

## Teaching mathematics with the active thinking model and its impact on metacognitive thinking among the fourth literary students

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### Abstract:

The aim of the research is to identify (Teaching Mathematics with the Active Thinking Model and its Impact on the Metacognitive Thinking of the Literary Fourth Students); The research sample consisted of (60) students of the fourth literary students, distributed equally into two experimental and control groups of (30) students in each group. , and check its psychometric properties; The researcher applied the test to the two research groups after the end of the experiment, and the results showed: The students of the experimental group who studied with the active thinking model outperformed the students of the control group who studied in the usual way in the metacognitive thinking test.

**Keywords: active thinking model, metacognitive thinking, mathematics.**

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### Research problem:

The researcher noticed, through his experience in teaching mathematics, that many of the literary fourth students do not improve the skills (planning, monitoring, control, and evaluation) and these are metacognitive thinking skills, not because they lack intelligence or lack mental abilities, but because they did not learn the special methods of how to think well. They did not receive the correct guidance nor the training necessary for it, and it is believed that the reason for this is due to the teaching methods used in teaching, as the methods and methods of teaching mathematics are a direct presentation method whose focus is the teaching and the student's position is the recipient of information, and accordingly the researcher chose the active thinking model for teaching mathematics and knowing its impact on thinking The metacognitive among the literary fourth students, so the problem of the current research is determined in answering the following question:

What is the effect of teaching mathematics with the active thinking model on metacognitive thinking among the literary fourth students?

### research importance:

Mathematics is one of the basic education subjects and is a fertile field for the acquisition and development of different types of thinking. (Zahran, 2018, pg. 164).

Metacognitive thinking is the highest and most complex level of thinking, and it refers to the thought processes of thinking or self-monitoring and the conscious use of learning strategies, meaning: the learner learns how to learn; Therefore, adopting this concept in the education process requires providing a learning environment that encourages thinking and makes the learner more positive and active in the learning process, collecting information, and organizing it during the learning process, as well as enabling him to employ his learning in the situations he faces. (Atiya, 2010, p. 139) .

Sternberg classified metacognitive thinking into three main skills:

**Planning:** The planning skill includes having a specific goal for the learner, whether that goal is specific from the learner himself or from others, and he has a plan to achieve this goal. what is the nature of the task I shall perform; Therefore, the planning skill includes sub-skills, which are:

1. Defining the goal or sense of the problem.
2. Choosing the implementation strategy and skills.
3. The order of the sequence of operations or steps.
4. Identify potential obstacles and errors.
5. Determining the methods of facing difficulties and errors.
6. Predicting the desired or expected results.

**Monitoring and Control:** At this stage, the learner needs to provide self-mechanisms to monitor the extent to which the objectives to be achieved are achieved. Monitoring includes asking many questions, such as: Does the task I am doing make sense? Are necessary changes required to facilitate the process of achieving the goals, including the following sub-skills:

1. Keeping the goal in focus.
2. Maintaining the sequence of operations or steps.
3. Knowing when a sub-goal will be achieved.
4. Know when to move on to the next process.
5. Choosing the appropriate process to follow in the context.
6. Discover obstacles and errors.
7. Knowing how to overcome obstacles and get rid of errors.

**Evaluation:** The evaluation skill includes evaluating knowledge, setting goals, and selecting sources. It also includes that the individual asks questions such as: Have I reached my goal? And what worked for me? And what didn't work? It includes the following sub-skills:

1. Evaluation of the extent to which the objective has been achieved.

2. Judging the accuracy and adequacy of the results.
3. Evaluate the appropriateness of the methods used.
4. Evaluate how obstacles and errors are addressed.
5. Evaluate the effectiveness of the plan and its implementation.

(Ghabari and Khaled, 2015, pp. 192-191).

And that the adoption of the model in teaching is one of the modern trends that have proven its effectiveness in education. It is important to choose teaching models and pay attention to them in order to meet the educational needs of learners, as well as their mental needs; Accordingly, the researcher decided to use the active thinking model in teaching mathematics to the fourth literary students. This model aims to assist in the development of various life skills, as it encourages discussion and dialogue as well as public participation in thinking, in order to address real-life problems to facilitate the transmission of the impact of learning and the future use of problem-solving skills through its steps that were prepared based on my theories (Vygotsky, 1978), which In his sociocultural theory, he emphasized the importance of social interaction in the development of higher psychological processes, as well as (Sternberg, 1985) in his tripartite theory of human intelligence, which assumed that there are three types of human intelligence (analytical intelligence, creative intelligence, and practical intelligence), which together help to a degree This model is considered one of the flexible models that can be modified to suit the needs, preparations and abilities of students in different areas of the curriculum. (Jaber, 2010, pp. 293-294).

### **The Aim of the Research:**

The current research aims to familiarize mathematics teaching with the active thinking model and its impact on metacognitive thinking among students of the literary fourth.

### **Research Hypothesis:**

In order to achieve the research objective, the following null hypothesis was formulated:

\* There is no statistically significant difference at the significance level (0.05) between the average scores of the experimental group students who are taught by the active thinking model and the average scores of the control group students who studied in the traditional way in the metacognitive thinking test.

### **The Scope of the research:**

The current search is limited to:

1. Human Frontiers: Fourth Literary Students.
2. Time limits: The second course for the academic year 2018-2019.
3. Spatial boundaries: the city of Ramadi / the center of Anbar Governorate.

4. Objective limits: Three chapters of the mathematics book for the fourth literary grade are: (Chapter Three: Trigonometry; Chapter Four: Coordinate Geometry; Chapter Five: Statistics).

### **Define terms:**

#### **1. Active Thinking Model: Define it:**

\* (Wallace & Adams, 1993): It is (an educational model based on the theories of Sternberg) and (Vygotsky), consisting of eight steps: “information gathering, identification and discrimination, idea generation, decision making, implementation, evaluation, communication, learning.” From experience” helps students to think effectively in an atmosphere of social interaction (Wallace & Adams, 1993, p3).

**The researcher defines it procedurally:** a teaching model consisting of eight successive procedural steps based on Sternberg’s triple intelligence theory, and Vygotsky’s social constructivist theory that begins with collecting the fourth literary request and organizing their mathematical information, and then distinguishing between that information, then generating ideas related to the topic of the lesson In order to make, evaluate and circulate decisions in an atmosphere of interaction between students.

#### **2. Metacognitive thinking: define it:**

\* Razoqi, Muhammad and Daoud (2019): They are (complex thought processes used by the teacher during his cognitive activities and include active monitoring of knowledge processes, represented by task planning, comprehension monitoring, and evaluation of progress). (Razuqi, Muhammad and Daoud, 2019, p. 164).

**The researcher defines it procedurally:** they are higher mental processes whose function is planning, monitoring and evaluation, and it is measured by the total score obtained by the fourth literary student when he answers the test items prepared by the researcher.

### **Theoretical framework:**

#### **Active Thinking Model:**

There is a close relationship between thinking and problem solving, because problem solving is achieved exclusively through thinking in its different patterns, and it cannot be achieved by any other way, and that thinking and its methods, methods and products are best formed in the context of problem solving, that is, when the learner collides with several solutions to problems and educational tasks And with the problems and issues that are commensurate with his level of mental development, and he is able to address their data, formulate them, know their limits, obtain data and information related to them, and find solutions to them; Thus, thinking is one of the most important scientific cognitive activities, and it results from the individual's ability to process symbols and concepts and use them in a variety of ways that enable him to solve the problems he faces in different educational situations (Nashwati, 2009, p. 50).

And that thinking is a continuous mental and emotional process, carried out by a healthy person when he is exposed to a problem or when he wants to achieve some gain, and it is

affected by the human culture, experiences and environment surrounding him, and it helps him in solving his problems and making his decisions; That is, thinking is an activity that an individual undertakes to solve a problem. (Al-Zuhairi, 2015, p. 325).

This point has been invested by many of the two missionaries in education who have tried to link the thinking process and problem solving as the latter is the ultimate goal of the educational process, and among these researchers are Belle Wallace (Harvey Adams), who proposed a model of thinking aimed at solving problems in an environment dominated by An atmosphere of social interaction and called it: The Active Thinking Model in a Social Context (TASC). They developed this model to improve students' thinking ability. The model provides a practical framework that supports problem solving through its various stages, as it includes all cognitive and supracognitive skills that It is used by the individual, including strategic thinking and reflection on what has been learned. The tools of the model consist of a mixture of strategies that include logical, innovative and practical thinking, tendencies and tendencies included under motivational and directional factors in an atmosphere of communication, and this model is presented for the formation and development of thinking through collaborative problem solving. Jaber, 2010, pg. 288).

The active thinking model relies on a set of cognitive tools that can be used by learners inside and outside the school to focus their learning, and then develop these tools into supra-cognitive functions through social interaction among students in order to develop their problem-solving ability. Through which students develop their thinking skills, it must be meaningful, through which they are introduced to positive principles and values. (Wallace & Adams,1993, p1).

### **Theories on which the active thinking model is based:**

The active thinking model is based on the theoretical propositions presented by (Vygotsky, 1978), who emphasized in his sociocultural theory the importance of social interaction in the development of higher psychological processes, as well as (Sternberg, 1985) in his tripartite theory of human intelligence. (Jaber, 2010, p. 294), and the following explains both theories:

#### **1. Vygotsky's Sociocultural Theory:**

Vygotsky focused in his theory on social interaction, which plays a key role in the development of cognition, as he explained the extent of the cultural development of the individual twice, once at the social level, and later at the individual level, and this applies both to attention, memory, concept formation, and all higher functions, and the second subject What was addressed by Vygotsky's theory is that the level of development progresses when individuals engage in an environment in which an atmosphere of social interaction prevails, as the extent of skills that are accomplished by directing and cooperating with others exceeds what can be accomplished by the individual alone, that is, social interaction plays an important role in the individual's acquisition of knowledge. This is confirmed by the fact that (Vygotsky) focused through the second feature of the theory on the zone of proximal development that can be

developed by social interaction with adults or more experienced peers. (Al-Dawahidi, 2006, p. 42).

The word (Proximal) indicates that the zone determines those behaviors that will develop in the near future (that is, the behavior is closer to appearing), and Vygotsky believes that the behavior occurs at two levels that form the boundaries of the zone of closest development (ZPD, the (lowest) level represents the individual's performance independently, And the (higher) level is the upper limit that an individual can reach with the help of others, as this assistance is either through an adult or through a peer, and assistance may be giving hints and ideas, re-answering a question, paraphrasing what has been said, or completing part of what has been said. The task, etc., and the assistance may be indirect, such as: creating a specific environment that facilitates the performance of skills and interaction with others, such as the individual explaining a certain thing to his peers (Al-Dawahidi, 2006, p. 42).

Vygotsky explained that the most important factor for constructing meaning for learners is the importance of interactions for the external psychological level, especially the nature of dialogue and discussion between the teacher and students in the classroom. And the development of the central region to gain a level of performance and knowledge that they cannot reach on their own. (Abdul Salam, 2009, p. 109).

## 2. Sternberg's Triple Theory of Human Intelligence

According to Sternberg's triad theory of human intelligence, there are different types of intelligence:

1. Analytical intelligence: This type of intelligence refers to the ability to segment the problem and understand its components. Individuals who are characterized by this type of intelligence are able to analyze, make judgments, criticize, compare, find differences, evaluate and clarify, and often these individuals perform excellent in intelligence tests that It relies on analytical thinking.
2. Creative intelligence: It is the individual's ability to deal efficiently and effectively with emerging problems and situations. (Zogoul and Shaker, 2010, p. 154).

Creative talent appears in individuals who possess clairvoyance or intuition or those who successfully adapt to relatively unfamiliar or new situations, and who are not necessarily outstanding on traditional intelligence tests, may see things differently, and are usually among those who make outstanding achievements. In the fields of science, literature, drama, and others. (Sternberg & Grigorenko, 2002, p265).

3. Practical intelligence: It is the individual's ability to deal with multiple problems and respond to the demands of daily life. (Zogoul and Shaker, 2010, p. 154) through the individual's ability to apply analytical and creative abilities in daily and practical situations. People who possess this kind of intelligence have the ability to realize the factors that affect their success, and the factors that help them to shape and adapt to their environment, Therefore, these people succeed in achieving many goals.

**Basic principles underlying the active thinking model:**

Wallace & Adams, 1993 mentioned the principles of the active thinking model as:

1. The model depends on solving problems, where the students are placed in a problematic situation, and the problem encounters a set of obstacles, that is, the problem = the goal + the obstacles.
2. It needs a set of simple and complex thinking skills through its successive stages (setting goals, setting priorities, exchanging ideas, weighing evidence, planning, comparisons and measurement), and it should be noted here that these skills must occur in a social context.
3. The vocabulary should be formulated in a manner commensurate with the age of the students and their cultural background.
4. The problems should be important and relevant to students' lives wherever possible, and their own experiences should be a starting point for analyzing and developing their cognitive performance.
5. Paying attention to motivating students by urging them to take their positive role in society and avoid feeling helpless.
6. It requires students to use metacognitive skills in addition to their cognitive skills.
7. That learning depends primarily on the students themselves, and the role of the teacher is to provide assistance when needed. (Wallace & Adams,1993, p7-8).

**Research Methodology:**

The researcher followed the experimental research method based on fixing all the variables that affect the research problem except for one specific variable whose impact is being studied in these new circumstances, and the experimental method is the method in which the parameters of the scientific method are correctly represented.

**Experimental design:**

The researcher adopted the experimental design with partial control for two equal groups as it is more suitable for the research conditions, and Table (1) shows this:

**Table (1) Distribution of the research sample members to the two groups:**

The group	Equivalence of the two groups	Independent Variable	Dependent Variable
Experiential	* The lifetime is calculated in months * Intelligence test * Mathematics score for the previous year	Active thinking model	* Metacognitive thinking
Control		The traditional way of teaching	

**Research community and sample:**

The research community identified all students of the fourth scientific grade in the preparatory and secondary schools for government boys for morning studies in the city of Ramadi; Then the researcher randomly chose Al-Shumukh Preparatory School for Boys to conduct his research; It contains two divisions for the fourth literary grade; Division (a) was chosen randomly to represent the experimental group that will be taught by the Adey & Shayer active thinking model, and the number of its students was (30), and division (b) to represent the control group that will be taught in the usual way, and table (1) illustrates this.

**Table (1) Number of students of the two research groups, before and after the study**

Group	Section	Total number of students	Failed students	No of students in the study
Experiential	A	31	1	30
Control	B	32	2	30
Total		63	3	60

The equivalence of the two search groups:

The researcher rewarded the students of the two research groups statistically in the variables: (chronological age calculated in months, intelligence test, and mathematics scores for the previous year), and Table (2) shows this:



**Table (2) Results of the T-test for two independent samples of the three variables for students of the two research groups**

Group	Experiential group (30)		The control group (30)		Degree of freedom	T-Value		Significance level 0.05
	Mean	Standard deviation	Mean	Standard deviation		Calculated	P. value	
lifetime calculated in months	194.44	6.83	193.32	7.13	58	0.165	2000	Not significant
Intelligence test	38.66	4.74	39.80	8.37		0.091		Not significant
Mathematics score for the previous year	58.13	12.53	56.22	11.18		0.154		Not significant

**Determining the scientific subject:** The scientific subject (Chapter III: Trigonometry; Chapter IV: Coordinate Geometry; Chapter Five: Statistics) from the mathematics book for the fourth literary grade.

**Formulation of behavioral objectives:** The researcher formulated the behavioral objectives according to Bloom’s classification of cognitive objectives at its six levels, and presented them with the content of the scientific material to a group of arbitrators to express their views on the extent of their formulation and suitability to cognitive levels, and they all agreed on them.

**Preparation of Teaching Plans:** The researcher prepared teaching plans for teaching mathematics classes to be taught in the second course for fourth-grade literary students according to the model of active thinking for the students of the experimental group, and according to the usual method for the students of the control group.

**The metacognitive thinking test:**

The researcher prepared a test of (30) objective paragraphs of a multiple-choice type distributed on three skills (planning, monitoring, and evaluation), for each skill (10) paragraphs, and it was presented to a group of specialists in the methods of teaching mathematics, and they agreed by (90%) or more. on all its paragraphs with minor modifications to some of its paragraphs; Then the researcher applied it to a sample of (30) students and it was found that the test paragraphs and instructions were clear, and that the time taken to answer it was from (26-30) minutes, with an average of (28) minutes; Then he applied it to the statistical analysis sample, which amounted to (140) students, as the researcher took the highest answer sheets ((27%) and the lowest ((27%)), so their number became (38) students in the upper group, and (38) students in the lower group, then according to the level of difficulty and the It ranged between (0.43-0.68), and the discrimination coefficient ranged between (0.45-0.69), and as for the effectiveness of the alternatives, all values of the wrong alternatives appeared negative, that is, it camouflaged a number of students with weak levels.

The researcher also verified the sincerity of the internal consistency of the test items by finding the correlation of the degree of each item with the total score of the test using the Pearson correlation coefficient and it ranged between (0.36-0.61) and it appeared that all the calculated correlation coefficients are statistically significant when compared with the tabular value of the correlation coefficient (0.195) when Significance level (0.05) and degree of freedom (138).

### Statistical means:

In analyzing the results of his research, the researcher relied on the Statistical Package for Social Sciences (SPSS).

View and discuss the result:

Verifying the null hypothesis which states that: There is no statistically significant difference at the significance level (0.05) between the average scores of the experimental group students who studied with the active thinking model and the average scores of the control group students who studied in the usual way in the metacognitive thinking test; The researcher applied the test to the students of the two research groups, then calculated the arithmetic mean and standard deviation of their scores on the test.

Table (3) The results of the T-test for the scores of the students of the two groups in the metacognitive thinking test

Group	No. of students	Mean	Standard deviation	Degree of freedom	T value		Significance level 0.05
					Calculated	P. value	
Experiential	30	22.13	5.32	60	4.434	2.000	Significance
Control	30	16.34	4.78				

It is clear from the table that there is a statistically significant difference between the mean scores of the students of the two groups on the metacognitive thinking test in favor of the students of the experimental group. Accordingly, the null hypothesis is rejected and the alternative hypothesis is accepted; The researcher attributes this result to the fact that teaching mathematics with the active thinking model helped prepare the mathematics material for students to study through sequential mental operations according to their educational abilities and aptitudes, which led to giving them many opportunities to think of various types of thinking, including metacognitive thinking. The questions raised by the teacher and the solutions posed by the student motivate other students to think of more than one solution and develop their metacognitive thinking skills in particular; The model also helped in accelerating the cognitive and mental development of the students who studied through the activities and tasks included in the mathematical content to solve the intellectual and cognitive contradiction in order to reach

the highest level of thinking and then to the stage of cognitive equilibrium and then rely on himself in his learning to reach illogical solutions or require a new vision of the problem represented by the educational task; It also helped to organize the mathematical knowledge that the student obtains by helping the teacher to connect the previous information with the new information, then presenting a situation or problem to them, then thinking about the problem and awareness of what they think, and finally linking what they reached with their previous experiences in practical life or Other study subjects, and this led to the practice of metacognitive thinking skills and their superiority over the students of the control group.

### **Conclusions:**

In light of the results of the current research, we reach the following conclusions:

1. Using the active thinking model in teaching requires more time and effort than is required when using traditional methods and methods of teaching.
2. Teaching procedures according to the active thinking model are consistent with what modern trends in teaching focus on making the student the focus of the educational process.
3. The active thinking model contributed to improving the metacognitive thinking of the students of the experimental group compared to the students of the control group who were taught in the traditional way in mathematics.
4. The lesson presentation with the active thinking model includes the element of suspense and various activities and methods that increase the interaction of learners mentally and emotionally, and this in turn enhances the learner's confidence in himself and his own ability, which helps to enjoy the lesson and learn the subject matter, and then realizes the importance of the subject.

### **Recommendations:**

In light of the foregoing results, the researcher recommends the following:

1. Adopting the active thinking model in the teaching of mathematics due to its impact on metacognitive thinking.
2. Holding training courses for mathematics teachers that focus on using modern trends in teaching, including the active thinking model.

### **Suggestions:**

In light of the above and to complement the current research, the researcher suggests the following:

1. Conducting a study of the impact of the active thinking model on the achievement and lateral thinking of fourth-grade literary students in mathematics.
2. Conducting a study of the effect of typical active thinking and labels on achievement and reflective thinking among students of the literary fourth in mathematics.

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