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Teaching strategy based on allosteric learning and its impact on lateral thinking in mathematics for Preparatory school students.

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Abstract

The current research aims at identifying the impact of strategy based on allosteric learning in lateral thinking in mathematics for Preparatory school students, the researchers adopted empirical research, as the semi-experimental design was used for two independent and unequal groups with a post-test, the experiment was applied to a sample consisting of (67) fourth scientific grade students in the Preparatory School (Al-Rusafi for Boys) affiliated to the General Directorate in Anbar Governorate - Fallujah Education Department for the academic year (2022-2023), the research sample was distributed equally among the two research groups, as division (C) was chosen randomly to be the experimental group, while Division (A) was chosen to be the control group, the distribution was made according to the following variables data (previous achievement, prior knowledge, intelligence), the lateral thinking test was constructed, which consisted of (24) items, divided into (14) objective items of the multiple choice type with four alternatives and (10) items of essay items, where validity and reliability were verified and found acceptable, after the experiment completion, the lateral thinking test was applied, and the statistical program (SPSS) version (23) was used, Levine's test and t-test were adopted for two independent samples, the results showed that the experimental group students superiority on the control group students in the lateral thinking test.

Keywords

Teaching strategy - allosteric learning - Preparatory school - mathematics - Hypothesis.

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First: research problem

The impacts of scientific and technological development were reflected in the curricula, of learning methods and techniques, which used modern technologies in the instructional process and became an integral part of it, this development has a great impact on the instructional thought development and a reconsideration of many of the education goals, education is no longer just a collection of information, but rather it has a comprehensive role that seeks to help the learner. (Hamad & Jasim, 2018, p. 1206). There was a need to find a new teaching strategy that keeps up with technological progress, at a time when cognitive trends in psychology produce new contemporary concepts that focus on new thinking types, such as lateral thinking, which seeks to crystallize old ideas and concepts and generate new ideas and concepts that are applicable in areas that need atypical and unconventional thinking, that mathematics seeks by emphasizing the discover of new mathematical knowledge from concepts, generalizations and theories and applying them in non-traditional and unfamiliar fields . . (Jawad, 2021, p. 173)

And "Despite the efforts made by our instructional organizations, and its quantitative and qualitative changes, their instructional programs and activities are still relatively limit to develop sound thinking methods between our students, and their programs and evaluation methods still depend on facts and information indoctrination to students, so we find that many students do not think well, (Majeed, 2020, p. 334), not because they lack intelligence or lack mental ability, but rather they did not learn proper thinking skills in how to think well, and they did not obtain good and correct guidance nor the necessary training for it, and it is evident that the teaching methods used in the present time to achieve thinking goal between fourth scientific grade students (Mashkour and Hamoudi, 2022, p. 121), Considering the importance of this topic and the lack of studies that examined the research variables, the researcher sought to use a teaching strategy that is useful in addressing the difficulties faced by students, especially this strategy was not addressed the mathematics field inside Iraq, to the knowledge of the researchers.

Based on the foregoing, the research problem can be determined by answering the following question:

What is the impact of a teaching strategy based on allosteric learning on lateral thinking in mathematics for Preparatory school students?

Second: Research Importance:

A. The allosteric learning model is one of the post-constructivist models, and it is one of the recent trends that have emerged to introduce new and innovative learning methods in the instructional process, It is based on its philosophy that the student understands and gains knowledge by using a group of existing cognitions in his mind and the surrounding environment, and through which the student analyzes or reconstructs the existing knowledge in his mind.

B. It is a response to the increasing global trends of the need to pay attention to thinking in general, and lateral thinking in particular between students, through the study materials offered to them.

C. The research is a response to the recent trends in education that the mathematics curricula should include lateral thinking skills, to keep up with the tremendous progress in education.

D. Providing a test in lateral thinking skills prepared by the researcher that has psychometric characteristics for the fourth scientific grade students, which researchers and teachers can benefit from in the mathematics curriculum.

Third: Research objective:

The current research aims at identifying the impact of a teaching strategy based on allosteric learning on lateral thinking in mathematics for Preparatory school students.

Fourth: Research Hypothesis:

There is no statistically significant difference at the significance level (0.05) between the mean scores of the experimental group students who studied the subject based on the teaching strategy according to the optional learning strategy and the students' scores who studied the subject based on the traditional method in the lateral thinking test.

Fifth: Research Limitations:

1. Fourth scientific grade Students in government secondary and preparatory day schools in the General Directorate of Education of Anbar / Education Department of Fallujah District - the first semester of the academic year $2022/2023$ AD.

2. Lateral thinking skills: (generating new perceptions, generating new concepts, generating new ideas, generating new alternatives, generating new creations)

Sixth: Terms identification:

First: teaching strategy:

(Hammadi & Majeed & Hassan, 2023) indicated that: "It is a set of methods that the teacher uses and can organize his ideas, and link between the new knowledge and the previous knowledge." (Hammadi & Majeed & Hassan, 2023, p. 43).

Second: Allosteric learning:

(Mukhtar and Mahdi, 2013) defined it as: A model that describes what happens in the learner's mind in terms of mental processes, as well as the external factors that make the learning process easier, and creates a highly efficient learning environment that interacts with the student's learning processes, and it includes five steps: problem, references, mental processes, semantic network, semantics" (Mukhtar and Mahdi, 2013, p. 213).

Third: Lateral Thinking:

(Hassan, 2018) indicated that it is: "that type of thinking that requires solving problems in untraditional ways or seem illogical" (Hassan, 2018, p.68)

Chapter Two: References Review

First: theoretical background

The first axis: allosteric learning

It is deep and organized learning to acquire and build knowledge. Andre Giordn is the founder of the allosteric learning model, as he made an analytical study of various learning theories, and then organized those theories in the form of three axes or factors, namely: (knowledge, society, and the learner), he concluded that most of the current theories are very close to one of these three factors, that is, they focus on only one major factor, while Gordon designed the allosteric learning model, which is located at the meeting point of several factors, as an attempt to fill this gap and achieve integration between the three factors that appear in the following figure. (Bishay, 2017, p. 16).

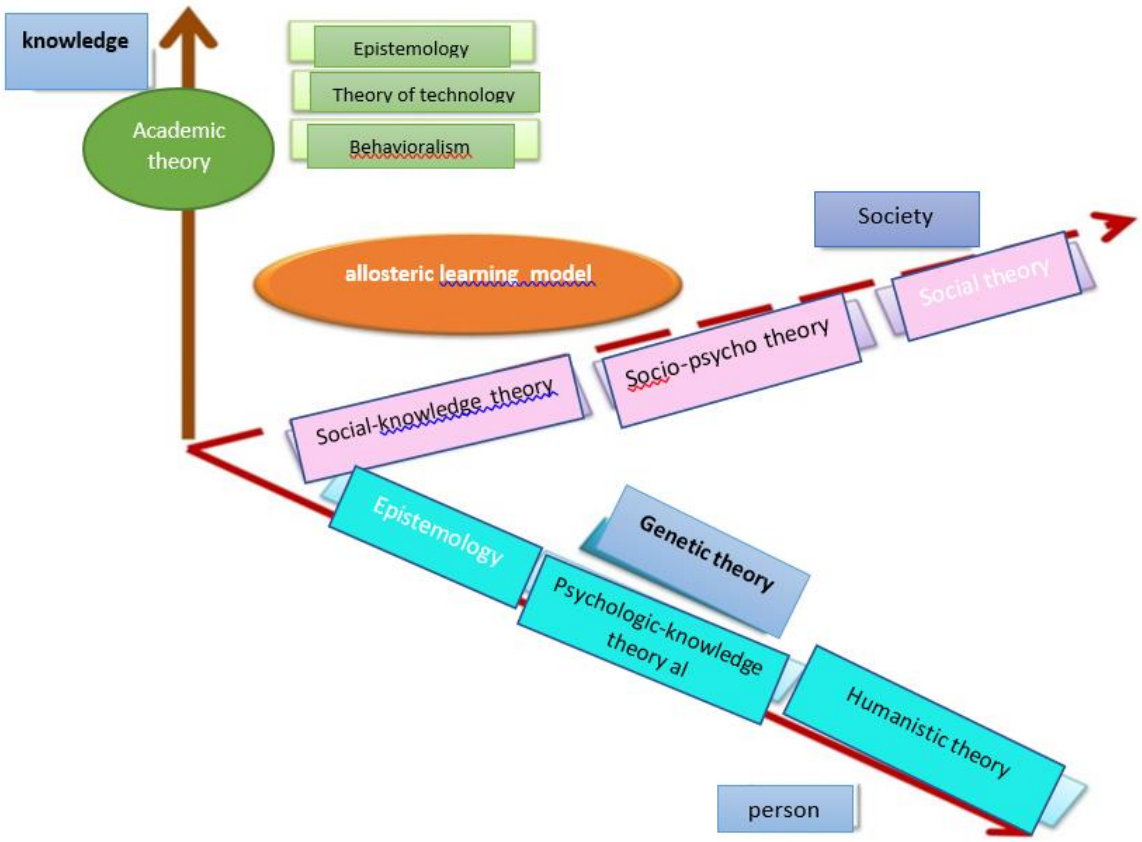

Chart No. (1)

The location of the allosteric learning model in relation to different learning theories

(GIORDAN, A., 2012)

We note from the chart that learning based on allosteric learning does not depend on one factor only, but depends on a network of conditions and factors that can be called the didactic environment which plays an important role in how learning takes place. Learning results from the mental processes that occur within the learner mind and the processes that occur within the didactic environment.

Allosteric learning model stages

(Jordan and his colleagues, 1999) identify teaching stages using the allosteric learning model, according to five steps, namely:

1. The problem stage: the teacher starts by asking a set of questions to the learners, and these questions may be completely clear to the learners, and they may be less clear, but the important thing is that these questions are related to a specific concept or one of its applications, These questions are the driving force for every mental activity of the learners.
2. **Reference stage:** In order for the learners to be able to answer the teacher's questions, the learners begin to try to find a relationship between the previous knowledge they possess and the new knowledge.
3. Mental operations: a group of intellectual operations carried out by learners while participating in problem-solving activities and expanded investigative activities, the learners at this stage express the relationships between the new knowledge and the previous knowledge through (drawings, diagrams, symbols).
4. Semantic network: It is the interactive knowledge system that arises from the mental processes that are based on previous knowledge, and this system gives the comprehensive semantic coherence to the new concept, Thus, it becomes easy to apply it in many situations, that is, this system arises as a result of the of all the relationships interaction that were formed between the main and sub-elements of the concept, and a network of meanings results from this process.
5. Semantics: It is a group of ideas, signs and symbols necessary to express the concept and the interpretations associated with it.

(Giordan et al, 1999, p. 65), (Bishay, 2017, p. 20).

The second axis: lateral thinking

Lateral thinking returns to the world (Edward de Bono) to generate information that is not available about the problem, this requires a change in attitudes, it also requires a change in the way of understanding the subject, and lateral thinking requires at the same time looking at the things that help us to look at them in the same way, it also requires considering at these matters in a different way in order to liberate from old ideas, and to raise new ideas that are Identical manifestations of lateral disintegration." (Mahdi, 2018, p. 149).

Lateral thinking was developed by the scientist (De Bono) to understand the brain mechanism by which it works, based on what has been achieved in neuroscience through his author "The Mechanism of the Mind", where the brain organizes and arranges the information that it receives through the senses in a spontaneous way, as the brain works to form patterns and search for them

later, and what is meant by the pattern is the organized formation of neurons that make up the (brain) or the organization of information on the memory surface, the pattern means a repetitive neural sequence in its responses to the information it receives, as it allows it to organize itself on its surface. (Al-Khafaji, 2015, p. 40) (Abu Jadu and Muhammad, 2007, p. 464).

Principles of Lateral Thinking: The basic principles of Lateral Thinking are as follows:

"Lateral thinking is not an inherited talent, in addition to being very interested in possibilities. It is a pattern of thinking that can be trained and acquired, and it is different from logical thinking, beyond it, and different from vertical thinking, true logic is interested in facts or what can happen." (Jasim, 2023, p. 323)

Lateral thinking skills

1. **Generate new perceptions skill:**

"It means (awareness or understanding), this means that the learner becomes aware of things through thinking about them, in other words, perception is the hypothetical, conscious, purposeful thinking of the mental (mind) operations that the learner performs, which impose understanding, decision-making, problem-solving, or judge things or doing something to realize the type of inner vision directing the learner towards the idea with the aim of understanding it, and de Bono confirms that thinking and understanding are one thing" (Saleh and Saud, 2014, p. 40)

2. generate new concepts skill

It is general methods or ways of doing things. Concepts are sometimes expressed in clear ways, and in order to express a concept, an effort must be made to extract this concept.

3. generate new ideas skill:

It is an idea of something that is conceived (understood) through the mind and ideas which are material ways of applying concepts and an idea must be specific and the idea must be put into practice.

4. generate new alternatives skill:

It is a special way of contemplating solutions among a group of possible and available ones, where lateral thinking is concerned with discovering or generating other ways to reorganize the available information and generate new solutions instead of going in a straight line which then leads to the development of a single pattern. (Al-Kubaisi, 2013, p. 131).

5. generate new creations skill:

"De Bono confirms that creativity is the work of creating something new rather than analyzing an old event, Creativities or innovations include a pattern of lateral thinking – the generation of familiar creations is often rapid, while the production of authentic innovations occurs slowly, hence, it is easy to exclude the most common production by asking economical individuals to produce original and creative ideas, usually, individuals tend to produce the most original responses by continuing to work on the learning task or problem they face. (Theeb and Alwan, 2012, p. 476)

Second: previous studies

1. Mahdi's (2016) study: identifying the impact of using the allosteric learning model to teach nanotechnology to develop creative thinking, achievement, and inclination towards mathematics between secondary school students, the researcher used the Empirical research, The study sample consisted of (98) students distributed equally between the two research groups, and the study tools are a test of creative thinking, an achievement test, and a measure of inclination towards mathematics.
2. Al-Khafaji Study, (2015): Identifying the impact of an instructional design based on education strategy for understanding on mathematics achievement and lateral thinking between fifth-grade female students, the researcher used the experimental method, the study sample consisted of (58) female students distributed equally into the two research groups, and the two research tools are an achievement test and a lateral thinking test.

Chapter Three / Research Procedures

First: Research Methodology: In this research, the researchers adopted the empirical research, in order to achieve the research objectives.

Second: The experimental design of the research: The two researchers adopted one of the experimental designs with partial control for two independent, equal groups with a post-test, due to its suitability to the current research problem, Table (1):

Table (1) the experimental design of the research

group	equivalence in a number of variables	independent variable	dependent variables	dependent variable measurement
Experimental	– Previous achievement in mathematics – IQ test	A teaching strategy based on allosteric learning	– Lateral thinking	– Lateral thinking test
Control	– Previous knowledge test in mathematics	Traditional method		

Third: research community: fourth scientific grade students were selected from secondary and preparatory day schools, affiliated to the Fallujah Education Department / General Directorate of Education in Anbar Governorate, for the academic year (2022/2023), as the total number of schools in them reached (36) schools and the total number of students are (1564) students distributed among (19) secondary schools and (17) preparatory schools.

Fourth: Research sample: The research sample, which reached (67) students, was distributed equally to the two research groups based on the following variables data (previous achievement, prior knowledge, intelligence), and group (A) was randomly chosen to be the control and group (C) was chosen to be to be the experimental.

Fifth: control procedures:

Sixth: Research Tool (Lateral Thinking Test)

1. **identify the test purpose:**
2. **Look at the literatures and previous studies:**

3. **identify lateral thinking skills:**

4. **identify test items in light of the specific areas:**

5. **Presentation of skills with paragraphs to the arbitrators**

6. **Preparation of test instructions**

7. **Test validity**

A. **Virtual validity:**

Virtual honesty is achieved by presenting the test to a number of arbitrators and specialists in mathematics, methods of teaching mathematics, measurement, evaluation and psychology, and the items on which arbitrators' agreed of more than (91%) of the arbitrators' opinions were accepted.

B. Construct Validity:

Internal consistency validity of the lateral thinking test was confirmed by finding the correlation between each of the following:

A. **Correlation coefficient of each item degree with its skill level:**

The correlation coefficient was extracted based on the correlation coefficient (Pearson) in order to find the correlation coefficient between each item degree and its domain degree, the results showed that all test items are statistically significant, which is a good indicator of the constructive validity of the lateral thinking test.

B. **Correlation coefficient of each test item scores and the total test scores:**

The correlation coefficient was extracted depending on the correlation coefficient between each item and the total test score, using Pearson correlation coefficient, the results showed that all test items are statistically significant, which is a good indicator of the constructive validity of the lateral thinking test.

8. **Exploratory for test lateral thinking:**

A. First **exploratory:**

The first survey test was applied to a group of students, to ensure its items clarity and instructions, and to determine the time.

B. Second **exploratory:**

The test was applied to (100) fourth scientific grade students, and the purpose of applying this test is to know the psychometric characteristics.

9. **Statistical analysis of test items**

After the test was applied to the statistical analysis sample, the following was performed:

- Correct and arrange the answer sheets in descending order from the highest total score to the lowest total score.
- Identify and sort the group scores with the highest (highest) scores, and the scores of the group with the lowest (lowest) scores, by using the highest percentage (27%) and lowest (27%) of the two groups in order to analyze them statistically.

a. Difficulty and ease coefficient **of the lateral thinking test items:**

The difficulty coefficient was calculated for each item of the test, which was (14) items, according to its own difficulty coefficient, and it was found that it ranged between (0.314-0.529), as for its ease, it ranged between (0.370-0.685), and the difficulty of the essay items ranged between (0.320-0.574), and its ease ranged between (0.425-0.679).

b. Effectiveness of distractors

The effectiveness of distractors was calculated for each objective test item based on the equation for the effectiveness of distractors, and it was found that they were all negative, and this means that these distractors distracted the students with lower levels, which indicates their effectiveness for the lateral thinking test.

10. Lateral thinking test stability:

Stability coefficient value was calculated for the lateral thinking test that was applied to the statistical analysis sample based on the equation (Alpha Cro Nabach), where the stability value was (0.87), indicating that (Allam, 2000) that the stability value is (0.80) and above is a high value of stability (Allam, 2000, p. 543).

11. Lateral thinking test in its final form and application:

The lateral thinking test was applied in its final form, at the same time, on the two research groups, on Sunday 15/1/2023 AD.

Chapter Four: Presentation and interpretation of the results

First: Presentation of the results and the objective: It aims at identifying the impact of a teaching strategy based on allosteric learning on lateral thinking for Preparatory school students. The null hypothesis was derived which states that "there is no statistically significant difference at the

significance level (0.05) between the mean scores of the experimental group students who studied the subject based on teaching strategy according to the voluntary learning and the scores of the control group students who studied the subject based on the traditional method in the lateral thinking test ". Hence, we find the scores arithmetic mean of the experimental group students (12.8529) with a standard deviation of (2.92463), and the scores arithmetic mean of the control group students (10.0303), with a standard deviation of (3.44134), then, the performance level is in favor of the experimental group, because the arithmetic mean of the experimental group is greater than the arithmetic mean of the control group.

By using t–test for two independent samples to find out the difference significance between the mean scores of two groups students, where the value of (t) was (3.622) at the significance level (0.001), which is smaller than the significance level (0.05) approved and with a degree of freedom (65), As the results showed the superiority of the experimental group students, and this indicates the rejection of the null hypothesis and the acceptance of the alternative hypothesis, and by using the effect size equation, since the effect size was large in relation to the strategy, and the following table shows that.

Table (2)

group	number of students	arithmetic mean	standard deviation	standard error of the arithmetic	e ، s F	t e i f i c	degrees of freedom	Statistical significance at the level (0.05)

Experimental	34	12.8529	2.92463	0.50157	0.097	0.001	65	Statistical significance
Control	33	10.0303	3.44134	0.59906				

Statistics of the results of the lateral thinking test application

Second: Conclusions: The most important conclusions reached by the researchers:

The use of a teaching strategy based on allosteric learning contributed to raising the level of thinking among experimental group students, through the students' level in the lateral thinking test.

Third: Recommendations:

The use of the teaching strategy based on allosteric learning in teaching mathematics at all levels of study due to its impact on lateral thinking skills.

Proposals:

To conduct similar study to the current research for the intermediate stage and other variables such as critical thinking, creative thinking, reflective thinking, etc.

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