at the chemistry laboratory in the preparatory year.

Post applying for tools

After completing the teaching of chemistry subjects, the researcher applied all the study tools to the same sample of the experimental group, as before teaching, and the results of the tools were monitored after the tools were monitored in a dimension in order to address them statistically to take the most important results of the study, and come up with recommendations that can be applied.

III. The results and interpretation of the study

This chapter deals with a presentation of the findings and their interpretation in the light of the results of the statistical treatment.

View and discuss the results of the first hypothesis:

The validity of First Hypothesis, which states:

1.There are statistically significant differences at 01 ≤a, 0 between the averages of pre application grades, and the degrees of dimensional application in the metacognitive skills scale in the

laboratory investigation in chemistry in favor of Post application., "T" test was used, and the Table 6 shows the results obtained.

2.There are high impact values for the two main skills included in the metacognitive scale in the laboratory investigation in chemistry and the scale as a whole, ranging from 0, to-4,9,53, indicating an effect of experimental treatment in the development of skills and knowledge opinions.

3.The value of the impact volume for both the skill of organizing knowledge planning - observation or control - evaluation or meditation which amounted to 49,0, and the scale as a whole which amounted to 93.0 for the value of the magnitude of the impact in relation to the skill of knowledge about knowledge reportability - conditional knowledge - procedural knowledge which amounted to 53,0

The first hypothesis was thus validated.

This finding is consistent with the studies of Watkina & Heuvelen,2007, which found the effectiveness of using the ISLE investigation environment model in the development of metacognitive in laboratory investigation in physics.

It also agrees with the Davidowitz & Rollnick study, 2003, which found that it was possible to develop skills metacognitive in laboratory investigation chemistry using teaching models that are concerned with the learner's cognitive structure.

This result can be explained as follows:

1 To improve the skill of knowledge about knowledge, which included the third sub-skills: report knowledge. Procedural knowledge and police knowledge are mainly due to:

1.Activating the student's pre knowledge about the main subject of the investigation , which makes the learner active by linking new knowledge with previous knowledge, where the student at the beginning of each investigation writes the information that they have and then the information added to them by the teacher, and this is linked to one of the principles of brain-based learning, which is that the search for meaning is done through profiling.

2.The program's interest in attracting the attention of the brain through guidance, alerting and identifying the subject of the investigation that will be addressed for the occurrence of specialized brain activity, and emphasizing the importance of physical movement at the beginning of each brain gym investigation as it is important for learning and provokes triggers that increase the strength of the brain and help it to form links that strengthen long-term memory allow students to rise and move forward are brain regions responsible for stimulating processes beyond knowledge.

1.Emphasizing the skills of repetition and secondary skills, secondary, routine repetition Rote, and elaborative i.e. the importance of repetition of the main ideas to make it easier to convey in long-term memory, which was through the student's writing of the steps of the experiment activating the left hemisphere, and expressed in the form of drawings and diagrams activating the right hemisphere, which

helped to activate both: the functions of the hemispheres, and the development of police knowledge skills.

2.Guiding the student to the need to write the difficulties they faced and the strengths and how to support them and weaknesses, and how to overcome them after the end of each investigation, which may help in the development of knowledge skill about knowledge, especially police knowledge as a qualitative skill.

2 To improve the skill of knowledge organization, which included the third sub-skills, namely planning, monitoring or control.

- Meditation or evaluation is mainly due to:
- Encourage students to express themselves in different ways by writing investigation steps themselves, giving them time to reflect on their experiments in the investigation, and encouraging them to challenge and engage in learning, which is one of the principles of brain-based learning which indicates that complex learning improves by challenging.

2.Using verbal and visual information as well as providing alternatives and choices for the student to learn collectively, even, and individually to suit each student's learning style according to brain control, and exaggerate the subject of the investigation and the objectives of conducting it in the presentation phase of the investigation , and provide feedback to correct the track first.

3.To allow the student to conduct the investigation s and practice his own steps to reach the results at the stage of the implementation of the investigation, allowing the opportunity to acquire skills beyond knowledge.

4.Guiding the student to the need to write the difficulties they faced, strengths, how to support them and weaknesses, and how to overcome them after the end of each investigation which helped to develop evaluation or meditation as a sub-skill to organize knowledge.

3.Improving the metacognitive skill as a whole knowledge about knowledge - the organization of knowledge is also mainly due to:

1.The metacognitive skills in laboratory investigation were developed in a real context where the student conducted laboratory investigation s themselves in the chemistry lab and not just theoretical teaching of investigation s, which is confirmed by the theory of brain-based learning which emphasizes the importance of focused attention and peripheral cognition.

2.The interest of the program and its consideration of individual differences between learners according to their dominant pattern of brain control is right-hand - acer - integrated which was done by giving the student the freedom to work individually or in groups.

3.The use of presentations in each lesson, which explain the detailed explanation of the subject of the investigation using colors and movement and according to what is contained in the teacher's guide, and providing the student with those presentations in printed papers, led to the ease of acquiring skills and how to practice them effectively.

4.Student book activities have worked to develop skills metacognitive in laboratory investigation throughout the investigation stages, and the student professor has encouraged the need to implement those active with precision and attention.

5.Continuous feedback by the teacher to the student in case of any errors in the implementation of the experiments and answer all their questions and questions on the subject of the investigation.

6.The high value of the impact for both the skill of the organization of knowledge, which amounted to 49.0, and the scale as a whole, which amounted to 93.0for the value of the value of the value of the value of the value of the value of the value of the value of the value of the value of the value of the value of the value of the value of the value of the value of the value of the value of the knowledge skill of knowledge, which amounted to 53.0; The teacher wants it, thus strengthening the student's self-monitoring and planning of the experience, which greatly enhances the skill of organizing knowledge.

Based on the above, it can be said that the results demonstrated the effectiveness of the existing brain-based learning program in developing skills metacognitive in the laboratory investigation of the preparatory year student

View and discuss the results of the second hypothesis:

The second hypothesis of the study, which states: There are statistically significant differences at the level of 0.05 in the skills metacognitive in the laboratory investigation in chemistry due to the methods of thinking and learning according to the pattern of brain control learned in the right hemisphere - learning in the left hemisphere - learning in both halves

The chemistry laboratory attributes the methods of thinking and education according to the pattern of brain control learned in the right hemisphere - learning in the left hemisphere - learning in both halves

The student was classified for the third groups according to the pattern of thinking and learning and is educated in the right hemisphere - educated in the left hemisphere - educated in both halves and their distribution was as Table 7 shows:

I don't know Then the distribution of the student's grades to both the knowledge skill sought about knowledge, the organization of knowledge and their overall degree in the scale of skills metacognitive in the laboratory investigation in chemistry, and then the calculation of the ph. ratio of the third groups right - left - integrated in the skills of knowledge about knowledge, and the organization of knowledge As sub-skills as well as metacognitive skills in laboratory investigation in chemistry as a whole to identify their statistical significance, the following table shows this: Table 8 Analysis of the

first variation of the third groups depending on the pattern of thinking and learning in the skills metacognitive in the laboratory investigation in chemistry and its sub-skills

From the previous table it is clear that:

1. There is a difference between the third groups in the knowledge skill of knowledge in the laboratory investigation in chemistry at 0.05 ≥ attribution to the pattern of thinking and learning according to the pattern of brain control.
2. There is a difference between the third groups in the skill of organizing knowledge in the laboratory investigation in chemistry at 0.05 ≥ attribution to the pattern of thinking and learning according to the pattern of brain control.
3. There is a difference between the third groups in the skills metacognitive in the laboratory investigation in chemistry as a whole at the level of 0.05 ≥ attribution to the pattern of thinking and learning according to the pattern of brain control

The second hypothesis of the study was thus accepted.

That finding is consistent with the study of Sousa, 2011, 216 , Saleh ,2012, 107-122

Which showed that each side of the brain has special ways of processing information and that they reflect the pattern of learning and the way in which each individual organizes information, as well as agreed with Haghighi,2013. These results differed with the study of Erkan and Ozlem, 2013,104, which emphasized the importance of integrating the two hemispheres, the study of Fathallah Mohammed, and Eid Abdul Aziz, 2012,31, which reached the importance of the left hemisphere in science learning.

This result can be explained as follows:

All models that were interested in the processes metacognitive from a neurological point of view emphasized the role of the cortex cerebral cortex as well as agreed on the role and importance of the anterior lobe of the prefrontal cortex and its role in the processes metacognitive without addressing the role of the spherical hemispheres.

That the skill of the organization of knowledge may be mainly related to the work of one half without the other, and this is illustrated by the sub-skills emanating from it, some of which are related to the work of the left hemisphere, such as: follow the instructions of the implementation of the experiment regulation time to do the steps of the experiment and achieve the goal of maintaining the sequence of the steps of the experiment, some of which are related to the right hemisphere such as: monitoring the use of materials and tools correctly work to listen to the results of the experiment, others may be performance In either half, such as: assessing the consistency between what was achieved in the experiment with the correct results, assessing how the obstacles and errors that occurred during the trial and how successful they were to address them, and assessing how to correct and subsequently correct the errors that occurred.

That all the skills metacognitive in the laboratory investigation in chemistry are related to one of the functions of the spherical halves individually, some of them are related to the right hemisphere, some of them are related to the left hemisphere, and there is the preference to use one without the other in performing those skills, but they all need to activate

The anterior lobe of the cerebral cortex, which is also not linked to the functioning of the spherical hemispheres in models that explain the processes of what is known from a neurological point of view

IV. The Study Recommendations:

In light of the results presented and interpreted, the study recommends:

The need to pay attention to the organization of the student's knowledge structure in the laboratory investigation by linking the previous information to the new information, thereby achieving meaningful learning.

The need to teach the student the procedures of obtaining information and linking procedural and reporting knowledge in the laboratory investigation without limiting only the indoctrination of information and knowledge.

The need to teach skills metacognitive in laboratory investigation in science in the curricula and methods of teaching science in the Faculty of Education.

V. The Study Suggestions:

The study suggests conducting the following research:

- A proposed building-based program to develop beyond knowledge skills in laboratory science investigation
- The effectiveness of some structural and brain-based learning models in developing skills beyond knowledge in laboratory investigation in science

References:

1. Davidowitz , B and Rollnick, M.(2003) . “Enabling metacognition in laboratory, A Case study of four second year university chemistry students”. Research in Science Education. 33:43-69.
2. Erkan , A., Ozlem,, A. (2013) . “Effects of Brain Approach on Students Motivation and attitudes levels in science class. Mevlana International Journal of Education, 3(1): 104-119.
3. Etkina, E. and Heuvelen , A. (2007). “Investigative science learning environment - A Science process approach to learning physics”. Research - based Reform of University physics.

4. Goli Z., & J., Momeni et. (2014). Effect of Metacognitive Skills Training on Metacognitive Awareness, Self- Efficacy and Academic Achievement of University Students. International Archives of Health Sciences. Fall 2016, Vol.3, No.4, pp l71-177 .

5. Guven, M. (2010). “Primary School teacher trainees' opinions on epistemological beliefs and metacognition” , Elementary Education Online, 9(1): 361-378

6. 18) Haghighi, M. (2013). “The effect of brain based learning on Iranian EFL learners’ achievement and retention “, Procedia – Social and Behavioral Science, Vol. 70, 508-516

7. Mohammed Nader Shalaby. (2017). “The Determinants of Leadership: Genetic, Hormonal, Personality Traits Among Sport Administrators”, International Journal of Pharmaceutical and Phytopharmacological Research, 7(5), pp:9-14.

8. Mohammed Nader Shalaby. (2018). “The Effect of Whey Protein (Natural Nanoparticle) on Muscle Strength, GH, IGF, T. Protein and body composition”. Int. J. Pharm. Res. Allied Sci., 2018, 7(1):126-132.

9. Mohammed Nader Shalaby, Mona Mostafa Abdo Sakoury, Omar Ali Hussein Mohammed, Shaimaa Elsaid Ebrahim Elgamal. (2017). “Effect of PNF Stretching Training on Stem Cells and Growth Factors in Performance Soccer Players”, International Journal of Pharmaceutical and Phytopharmacological Research, 7(2), pp:12-17.

10. Mohammed Nader Shalaby. (2018). “Study of Markers behavior in Myocardial Infarction”. Int.J. Pharm. Res. AlliedSci., 2017, 6(2):138-148.

11. Mohammed Nader Shalaby, Mona Mostafa Abdo Sakoury. Effect of different exercise intensities on CD34+ stem cells and physiological variables parameters. Life Sci J 2017;14(1):104-110.

12. Mohammed Nader Shalaby, Nawaf Elshemary, Ezz El-Din Mohamed Ahmed, Mona Mostafa Abdo Sakoury. Sport College Students Uses and Perceptions of Social Networking Sites of Sport Doping Information. J Am Sci 2018;14(2):20-66

13. Mohammed Nader Shalaby, Jin Yu Liu, Hussein Heshmat, Nader M. Shalaby, Mohammed Salah Zaeid, Ahmed Ibrahim Shalgham, Maged Elazazy, Samy Akar, Hossam Elaraby, Mohammed Abdelrazik Taha, Wael Elfiel.. The Effect of Aerobic and Anaerobic Exercise Bouts on CD34+ Stem Cells and Some Physiological Parameters. Life Sci J 2012;9(2):1037-1043

14. Shalaby, Mohammed & Saad, Mohammed & Akar, Samy & Reda, Mubarak & Shalgham, Ahmed. (2012). The Role of Aerobic and Anaerobic Training Programs on CD34+ Stem Cells and Chosen Physiological Variables. Journal of Human Kinetics. 35. 69-79. 10.2478/v10078-012-0080-y.

15. Mohammed Nader Shalaby, Jin Yu Liu, Mohamed Saad and Hossam Elaraby. Impacts of Different Exercise Intensities on Hematopoietic Stem Cells and Certain Physiological Parameters on Handball Players and Non-Athletes. Life Sci J 2012;9(3):2100-2105.

16. Mohammed Nader Shalaby, Jin Yu Liu, Mona Mahmoud Kassem, Mohammed Saad. Circulating Hematopoietic Stem Cell and Some Physiological Parameters in Different Training Programs. Life Sci J 2012; 9(1):965-971.

17. Mohammed Nader Shalaby, Jin Yu Liu, Hussein Heshmat, Nader M. Shalaby, Mohammed Salah Zaeid, Ahmed Ibrahim Shalgham, Maged Elazazy, Samy Akar, Hossam Elaraby, Mohammed Abdelrazik Taha, Wael Elfiel.. The Effect of Aerobic and Anaerobic Exercise Bouts on CD34+ Stem Cells and Some Physiological Parameters. Life Sci J 2012;9(2):1037-1043.

18. Mohammed Nader Shalaby, Mona Mostafa AbdouSakoury and Marwa Ahmed Kholif, Mona FathiRizk.Assessment of the muscular power index using infrared technology.Life Sci J2019;16(12):20-31

19. Shalaby, M. N. (2020). The effectiveness of a water sports program on the level of poly unsaturated fatty acids and the severity of the disease in children with Autism spectrum disorder. Medical Science, 24(101), 143–164.

20. Julie, E. and Etkina, E. (2008). “Fostering self-reflection and meaningful learning :Earth science professional development for middle school science teachers”. Journal of Science Teacher Education 19:455-475