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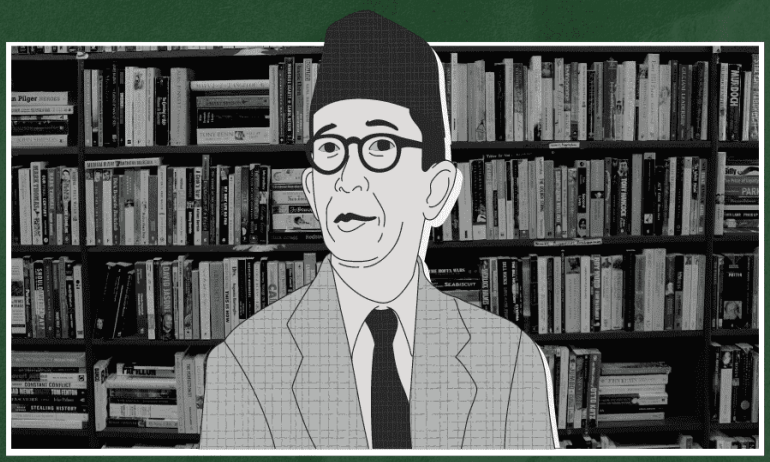

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High Cognitive Activation Strategy Boosts Students' Math Achievement and Self-Efficacy

Strategi Aktivasi Kognitif Tinggi Meningkatkan Prestasi Matematika dan Efikasi Diri Siswa

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Abstract

General Background: Mathematics education plays a critical role in shaping students' cognitive abilities and self-efficacy. Effective instructional strategies are essential to enhance learning outcomes and foster students' confidence in mathematical problem-solving. **Specific Background:** Traditional teaching methods often fail to engage students in higher-order thinking, limiting their ability to develop deep mathematical understanding. The "High Cognitive Activation" strategy has emerged as a promising approach to enhance student engagement and achievement.**Knowledge Gap:** While previous research has explored various active learning strategies, limited studies have examined the impact of high cognitive activation on both mathematical achievement and self-efficacy among preparatory students. **Aims:** This study investigates the effectiveness of the High Cognitive Activation strategy on the achievement and mathematical self-efficacy of fourth-grade scientific students in Baghdad. **Results:** A quasi-experimental design was implemented with 77 students, divided into experimental and control groups. Findings revealed that students taught using the High Cognitive Activation strategy significantly outperformed those taught using conventional methods in both achievement and self-efficacy. **Novelty:** This research provides empirical evidence supporting the effectiveness of high cognitive activation in mathematics education, highlighting its role in fostering deep learning and self-confidence. **Implications:** The findings suggest integrating high cognitive activation strategies into mathematics curricula to enhance students' learning experiences and motivation, ultimately improving educational outcomes.

Highlights:

1. Investigate high cognitive activation's impact on math achievement and self-efficacy.
2. Improved achievement and self-efficacy in the experimental group.
3. Supports active learning integration in mathematics education.

Keywords: High Cognitive Activation Strategy, Mathematical self-efficacy.

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Intoduction

Academic achievement in mathematics is a key indicator of the quality of the educational process, as it reflects students' mastery of basic and advanced mathematical concepts. However, educational research indicates that low achievement may be due to cognitive and affective factors, most notably mathematical self-efficacy, which is directly related to an individual's perception of their learning abilities and academic performance. High self-efficacy motivates students to exert effort and persevere, enhancing their chances of success in mathematics.

Despite evidence confirming the positive relationship between self-efficacy and academic achievement, the traditional teaching methods prevalent in the Iraqi educational system rely on rote learning and memorization rather than focusing on higher-order thinking skills such as analysis, synthesis, and evaluation. This approach limits students' ability to self-regulate and learn deeply, leading to lower achievement in mathematics.

Therefore, there is a need for modern teaching strategies that promote deep thinking and enable students to actively participate in learning. The high cognitive activation strategy is one such strategy, focusing on activating higher cognitive processes and promoting effective learning, which may contribute to improving both academic achievement and mathematics self-efficacy.

Based on the above, this study seeks to analyze the effectiveness of the high cognitive activation strategy in improving academic achievement and enhancing mathematics self-efficacy among middle school students. This study compares their performance before and after implementing this strategy and measures its impact compared to traditional teaching methods.

The research problem:

The research problem is represented by the following question:

"What is the effectiveness of the high cognitive activation strategy on mathematics achievement and self-efficacy among middle school students?".

Research Importance:

The importance of this research lies in the following two areas:

First: Theoretical Significance:

The theoretical significance of this research lies in several fundamental aspects:

1- There are few studies that have addressed the high cognitive activation strategy in the local educational environment, making this research one of the first to shed light on this strategy in the context of Iraqi education.

2- The research provides a solid theoretical framework for designing and implementing effective educational strategies that enhance students' critical and creative thinking skills, contributing to improved academic performance in mathematics.

3- The research encourages students to be more independent in their learning, which enhances their skills in self-learning and personal organization, which contributes to improving their overall academic outcomes.

4- The research aligns with the efforts of the Iraqi Ministry of Education to raise student achievement through the use of innovative educational strategies that improve the quality of education.

5- This research draws the attention of those interested in education, especially mathematics teachers, to the importance of using the high cognitive activation strategy in teaching mathematics. This strategy contributes to organizing students' thinking and increasing their self-confidence, which helps them achieve better academic results.

Second: Applied Importance :

From a practical perspective, the current research is expected to benefit:

1- Fourth-grade middle school students: The current research seeks to raise their mathematical self-efficacy by having mathematics teachers use the "high cognitive activation" strategy when teaching them.

2- Fourth-grade middle school mathematics teachers, by implementing the "High Cognitive Activation" strategy in their classroom teaching, and also providing them with tools that enable them to measure their students' mathematics self-efficacy and achievement.

3- Educational leaders: This research presents the "High Cognitive Activation" strategy as a practical solution to the problem of developing mathematics teaching at the middle school level. It provides educational supervisors and school principals with the opportunity to guide their teachers to implement this strategy, which contributes to raising teaching efficiency and

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improving student outcomes.

4- Researchers: This research is expected to encourage researchers to conduct further research and studies that explore the potential of the "High Cognitive Activation" strategy in improving the learning process in various subjects and educational levels, thus developing teaching practices.

Research objectives:

This research aims to determine:

1- The effectiveness of the "high cognitive activation" strategy on fourth-grade science students' achievement in mathematics.

2- The effectiveness of the "high cognitive activation" strategy on fourth-grade science students' mathematical self-efficacy in mathematics.

Research Hypotheses:

To achieve the research objectives, the following two hypotheses were formulated:

1- “There is a statistically significant difference at the 0.05 significance level between the mean scores of the experimental group students, who will be taught using the High Cognitive Activation strategy, and the control group students, who will be taught using the traditional method, in academic achievement”.

$H_1 : \mu_1 \neq \mu_2$

2- “There is a statistically significant difference at the 0.05 significance level between the mean scores of the experimental group students, who will be taught using the High Cognitive Activation strategy, and the control group students, who will be taught using the traditional method, in mathematical self-efficacy”.

$H_1 : \mu_1 \neq \mu_2$

Research Limits:

This research is limited to the following:

1- Human Limits: Fourth-year scientific stream students under the General Directorate of Education of Baghdad / Third Rusafa.

2- Temporal Limits: The second semester of the 2023–2024 academic year.

3- Spatial Limits: The General Directorate of Education of Baghdad / Third Rusafa.

4- Subjective Limits: The mathematics textbook for the fourth-year scientific stream, prescribed by the Ministry of Education – General Directorate of Curricula, authored by a specialized committee within the Ministry of Education, fifth edition, 2023.

Definition of Terms

1- Efficacy:

Theoretically: "The ability to influence, achieve goals, and attain desired outcomes" [4].

Operationally: The degree of positive impact on the achievement and mathematical self-efficacy of fourth-year preparatory students after their mathematics teachers implement the High Cognitive Activation strategy in classroom instruction.

2- Strategy:

Theoretically: "Plans directed toward successfully performing tasks or generating systems to reduce the gap between an individual's current knowledge and the goals they aim to achieve" [18].

Operationally: A structured and integrated sequence of steps with defined objectives and a specific timeframe, implemented by mathematics teachers to achieve instructional goals for fourth-year preparatory students in mathematics.

3- High Cognitive Activation Strategy:

Theoretically: "The cognitive stimulation of learners to engage in achieving a deep understanding of the subject within the learning context" [8].

Operationally: The teaching strategy used for the experimental group, designed by the researcher, consisting of three main

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phases: awareness, exploration & application, and problem-solving & transfer. Each phase is implemented sequentially with specific objectives.

4- Achievement:

Theoretically: "A structured method to determine the level of student attainment in previously learned academic content by assessing responses to a sample of questions representing that subject" [6].

Operationally: The extent of mathematical skills and knowledge acquired by fourth-year scientific stream students after studying the designated content, measured through their total scores in the achievement test developed for this research.

5- Mathematical Self-Efficacy:

Theoretically: "Individuals' beliefs in their ability to successfully perform specific academic tasks within defined levels" [19].

Operationally: Fourth-year scientific stream students' beliefs about their capability to learn mathematics based on their perceived skills and abilities to complete mathematical tasks. It is measured using a self-efficacy scale that includes competence level, generality, perseverance, and persistence.

Theoretical Background

High Cognitive Activation Strategy

Defining the characteristics of high-quality teaching is a key concern in educational research and has been extensively examined in multiple studies, such as [10] and [17]. The three core dimensions of teaching quality, identified by [13], have gained international attention as they highlight the fundamental aspects of effective classroom instruction: "Classroom Management," "Supportive Classroom Climate," and "Cognitive Activation." There is a clear overlap between these dimensions and the three components of the Classroom Assessment Scoring System (CLASS), which has been internationally discussed by [9]. These components include "Emotional Support," "Classroom Organization," and "Instructional Support," which are widely applied in international research [8].

The concept of "High Cognitive Activation" has gained widespread recognition within the framework of the three core dimensions of teaching quality. High cognitive activation refers to stimulating students to engage in deeper mental processing of the subject at an optimal level of learning. This is achieved through two main aspects:

1- Providing complex mathematical tasks that challenge learners to develop independent solutions.

2- Teacher supervision in task completion, where the teacher plays an active role—for example, by stimulating cognitive conflicts, highlighting differences in ideas and perspectives, and encouraging students to connect their responses. This is particularly significant in high school mathematics, where students face substantial academic demands. Furthermore, collaborative learning settings are believed to be effective in stimulating students' cognitive activities. Exposure to differing viewpoints may trigger cognitive conflicts, making collaborative discussions a powerful tool for constructing new concepts or redefining existing beliefs. Similarly, verbalizing questions and explanations can serve as an effective means of clarification. The term "High Cognitive Activation" encompasses all learning activities that students engage in while interacting with academic content [7].

Stages of the High Cognitive Activation Strategy

In the teaching process, High Cognitive Activation consists of three stages:

Awareness

The awareness stage aims to activate students' prior knowledge about the topic and connect it to their current knowledge and experiences. This activation is essential for engagement and motivation. Research suggests that effective learning depends on how teachers value students' prior knowledge and provide opportunities to link new content with previously learned topics and experiences. Techniques such as brainstorming, image associations, mind maps, and evaluating and justifying theses help make new lessons meaningful, relevant, and engaging, thereby enhancing motivation and commitment—two key factors in academic performance [14].

Exploration and Application

The exploration and application stage shifts students from passive recipients of information to active knowledge constructors. This is achieved by encouraging them to actively engage in learning, interact with content in various ways, and build a deeper understanding of complex concepts. Students can explore and apply knowledge individually or collaboratively within a cooperative learning framework. Research indicates that allowing students to explore and clarify ideas through hands-on activities, such as problem-solving and group collaboration, enhances academic achievement and develops critical and creative thinking skills. Activation techniques at this stage are key to deep learning, as students discover concepts independently and think about information in new and diverse ways [11].

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Problematization and Transfer

Effective teaching should include activities that enable students to transfer their learning from the classroom to real-life situations. This is achieved through interactive activities such as simulations and discussions, which help students develop problem-solving and decision-making skills, preparing them to face future challenges. These activities allow students to see how their acquired knowledge can be applied in daily life and professional settings [16].

The Teacher's Role in the High Cognitive Activation Strategy

1- Expect students to explain their reasoning when solving complex problems.

2- Encourage students to solve problems using multiple approaches.

3- Require students to provide written explanations of their problem-solving processes.

4- Promote collaborative problem-solving among students.

5- Connect mathematical concepts taught in class to real-world applications.

6- Review homework problems that students were unable to solve [15].

Based on this, the researcher views High Cognitive Activation as an effective teaching approach that develops students' critical and creative thinking skills, enabling them to solve problems innovatively and express their ideas clearly. This, in turn, enhances education quality and prepares students to face future challenges. By applying this strategy, teachers can create a stimulating learning environment that encourages exploration and discovery.

Mathematical Self-Efficacy

The concept of self-efficacy was first introduced by Albert Bandura in his 1977 paper, where he developed a comprehensive theory outlining its dimensions and sources. This theory is a core component of Social Learning Theory and plays a crucial role in explaining human behavior.According to Bandura [1], self-efficacy functions as a cognitive mirror, reflecting an individual's ability to make decisions about the activities they engage in, the effort they exert, and the persistence they demonstrate. Individuals with low self-efficacy tend to avoid challenging tasks, whereas those with high self-efficacy perceive difficulties as opportunities to test their abilities. People with strong self-efficacy beliefs put in greater effort and persist longer when facing challenges compared to those who doubt their capabilities.

[5] argue that self-efficacy shapes an individual's expectations of success or failure. When individuals are aware of their abilities, they tend to exhibit more optimistic behavior, increasing their confidence in successfully completing tasks. This self-awareness reinforces their self-confidence, motivating them to take on more challenges that may require additional effort or involve difficulties. Additionally, [12] suggest that self-efficacy increases when students experience repeated successes in learning and recognize their own achievements.

Thus, when students can identify their strengths and weaknesses during a task, they develop a sense of self-efficacy, which boosts their confidence, enabling them to enhance their strengths and address their weaknesses. This ability ultimately allows them to complete tasks more effectively. Therefore, self-efficacy plays a significant role in influencing students' performance in mathematics.

Dimensions of Mathematical Self-Efficacy

Mathematical self-efficacy can be analyzed through its key dimensions, which are summarized as follows:

Efficacy Level: This dimension describes a student’s expectations and personal judgments about their abilities and strengths in tackling mathematical problems, regardless of their difficulty. It reflects their confidence in solving problems and applying their skills, even in unexpected or surprise exam conditions.

Generality: This dimension assesses the student's beliefs about their ability to apply their skills to similar mathematical problems across different contexts. It refers to the transferability of their self-efficacy judgments to situations with similar levels of difficulty, types of problems, and branches of mathematics.

Persistence and Perseverance: This dimension focuses on students’ commitment and resilience in solving mathematical problems. It reflects their determination, patience, and consistency in maintaining the same level of effort and skill regardless of the type or complexity of the problem. Students with high self-efficacy persist in solving problems with the same intensity and focus each time[20].

In conclusion, mathematical self-efficacy acts as an internal driving force behind a student's success, perseverance, and achievement in mathematical tasks, regardless of their difficulty. The higher a student’s mathematical self-efficacy, the greater their confidence and capability, allowing them to tackle and solve mathematical challenges successfully.

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Methods

The experimental method was used, and the quasi-experimental design (with partial control) was adopted for two independent, equivalent groups (experimental and control), with a post-test for achievement and mathematical self-efficacy of the students. The following table (Table 1) illustrates the experimental design used in the research.

Research tools	Dependent variable	I ndependent variable	The group
Achievement test Mathematics Self-Efficacy Scale	Achievement Mathematical self-efficacy	High cognitive activation strategy	Experimental
		The usual method	Female officer

Table 1. ***shows the experimental design***

Research procedures

Research community: Includes all fourth-grade science preparatory students enrolled in schools of the General Directorate of Education in Baghdad Governorate/Third Rusafa, during the academic year (2023-2024 AD).

Research sample: The sample was intentionally selected for Sahl bin Saad Al-Saadi Intermediate School for Boys, affiliated to the General Directorate of Education of Baghdad Governorate / Third Rusafa, to cooperate with the school administration in completing the research, which includes (5) sections for the fourth scientific grade, which is sufficient to select individuals for the research sample. By the method of (lottery) random drawing, section (A) was selected to represent the (experimental) group, which is taught using the (high cognitive activation) strategy, and section (C) to represent the (control) group, which is taught in the usual way. The number of the research sample was (77) students, of whom (39) were in the experimental group and (38) in the control group. After excluding those who failed (4 from the experimental group and 5 from the control group) for studying the subject previously, and the remaining of their data may affect the results of the research, and thus may affect the internal integrity of the experiment, Table (2) shows that:

Number of students after exclusion	Number of excluded students	Number of students before exclusion	Section	The group
39	4	43	A	Experimental
38	5	43	C	Female officer
77	9	86	Total	

Table 2. ***Sample individuals in the two research groups***

Internal integrity of experimental design: The two research groups were rewarded in a number of variables before starting to implement the experiment, according to the following Table (3):

Variables	The group	SD.	MA.	Levene's F	Sig.	T.TEST	D.F	Sig.	Sig. (0.05)
Chronological age	Experimental	6.36	186.38	1.379	0.244	0.974	75	0.333	Non-functional
	Female officer	4.81	185.13						
Previous achievement in mathematics	Experimental	12.71	66.85	0.458	0.501	0.540	75	0.591	Non-functional
	Female officer	11.69	65.34						
Previous math information	Experimental	4.43	12.97	0.130	0.911	1.050	75	0.297	Non-functional
	Female offic	4.38	11.92						

Table 3. ***Statistical results of equivalence between the two research groups***

External soundness of the experimental design (controlling extraneous variables): In addition to the equivalence procedures carried out by the researcher for the two research groups and for several variables that may have an effect with the independent variable on the dependent variables, the researcher therefore tried to prevent or reduce the effect of the (extraneous) variables, to achieve accurate and objective results. The most prominent of these variables are the following**:**

1- Selection of sample individuals:The effect of this variable was controlled, as the two research groups (experimental and control) were chosen randomly, and the equivalence of the students in the two groups was statistically proven.

2- Maturity factor: Since the duration of the experiment was uniform between the two groups in the second semester of the academic year (2023-2024 AD), the growth that occurred would return to the individuals of the two groups at the same level, so it had no effect on the current research, and the same thing.

3- measuring tool: The researcher was able to control this variable using standardized tools for the two research groups.

4- experimental extinction: The research sample members were not subjected to interruption or leaving school throughout the duration of the experiment.

Research requirements:

Preparing teaching plans: He prepared teaching plans for the two research groups (experimental and Female officer), and there were (41) plans for the experimental group using the strategy.

Search tools:

Achievement Test**:** The achievement test was constructed according to the following steps:

1- Determining the objective of the test: The objective of the test is to measure the achievement of fourth-grade science students in the two research groups (experimental and control) in the specific mathematics subject.

2- Determining the scientific material:The scientific material for the test in mathematics was determined in the last three chapters of: The mathematics book for the fourth scientific grade, approved by the Ministry of Education - General Directorate of Iraqi Curricula, for the second semester, fourteenth, 2023 AD.

3- Content analysis and formulation of behavioral objectives: The content of the mathematics subject for the last three semesters (vectors, coordinate geometry, statistics) was analyzed and divided into its basic elements according to the components of mathematical knowledge (concepts, generalizations, skills, problem solving). (146) behavioral objectives were formulated, distributed across the six cognitive levels of Bloom (remembering - comprehension - application - analysis - synthesis - evaluation).

4- Preparing a specification table:A specification table was prepared according to the following steps:

· Determining the relative weight of the chapter content: The relative weight of the last three chapters of the mathematics book for the fourth year of middle school in the second semester according to Bloom’s six cognitive levels, which are (knowledge – comprehension – application – analysis – synthesis – evaluation).

· The relative importance of each chapter : was determined by dividing the number of lessons for one chapter by the number of lessons for the three chapters.

· Determining the percentage for each level: The percentage for each level was calculated based on [dividing the number of behavioral objectives for each level by the total number of objectives].

· Determining the number of test paragraphs: After consulting a number of judges, supervisors, and mathematics teachers with experience in teaching mathematics, it was agreed to determine the number of achievement test paragraphs at (30) paragraphs. Table (4) shows the test map for a sample of behavioral purposes:

Content		Goals						Total
Chapters		knowledge	comprehension	application	analysis	synthesis	evaluation	
		37 %	30 %	20 %	7 %	3 %	3 %	100 %
Five	27%	3	2	2	1	0	0	8
Six	44%	5	4	3	1	0	0	13
Seven	29%	3	3	2	1	0	0	9
Total	100 %	11	9	7	3	0	0	30

Table 4. ***Test map of a sample of behavioral objects to be represented in an achievement test***

Statistical analysis of test items: The test was applied to a second sample of (100) students after ensuring the accuracy and clarity of its items and instructions. The aim of the application was to examine its psychometric properties and verify the validity of the items. After correcting the answers, the data was arranged in descending order and divided into upper and lower groups. The answer sheets were taken at a rate of 27% from the upper group and 27% from the lower group to analyze the items and calculate the difficulty coefficient, which ranged between (0.26 - 0.52), and the essay items ranged between (0.46 - 0.55). states that the difficulty coefficient of the test items is acceptable if it ranges between (0.80 - 0.20) [3]. Accordingly, all paragraphs were kept because they were within this range, and the discrimination power of the paragraphs ranged from (0.30 - 0.63) for the objective paragraphs, and ranged from (0.41 - 0.62) for the essay paragraphs, and all of them are acceptable results, as [2]. mention that a paragraph is considered to have weak discrimination power if it

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is less than (0.20). Accordingly, all the objective and essay items of the achievement test were kept because their discrimination power is greater than (0.20).

Test validity:

a. Determining the relative weight of the chapter content: The relative weight of the last three chapters of the mathematics book for the fourth year of middle school in the second semester according to Bloom's six cognitive levels, which are (knowledge – comprehension – application – analysis – synthesis – evaluation).

b. The relative importance of each chapter : was determined by dividing the number of lessons for one chapter by the number of lessons for the three chapters.

c. Determining the percentage for each level: The percentage for each level was calculated based on [dividing the number of behavioral objectives for each level by the total number of objectives].

d. Determining the number of test paragraphs: After consulting a number of judges, supervisors, and mathematics teachers with experience in teaching mathematics, it was agreed to determine the number of achievement test paragraphs at (30) paragraphs. Table (4) shows the test map for a sample of behavioral purposes:

e. Face validity:The test items were presented to a group of judges and specialists in mathematics and its teaching methods to review their opinions and comments on the validity of the items. Based on their comments, some items were modified in accordance with the suggestions provided, while items that achieved an agreement rate of (80%) or more were retained.

f. Content validity: The specification table is an indicator of content validity, as it ensures that the test items cover all aspects of the study material.

Test Reliability:After applying the mathematics achievement test, the reliability coefficient was calculated using the statistical package (SPSS-20) and the (Cronbach's alpha) equation, where the coefficient reached (0.75), which is considered a good value, as the reliability coefficient ranges between (0) and (1), and the closer it is to (1), the more accurate the test tool is [6]. Thus, the test became ready to be applied to the research sample**.**

Preparing the Mathematical Efficiency Scale: The Mathematical Self-Efficiency Scale was prepared according to the following steps:

1- Defining the scale's objective**:** Measuring the mathematical self-efficacy of (the two research groups) fourth-grade science students.

2- Defining the scale's dimensions:Three dimensions were identified for the mathematics self-efficacy scale (the degree of competence, generality, persistence, and perseverance), with indicators under each dimension.

3- Correcting the scale:The mathematics self-efficacy scale, in its initial form, consisted of (20) indicators distributed across the scale's main dimensions. The five-point Likert scale was used to measure mathematics self-efficacy, with ratings being (very high, high, medium, low, and weak). Quantitative ratings were determined by assigning scores of (5, 4, 3, 2, and 1), respectively.

4- Validity:To ensure the validity of the scale, it was presented to a group of arbitrators and specialists in mathematics and its teaching methods to review their opinions and observations regarding the validity of the indicators. Indicators that achieved an agreement rate of (80%) or more were retained. To calculate the internal consistency validity of the scale, it was applied to a sample of (50) students, and the correlation coefficient between the score of each indicator and the total score of the scale was extracted. The values of the correlation coefficient ranged between (0.82 - 0.89), which are indicative of validity. Thus, the scale, in its final form, consists of (20) indicators distributed among its three main dimensions, with the score obtained by the student ranging from (20 - 100) points.

5- Scale Reliability:To calculate reliability, the statistical package (SPSS-20) and the (Cronbach's Alpha) equation were used, with the overall reliability coefficient of the scale reaching (0.90), which is a good coefficient.

Result and Discussion

To verify the following two hypotheses:

1- Results related to the first hypothesis, which states that "there is a statistically significant difference at a significance level of (0.05) between the average scores of students in the experimental group, which will be taught according to the (high cognitive activation) strategy, and the scores of students in the control group, which will be taught according to the usual method, in achievement."

2- Results related to the second hypothesis, which states that "there is a statistically significant difference at a significance level of (0.05) between the average scores of students in the experimental group, which will be taught according to the (high cognitive activation) strategy, and the scores of students in the control group, which will be taught according to the usual

method, in mathematical self-efficacy." As shown in Table (5):

Variables	The group	SD.	MA.	Levene's F	Sig.	T.TEST	D.F	Sig.	Sig. (0.05)
Achievement	Experimental	5.02	29.59	1.333	0.252	3.598	75	0.000	Statistically significant
	Female officer	6.31	24.92						
Mathematical Self-Efficacy	Experimental	12.71	59.83	1.641	0.182	6.289	75	0.000	Statistically significant
	Female officer	11.69	50.15						

Table 5. ***Results of the t-test for two independent samples between the two research groups***

From Table (5) above, the hypotheses related to the results of achievement and mathematical self-efficacy in mathematics are verified. It is clear to us that the difference between the arithmetic means of the two groups (experimental and control) in the achievement test and the mathematical self-efficacy scale is statistically significant in favor of the experimental group, and this confirms the validity of the hypotheses. Therefore, the hypotheses are accepted in favor of the experimental group.

To determine the effect size, Cohen's d was used to measure the effect of the high cognitive activation strategy on achievement and self-efficacy in mathematics. Table (6) shows the value of (d) and the effect size on the research sample students.

Independent variable	Dependent variable	d value "effect size "	Effect size
High cognitive activation strategy	Achievement	0.831	Big
	Mathematical Self-Efficacy	0.804	Big

Table 6. ***The magnitude of the impact of the high cognitive activation strategy***

The results showed a statistically significant difference between the average scores of the students in the two research groups, in favor of the students in the experimental group, on the variables of achievement and mathematical self-efficacy, with a large effect size. This result is attributed to the following reasons:

1. The "high cognitive activation" strategy contributed to making learning "meaningful" by linking the students' cognitive structure with new knowledge, resulting in a new concept within the cognitive structure. This facilitated information retrieval and use in similar and even different situations, thus increasing academic achievement in the experimental group.

2. The nature of the "high cognitive activation" strategy provided students with a full opportunity to be aware of their behaviors, monitor their responses, and organize their activities. This, in turn, enabled them to become more confident in their learning resources, thereby enhancing their higher-order thinking skills. All of this helped increase their mathematical self-efficacy.

3. In the high cognitive activation strategy, the student is considered the "center of the educational process," as he or she is given the role of research and investigation to arrive at the results himself, which helps him or her consolidate mathematical information into his or her cognitive structure.

4- Finally, the traditional method was ineffective in the control group, as it lacked the ability to generate new alternatives, ideas, and perceptions. It dealt with pre-existing information without adopting multiple thinking methods. The student's role remained limited to receiving this pre-existing information from the teacher, leading to rote learning and relying on existing solutions.

Conclusions

1- The "High Cognitive Activation" strategy contributed to encouraging students to strengthen their personalities, enhance their self-confidence and ability to discover mathematical facts and information, and foster a spirit of teamwork among them.

2- The "High Cognitive Activation" strategy placed the student at the "center of the educational process," which positively impacted their motivation and provided them with the opportunity to think, reflect, and discuss during the learning process. Thus, their role was active and effective within the classroom.

3- The possibility of teaching using the "High Cognitive Activation" strategy, as it supports good and effective education in our schools, using the simple resources available.

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