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The Effect Of A Teaching Strategy Based On The Wallace Model On The Logical-Mathematical Thinking Of Middle School Female Students In Mathematics

Nawal Hamidi Raddad[1], Dr. Hassan Kamil Risen[2]
[1]Researcher, nawal.abd2203@ihcoedu.uobaghdad.edu.iq
[2]Prof.University of Baghdad / College of Education for Pure Sciences - Ibn Al-Haitham/ Mathematics Department, hasan.k.r@ihcoedu.uobaghdad.edu.iq

Abstract
The current research aims to investigate the effect of a teaching strategy based on the Wallace model on logical-mathematical thinking among secondary school female students in mathematics. An experimental research approach was adopted, using an experimental design for two independent and equal groups with a post-test. The experiment was applied to a sample of (64) female students from the second intermediate grade at Al-Amasi Intermediate School for Girls, affiliated with the General Directorate of Education in the Second Rusafa. The research sample was distributed equally between the two research groups. Group (B) (31) was randomly selected to be the experimental group, while Group (D) (33) was the control group. Distribution was based on the following variables (previous achievement, prior knowledge, intelligence, and chronological age). A logical-mathematical thinking test consisting of (30) items was constructed, and its validity and reliability were verified and found acceptable. After completing the experiment, the logical-mathematical thinking test, the results showed that the experimental group students who studied according to the proposed strategy the control group students who studied according to the traditional method on the logical-mathematical reasoning test.
Keywords: *Innovative strategy, Wallace model, logical mathematical thinking*

INTRODUCTION

First: The Research Problem

The researchers believe that the problem of weak logical mathematical thinking among students is one of the most important problems facing teachers and those interested in the educational process. Moreover, the crowding of school curricula with a large amount of information is accompanied by a state of constant forgetfulness among students and teachers' adherence to teaching methods and strategies that were effective in the past, but not in the era of the rapidly accelerating knowledge and technological explosion that we live in today. These are problems that must be studied and effective solutions developed. This was observed through their mathematics teaching and direct interaction with fellow teachers in the same field. The teaching methods and approaches commonly used in education focus on memorization, indoctrination, and rote learning, She rarely showed interest in students' mental processes, and this was reflected in their level of achievement and thinking in general, as well as their level of achievement in mathematics in particular. The researchers also reviewed the success rates for the previous three years (2) for second-grade middle school students in mathematics in the evaluation department affiliated with the Baghdad Governorate Education Directorate. It appears from the rates that although they indicate success, they are weak and do not rise to the level of ambition. This weakness in mathematics achievement was diagnosed by some previous studies and research in mathematics, as in the study of (Daoud, 2019), (Ghanem, 2022), (Majli, 2022) This may be due to the weak logical-mathematical thinking skills of female students, which is a fundamental pillar of learning mathematics. Therefore, learners need effective strategies that enhance logical-mathematical thinking using modern strategies and methods. To achieve this,

those interested in teaching must move away from traditional indoctrination methods and start from the principle that a competent teacher is made, not born, in light of modernity.

Based on the above, the research problem can be defined by answering the following question:

What is the effect of a teaching strategy based on the Wallace model on logical-mathematical thinking among secondary school female students in mathematics?

Second: Importance:

1. The importance of mathematics in all fields and the importance of teaching it at various educational levels, as it requires more attention and focused care in selecting strategies that make students an effective and fundamental focus of the educational process.

2. The current research targets female high school students, which represents a transitional stage between childhood and adulthood, between the concrete and the abstract, and the physical and psychological changes that accompany it for students.

Therefore, this stage requires more comprehensive care to overcome the problems associated with it.

3. It may lead to a deeper, better, and longer-lasting understanding of the cognitive content by shifting from traditional teaching to one that selects information at a time of overwhelming information, and also works to ensure that the student is active and engaged in the educational process. (Hassan, 2022)

4. To the researchers' knowledge, there is no previous study that has addressed the Wallace model in teaching mathematics at the local level.

Third: Research Objective: The research aims to determine the effect of a teaching strategy based on the Wallace model on logical-mathematical thinking among secondary school female students in mathematics.

Fourth: Research Hypothesis:

There is no statistically significant difference at the significance level (0.05) between the average scores of the experimental group students who will study using the proposed strategy according to the Wallace model and the scores of the students who will study using the traditional method in the logical mathematical reasoning test.

Fifth: Research Limits:

1. Second-grade female students in daytime secondary schools affiliated with the General Directorate of Education in Rusafa II.

2. The study material consisted of (Chapter Five: Geometry and Measurement, Chapter Six: Coordinate Geometry, Chapter Seven: Statistics and Probability) from the mathematics textbook prescribed for the second-grade intermediate school (2023-2024), eighth series, 5th edition.

3. The second semester of the academic year (2024-2025) AD.

5. Mahmoud's classification (2006, pp. 148-149) of logical-mathematical thinking skills.

Sixth: Definition of terms:

1. Strategy:

(Al-Afoun and Fatima, 2011) It is: "The conditions and capabilities provided by the teacher in a specific teaching situation and the measures he takes to help his students achieve the specific goals of that situation."

(Al-Afoun and Fatima, 2011, p. 95). (Hassan, 2021)

2. Wallace's Model

Wallace (1926) defined it in his book The Art of Thought as a creative model that includes four stages of the creative process: preparation, incubation, illumination, and verification, which are the foundation of creative research. (Wallas, 1926, p. 10)

3. Logical thinking (Mahmoud, 2006) is "the type of thinking we employ when we try to understand the causes and reasons behind things, i.e., to understand the consequences of things and actions we perform and to arrive at evidence that supports or refutes a particular point of view" (Mahmoud, 2006, p. 146).

Chapter Two: Theoretical Framework and Previous Studies

First: The Wallace Model

Wallace indicated in his book, The Art of Thought, that his model is creative and includes four stages of the creative process: preparation, incubation, illumination, and verification, which are the foundation of creative research.

(Wallas, 1926, p. 10)

Maharani and Sukestiyarno (2017) also see it as one of the models of intellectual creativity that includes an indirect intellectual process. Creativity and analytical thinking are complementary elements that are reflected to varying degrees in other models of creativity. (Maharani and Sukestiyarno, 2017, p. 178)

Psychological and educational literature indicates that if we want to show creative outputs or outcomes in students, we must use educational strategies that provide a creative atmosphere, as the Wallace model is considered one of the educational models that emphasize creative work and generating hypotheses, as the Wallace model is based on placing the learner in an effective and active educational situation.

By providing activities that generate creative ideas, the individual reaches a stage of maturity that enables him to examine the problem and generate new ideas. The problem or issue at hand is approached from all angles and perspectives, and can be viewed from multiple perspectives. (Abu Zaid, 2013, p. 72)

2.1. Steps of the Wallace Model

The stages of creativity are a cognitive-mental process that encompasses all the psychological, cognitive, and motivational activities that occur within the creative individual and lead them to creative achievement. (Al-Rabghi, 2013, p. 66)

These steps represent the stages of the creative idea, which emerges and develops, eventually manifesting into reality in the form of a creative work. They are as follows: (Al-Barqawi, 2012, p. 83)

1. The preparation stage:

This is the basic seed of creativity, during which the creative person suddenly opens up to the first beginnings of his work. These beginnings often come suddenly and require the completion of two steps: a clear and specific definition of the problem and the gathering and organizing of the necessary information about it. This stage is concerned with defining the problem. ...and identifying and gathering ideas and information related to them by taking notes, asking questions, managing solutions and discussions, and collecting and recording evidence. What distinguishes the creative teacher at this stage is his ability to break free from fixed ideas or connect with the ideas of others in a free and authentic creative movement. In any case, the basic functions of this stage can be defined as follows:

- Creating a general creative direction and formulating the prerequisites for creativity. Identifying a specific aspect and focusing on it, especially in the field of scientific research.
- Preparing to collect and assimilate appropriate information and data.
- Intensive, targeted work to support and enrich the idea. (Al-Omariya, 2015, p. 47)

2. Fermentation Stage:

A fermentation period occurs during which the person responsible for the solution puts the problem aside and does something else, as if taking a vacation. During this stage, the mind is freed from many impurities and thoughts unrelated to the problem. It includes conscious and subconscious mental digestion and absorption of all appropriate information and acquired experiences related to the problem. This stage is also characterized by the intense effort exerted by the creative learner in order to solve the problem. The importance of this stage is due to the fact that it gives the mind a chance to get rid of impurities and wrong ideas that could hinder or perhaps disrupt the important parts of it. (Jarwan, 2002, pp. 24-26)

The Illumination Stage:

This is the solution or a crucial part of it. A sudden illumination occurs, resembling the idea in cartoons, which appears as a light bulb above the individual's head. This is the moment when a new idea is born, leading to a creative flash. This spark of creativity, in turn, leads to a solution to the problem. Therefore, this stage is considered the stage of precise and decisive mental work in the creative process. The moment of inspiration arrives, and the entire idea shines in the mind of the creator.

Isaac Newton was unable to discover that an apple falling from a tree was due to gravity until many years later. Einstein was not inspired to formulate his theory of relativity until years of preparation and preparation. Archimedes also arrived at his famous law of buoyancy, measuring volume, and momentum. (Abu Zaid, 2013, p. 74)

3. Verification Stage:

This is where the luminosity is corrected. At this stage, the creative learner must test and revisit the creative idea to determine whether it is complete and useful or whether it requires some refinement and polishing. In other words, the verification stage is the experimental stage of the creative (new) idea. (Al-Jizan, 2004, pp. 28-31)

Conditions to Consider When Applying the Wallace Model

Among the conditions that teachers must consider when applying the Wallace Model are:

- Progressively presenting information from specific to general, from part to whole, and from simple to complex.
- Employing clear and specific questions that help stimulate learners' ideas.
- Breaking down methods into smaller, elementary processes serves all learner levels.
- Providing examples, meaning that each example differs from the previous example and the example that follows it in the list of examples. (Bazzi, 2004, pp. 172-173)

2.2. Features of the Wallace Model

1. It leads to clarifying ambiguities and cementing ideas in learners' minds.
2. It is capable of creating motivation among learners, leading to their mental and cognitive development.
3. The learner is the focus of the educational process, which is consistent with modern educational trends.
4. It allows the teacher to diversify methods and approaches so that each learner learns in the way they find appropriate.
5. It takes into account the principle of individual differences among learners.
6. It helps connect topics together.
7. It helps learners think creatively and increase their motivation to achieve by organizing the steps and sequencing them in the presentation of the educational material.
8. It is consistent with recent experiments that have proven that the basis the learner arrives at on their own based on previous examples is the best aid in developing their thinking ability.
9. It plays a significant role in eliminating the phenomenon of mental distraction by drawing learners' attention to all steps of this model.
10. It develops learners' creativity.
11. It develops learners' ability to apply what they learn in new situations.
12. It leads to increased learners' love for their school. (Abu Zaid, 2013, pp. 73-74)

Second: (a) Mathematical Thinking:

Hass (2000, p. 396) views mathematical thinking as an organized mental activity aimed at solving mathematical problems using some or all of the following (aspects) of thinking: generalization, deduction, symbolic expression, and mathematical proof.

Abdel-Samee and Lashin (2006, p. 139) also argue that mathematical thinking is a flexible and organized mental activity aimed at solving problems using induction, deduction, symbolic expression, and understanding relationships.

4.5. The Importance of Mathematical Thinking:

Obaid and Afana (2003) mention several points of importance of mathematical thinking:

1. The individual's own self-benefit, meaning we must strive to educate and equip individuals with good thinking skills.
2. The general social benefit, as individuals in society acquire good thinking skills to solve their community's and social problems.
3. Mental health: Mental health stems from sound thinking. Thinkers have the ability to adapt to events and changes.
4. An individual's mastery of good thinking and the ability to analyze, evaluate, and criticize makes him/her knowledgeable and unaffected by the ideas of others. (Ubaid and Afana, 2003, p. 29).

Mathematical Thinking Skills

Abu Zeina (1988, pp. 150-151) identified mathematical thinking skills as generalization, induction and deduction, symbolic expression, formal or formal logic, and mathematical proof.

Al-Tawil (1991, p. 7) identified seven mathematical thinking skills for secondary school students: inductive thinking, deductive thinking, symbolic thinking, probabilistic thinking, relational thinking, spatial perception, visual perception, and mathematical proof.

The following are a number of mathematical thinking skills:

• Induction

Abu Zeina (1986, p. 150) views it as a mental process by which the general state is deduced from specific cases.

The researchers view it as the transition from particulars to generalities, where the general rule is reached through individual facts.

Induction, as stated by Jarwan (2002, p. 308), is divided into two types based on arriving at a conclusion:

1. Complete induction: This involves listing all members of a group individually, then arriving at a rule or generalization.
2. Incomplete induction: This involves arriving at a general rule by examining a number of individual cases, not all cases. It is noted that incomplete induction is the most commonly used method in most academic subjects (Hassan, 2020).

• Expressing with symbols

Al-Tawil (1991, p. 92) indicated that this skill refers to the use of symbols to express verbal data or mathematical ideas, and vice versa.

Abu Zeina (1986, p. 50) also sees it as the use of symbols to express ideas or verbal data, i.e., one of two directions of symbolic thinking.

• Logical thinking skills: Abu Jalala (2007) indicated that this type of thinking involves drawing correct conclusions from premises in light of the rules of logic. It is deductive thinking, through which a conclusion is drawn from premises according to rules that logically determine their validity. (Abu Jalala, 2007, p. 19)

• Problem-solving skills: This is the student's ability to conduct a problem and organize the solution by analyzing the problem into its data to arrive at the desired conclusion and choose an appropriate method for the solution.

Second: (b) Logical Thinking

Dewey was the first to advocate the study of thinking in a logical manner. He defined logical thinking as a series of steps, beginning with identifying the problem, then defining it and analyzing it into simpler elements, then formulating hypotheses. This refers to the initial solution to explain the

problem. It must be flexible, such that the individual is prepared to eliminate all or some of his hypotheses, modify them, or change them.

Hypotheses are interpretations that have not yet been supported by evidence. Hypotheses are then examined, discussed, studied, or experimented with to verify their validity and determine the logical and practical consequences of each hypothesis (Holland, 1962, p. 30). Several definitions of logical thinking have been developed, but perhaps the easiest way to define it is as the type of thinking we practice when we try to discern the causes and reasons behind things.

It is the thinking we practice when trying to know the results of what we might do, but it is more than just identifying causes or results. It means obtaining evidence that supports or proves the validity of your point of view or denies it. Logical thinking is based on evidence (Chanz, 1961, p. 17).

Logical thinking focuses on the process of reasoning according to logical rules, as logic is essentially the science of correct reasoning (2022 Jawad). Logicians distinguish between three types of reasoning: deductive reasoning, which means reasoning from the general to the specific, and inductive reasoning.

), which means reasoning from the specific to the general, and analogical reasoning, which is reasoning from the specific to the specific, and is done by making an analogy between two things or two situations that have similarities between them, and the process of analogy results in arriving at the result of transferring a ruling from one of the similar things to the other. (Jarwan, 1999, p. 261)

Scholars have defined the elements of reasoning in logical thinking as follows:

1. A premise or premises from which a conclusion is inferred.
2. A conclusion that follows from those premises or premises.
3. Logical relationships that connect the premises to each other and to the conclusion.
4. Principles and rules upon which the mind relies in its movement and transition from premises to conclusion.Logical thinking is a type of thinking that leads to a conclusion from premises. Thinking, in essence, is understanding the relationship between the elements of a situation, and it leads to comprehension, which is essentially the perception of the relationship between something known and something unknown. When a person issues a certain judgment, it is the result of realizing the relationship between the elements of a situation. (Al-Eisawi, 2000, pp. 74-76)

It is noteworthy that logical thinking is one of the forms of sound scientific thinking, and it has a single method that is suitable for working with all sciences, whether natural or human, because logical thinking is governed by several special laws and standards, and this point in particular requires us to pause for reflection,How can a single approach to thinking succeed in dealing with different types of sciences, including theoretical and practical, abstract and sensory, mathematical and practical, and human and natural? The purpose of this observation is that the steps of logical thinking are suitable for application to all types of sciences (natural and human) (Al-Aqabi & Kadhimi, 2023).In no case can we dispense with the direction of thinking to move from premises to conclusions, from hypotheses to probabilities, from facts to axioms. (Al-Harith, 1999, pp. 40-41)

Mustafa (2002) points out that logical thinking is what we practice when we attempt to understand the causes and reasons behind things, It is a mental activity of the individual that aims to solve a problem and make a decision. It is a process that includes reaching a conclusion from known premises, and during it the individual performs a number of mental operations, as logical thinking begins with natural sensory experiences, whether simple or complex (Ibrahim&et al, 2023), and then develops into low-abstract experiences such as simple mathematical operations such as addition and subtraction.....etc.

Then, we move on to more abstract experiences, as we clearly see in all the laws of science, both natural and human. This thinking operates within the scope of new problems that require our attention. (Mustafa, 2002, pp. 61-63)

Second axis: Previous studies:

First: Previous studies that dealt with the Wallace model: Through searching the literature and previous studies, it was not

Finding studies dealing with this topic directly according to the scope of this search.

Second: previous studies on mathematical logical thinking

Find studies that directly address this topic within the scope of this research.

Second: Previous studies that address logical mathematical reasoning.

T	The name of al-Bachid and Walbad	level educational	type of sample	sample volume	the material	Almanhaj type	the result
1	Abu Sultan (2012) Gaza	high school	females	76	Mathematics	experimental	The results show that the experimental group which is correct according to the independent variable (L.W.K strategy) is superior to the control group which is correct according to the usual method in the test of logical thinking and the development of concepts.

1	Abu Sultan, (2012) Gaza	High school	Females	76	mathematics	experimental	The results showed that the experimental group, which studied according to the independent variable (L.W.K strategy), outperformed the control group, which studied according to the traditional method, in the logical thinking test and concept development.
2	Shamma and AlKilani,(2018), Iraq	High school	Males	61	mathematics	experimental	The effectiveness of the guided imagination strategy in developing logical thinking skills in mathematics for second-grade middle school students compared to the traditional method
3	Al-Kadhimi, (2019) Iraq	High school	Females	100	mathematics	experimental	The results showed that the experimental group, which studied according to the independent variable (integral approach), outperformed the control group, which studied according to the traditional method, in the logical thinking test.

4	عبد الحسن (2021), العراق	High school	Females	61	mathematics	experimental	**The results showed that the experimental group that studied according to the posse strategy outperformed the control group that studied according to the traditional method in the achievement test and the logical thinking test.**

Chapter Three

First: External Validity of the Experimental Design:

1. Experimental Duration: The experiment was conducted on Tuesday, February 11, 2025, and ended on Tuesday, April 27, 2025, and was conducted uniformly across both research groups.
2. Subject Teacher: The researcher ensured that both research groups were taught by herself to avoid any potential discrepancies resulting from teachers' differences in abilities, styles, and skills.
3. Curriculum: The curriculum comprises Chapter 5: Geometry and Measurement, Chapter 6: Coordinate Geometry, and Chapter 7: Statistics and Probability from the prescribed mathematics textbook for the second intermediate grade (2023-2024), eighth series, 5th edition.
4. Number and distribution of classes: The weekly lesson schedule for the second intermediate grade for mathematics was approved by the school administration, with five classes per week) For each section, according to the instructions of the Ministry of Education, which stipulate that the school day is (five days), i.e. one class per day, and this class is compensated for by an additional lesson in the event of an official holiday. After agreeing with the school administration, the weekly class schedule was distributed equally between the two research groups.

5. Experimental attrition: No female students in either research group dropped out of school during the experiment.

6. Maturation factor: The biological changes that occur in the sample individuals in terms of physical, mental, and social development. This variable had no clear impact on the experiment's results, given the relatively moderate duration of the experiment.

Sixth: Research Tool (Logical Mathematical Reasoning Test):

The process of constructing the test items for logical mathematical reasoning skills included the following stages:

1. Defining the concept of logical mathematical reasoning.
2. Defining the main and sub-skills of logical mathematical reasoning skills.
3. Presenting the main and sub-skills and their indicators to the judges.
4. Formulate the test items
5. Prepare the test instructions
6. Present the test to the judges.

• Apparent (surface) validity: The mathematical reasoning test was presented to a number of judges specializing in mathematics and mathematics teaching methods. The number of items was distributed according to the skills.

The main and sub-skills were evaluated based on the importance of each skill. A consensus rate of 80% or more among the judges' opinions was used as a criterion for accepting each item of the test after making some modifications to its items. The test was finally approved.

7. Test Validity:

A. The first pilot experiment to test mathematical logical reasoning:

The test was applied on Wednesday, 4/23/2025, on a survey sample consisting of (42) female students at (Al-Hadara Intermediate School for Girls), in order to know the clarity of the test paragraphs. They were asked to read the test instructions first and also pay attention to the test paragraphs. It was found that the test paragraphs were understandable to the female students The time taken to complete the test items was calculated by calculating the time taken by the first five students and the last five students to complete the test, and then calculating the average time taken to complete the test. It was found that the average time required to complete the test was (55) minutes.

B. The second pilot experiment for the logical-mathematical reasoning test:

1. The second pilot application of the test

After determining the test time and ensuring the clarity of its paragraphs and instructions, the researcher applied the logical mathematical thinking test to a second survey sample (the statistical analysis sample) numbering (100) female students from the second intermediate school who were randomly selected from the schools affiliated with the General Directorate of Education of the Second Rusafa, whose administration showed cooperation with the researcher (Al-Hadara Intermediate School for Girls). After completing the application, the researcher corrected the items and conducted statistical analysis as follows:

2. Correcting the test items: This refers to assigning the individual a score or rating in the test. Interpreting this score is of great importance, as it serves as a prelude to making a practical decision or scientific interpretation about the individual or group of individuals being measured (Abu Hatab et al., 2008, p. 203).

If one mark was given for the correct answer and zero for the wrong answer, the omitted paragraphs were treated as a wrong answer, as were the paragraphs that contained more than one choice, so the total score for the test became (30) with a hypothetical average of (15).

10. Statistical analysis of test items: Statistical analysis of scores helps reveal the accuracy of items in measuring what they were designed to measure. The ease, difficulty, and discrimination coefficients help reveal the high abilities possessed by the upper group of the research sample, as well as the lower abilities possessed by the rest of the sample (Ebel, 1972, p. 269).

To obtain indicators for examining the paragraphs of the mathematical reasoning skills test, the researcher performed the following steps:

- After completing the correction of the answers, the total score for each student on the test was determined.
- The scores were arranged in descending order from highest to lowest.
- Since the size of the survey sample was (100) students, a percentage of (27%) was determined to represent the upper group, and a percentage of (27%) was determined to represent the lower group for the purpose of conducting statistical analysis.
- The correct and incorrect answers for the upper and lower groups in the logical-mathematical reasoning test were calculated, and then the following statistical analyses were conducted:

11. Difficulty coefficients for the items

The difficulty coefficient was calculated for each item in the logical-mathematical reasoning test, which consisted of (30) objective items, according to the difficulty equation for the objective items. It was found that they ranged between (0.22 - 0.55), and (Awda, 1998, p. 149) indicated that the item is considered acceptable if its difficulty coefficient ranges within the period (0.20 - 0.80)

12. Discrimination coefficient of test items The discriminating power of the test items was calculated using the discrimination coefficient equation, and it was found to range between (0.25 - 0.81). Therefore, all of them are considered acceptable. (Rasan and Abbas 2025)

13. Effectiveness of False Alternatives

The effectiveness of false alternatives for each item in the test was determined using the equation for the effectiveness of false alternatives. All values were found to be negative except for the correct choice. This means that the false alternatives were attractive to lower-level students, demonstrating their effectiveness in testing logical-mathematical reasoning. (Al-Azami and Jassim, 2019) 14. Verifying the Psychometric Properties of the Test

15. Test Validity:

The researcher relied on two types of validity:

• Face Validity

Also called arbitrator validity, this means that an instrument is valid if its appearance indicates this, and if the test items or instrument are related to the measured behavior the scale (Al-Zamli et al., 2009: 240), and the researchers verified the apparent validity of the test by presenting its paragraphs to a group of arbitrators in mathematics and mathematics teaching methods, to verify the test paragraphs, and after taking into account their comments and opinions, the paragraphs that obtained an agreement rate of more than (80%) among the arbitrators were accepted.

• 17. Construct validity: The concept of construct validity, as explained by Cronbach, is the analysis of scale scores based on the psychological structure of the characteristic to be measured. (Cronbach, 1970, p. 120-121)

This type of validity can be achieved by finding the correlation between each of the following:

A- Item score and total score: The researchers used Pearson's correlation coefficient to find the correlation between The score of each paragraph of the test and the total score of the test, as these scores represent the responses of the students of the survey sample to the test paragraphs. The results showed that all correlation coefficients for the test paragraphs are statistically significant at a significance level of (0.05) and some others at (0.01).

B- The paragraph score with the total score of the skill to which it belongs: The researchers used Pearson's correlation coefficient to extract the relationship between the score of each paragraph and the skill to which it belongs, and the results showed that all the test paragraphs were statistically significant at a significance level of (0.05) and some others at (0.01).

C- The skill score with the total score of the test: The researchers also used Pearson's correlation coefficient to extract the correlation between the skill score and the total score of the test, and the results showed that all test items were statistically significant when compared to the tabular value and at a significance level of (0.05). (There is no statistically significant difference at the 0.05 level between the average scores of the experimental group students who studied using the proposed strategy and the average scores of the control group students who studied using the traditional method on the logical-mathematical reasoning test.)

After correcting the students' answers on the logical-mathematical reasoning test, which was administered to both research groups (experimental and control), The results are shown in Table (2)

Table (2)

Statistical description of the data of the two research groups in the logical mathematical thinking variable

Group	Division	Number of female students	Arithmetic average	Standard deviation	Standard error of the mean	95% confidence interval for the arithmetic mean	
						ceiling	minimum

empiricism	**B**	**31**	**25.10**	**2.79**	**0.50**	**5.84**	**3.07**
The female officer	**D**	**33**	**20.64**	**2.74**	**0.47**	**5.84**	**3.07**

By applying (Leven's Test) to two independent samples, to know the significance of the difference between the variance of the scores of the students of the experimental and control groups, the value of (F) reached (0.07) at a significance level of (0.78), which is greater than the approved significance level of (0.05), and this means that the two groups are homogeneous in this variable.

By applying (t-test) for two equal independent samples to know the significance of the difference between the average scores of the students of the experimental and control groups, the t-value reached (6.43) at a significance level of (0.00), which is smaller than the approved significance level of (0.05) and with a degree of freedom of (62), and this indicates the superiority of the students of the experimental group The students in the control group, who were taught according to the proposed strategy, were taught according to the traditional method in the logical-mathematical reasoning test, as shown in Table (3).

Table (3)

The values of (t) and (f) for the two research groups (experimental and control) in the logical-mathematical reasoning variable

Group	**Number of students**	**Leven's Test To equalize the two variances**		**t-test To equal the averages**		**Degree of freedom df**	**Statistical significance at the level (0.05)**
		F	**Connotation**	**t**	**The significance of both parties**		
empiricism	31	0.07	0.78	6.43	0.00	62	Statistically significant
Control	33						

Thus, the first null hypothesis was rejected and the alternative hypothesis was accepted in favor of the experimental group.

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

1- The proposed strategy has a clear positive effect on logical mathematical thinking in academics, more so than the traditional method, among second-grade middle school students.

2- The use of the independent variable in teaching provided an opportunity for all students in the experimental group to participate in the lesson and work on connecting ideas.

3- The teaching procedures using the proposed strategy are consistent with modern educational guidelines in placing students at the center of the educational process and utilizing imagination and cooperative learning.

4- The interaction and cooperation of students who studied according to the proposed strategy was better than that of students who studied according to the traditional method.

5- The use of the proposed strategy in teaching helped instill desirable behaviors in students, including attentiveness during the lesson and interest in mathematics.

Third: Recommendations

1. Encourage and motivate teachers to use the proposed strategy when teaching mathematics at the secondary level, given its positive impact on logical mathematical thinking.
2. Urge preparation and training directorates to conduct training courses for mathematics teachers on the application of the proposed strategy and how to employ it in teaching mathematics.
3- Calling on colleges of education in Iraqi universities to include the proposed strategy in the curriculum of mathematics teaching methods taught to college students, outlining the main steps.

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