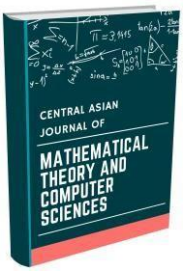

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Article

The Effect of Using Lee's Model on the Achievement of Fourth Scientific Grade Students in Mathematics and the Development of Their Critical Thinking

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Abstract: The present study aimed to identify the effect of Lee's Strategy (Lee's Model) on the achievement of fourth-grade scientific stream students in mathematics and the development of their critical thinking skills. To achieve the study objectives, the researcher adopted an experimental design with pre-test and post-test procedures for both the experimental and control groups. The study sample consisted of (60) fourth-grade scientific stream students who were randomly assigned to two groups: an experimental group taught according to Lee's Model and a control group taught using the conventional teaching method. Each group included (30) students. The researcher ensured equivalence between the two groups in variables related to the study, including age in months, intelligence, mathematics grades from the previous academic year, critical thinking, and parents' educational attainment. For data collection, an achievement test in mathematics was developed, consisting of (30) multiple-choice objective items. In addition, a critical thinking scale was employed. The researcher adopted the scale developed by Al-Saadi (2010), which in its final form consisted of (25) items distributed across five domains: recognizing assumptions, interpretation, evaluation of arguments, deduction, and inference, with five items for each domain. The scale utilized two response options (True/False), where one point was awarded for each correct answer and zero for each incorrect answer, resulting in a total score ranging from (0–25). The validity and reliability of both instruments were established. The post-achievement test was used to measure academic achievement, while the critical thinking scale was administered before and after the experiment to determine the extent of growth achieved by the participants during the experimental period. After completing the experiment and statistically analyzing the data, the results revealed statistically significant differences between the mean scores of the two groups in favor of the experimental group on the post-achievement test. The findings also showed that students in the experimental group outperformed those in the control group in critical thinking. These results indicate the effectiveness of Lee's Model in improving students' achievement in mathematics and enhancing their critical thinking skills. Based on these findings, the researcher recommends incorporating Lee's Model into mathematics instruction at the secondary school level, training teachers to implement it effectively in classroom settings, and conducting further studies involving other variables and educational stages.

Keywords: Lee's Model, Academic Achievement, Critical Thinking, Mathematics

1. Introduction

Research Problem: The current era is witnessing rapid changes and successive developments in various fields of scientific, technological, and intellectual life, in addition to global openness facilitated by the tremendous revolution in communication and transportation. These transformations have created numerous challenges that necessitate preparing individuals with the mental and intellectual capabilities to adapt to these changes and confront contemporary problems efficiently and effectively. This has made the development of creative and critical minds a fundamental objective of modern education [1]. Developing students' mental and intellectual abilities occupies a pivotal position in contemporary educational systems, as it is a significant indicator of societal progress and development, representing a genuine investment in human capital. Therefore, developed and developing countries have given increasing attention to developing their educational systems by conducting educational studies and research and employing the necessary resources to raise the level of thinking and creativity among students, enabling them to utilize their mental abilities to meet the demands of a constantly evolving life [2]. To achieve these educational goals, it has become necessary to reconsider the teaching methods used in classrooms, given their active role in achieving the desired learning outcomes. The continuous development of educational objectives requires the adoption of modern teaching methods and strategies that are compatible with educational developments and help develop the cognitive, skill-based, and intellectual aspects of learners, as traditional methods based on lecturing and rote learning are no longer capable of achieving these goals as required [3]. Despite modern educational trends that emphasize the importance of making the learner the focus of the educational process, the educational reality in many schools still witnesses a clear reliance on traditional teaching methods, where the learner's role is often limited to receiving, memorizing, and retrieving information during tests, while attention to developing thinking, analytical, investigative, and problem-solving skills is declining. This has negatively impacted the level of student learning, as the focus has become on memorization and recitation rather than understanding, application, and use in new situations, which limits the growth of their mental abilities and affects the quality of the outputs of the educational process [4].

Hence, the need arose to adopt modern teaching strategies based on cognitive theories of learning, strategies that activate the learner's role and actively engage them in constructing and acquiring knowledge. Among these strategies is the Lee Model, which stems from the principles of cognitive theory. It views the learner as an active participant in the educational process, interacting with learning experiences through a variety of activities and exercises related to the curriculum content. The learner plays a fundamental role in selecting and directing activities in accordance with their learning objectives, helping them construct their knowledge independently and effectively [5]. Furthermore, educational literature and previous studies indicate that teaching strategies based on learner engagement in knowledge construction and organization are among the most effective educational approaches for addressing the difficulties students face in learning various subjects. This is due to their role in developing thinking, inquiry, and problem-solving skills, as well as enhancing motivation towards learning and improving academic achievement [6].

Mathematics is a subject that demands high levels of thinking, comprehension, analysis, and logical reasoning. Therefore, the success of learning mathematics is directly linked to the effectiveness of the teaching methods employed. Mathematics teaching strategies have witnessed remarkable development as a result of the vast expansion of mathematical knowledge and the continuous evolution of teaching methods, as well as the demands of the information and technology age, which necessitates preparing students capable of sound mathematical reasoning and applying mathematical knowledge to various life situations. Consequently, modern standards for mathematics education emphasize the need to develop mathematical thinking and reasoning skills, strengthen

mathematical relationships and connections, and utilize mathematical knowledge to address diverse real-life problems [7].

Despite these modern trends, there remains a need to explore more effective teaching strategies that make learning mathematics an active and engaging process for students, develop their cognitive and thinking abilities, and motivate them to participate positively in educational situations, thus positively impacting their academic achievement and thinking skills. Based on this, the researcher saw the importance of employing the Lee Model strategy in teaching mathematics to determine its effectiveness in improving student achievement and developing their critical thinking. Therefore, the current research problem is defined by the following question:

What is the effect of using the Lee Model strategy on the achievement of fourth-grade science students in mathematics and the development of their critical thinking?

The importance of the research: Acquiring understanding and insight in mathematics is linked to the student's ability to discover mathematical rules and patterns on their own, which promotes viewing mathematics as a system of relationships and connections. From this perspective, learning mathematics is not limited to memorizing laws, but is based on understanding mathematical relationships and symbols, and building mathematical knowledge with the ability to employ the acquired concepts in the real situations they encounter in the contemporary world. Mathematics textbooks vary in the strategies they employ when presenting and organizing mathematical concepts [8]. The impact of these strategies on concept learning has garnered increasing attention over the last three decades. This interest is based on the assumption that teaching strategies play a crucial role in acquiring mathematical concepts and understanding related concepts. Given the importance of teaching strategies in mathematics education, numerous studies have been conducted to identify the most effective strategies for enhancing students' learning of mathematical concepts [9]. Since it is difficult for teachers to directly grasp all learning theories and their applications, educators have focused on proposing and developing teaching strategies that align with the principles of these theories. One such strategy is Lee's approach. This strategy emphasizes problem-solving in mathematical and other fields, developing a plan to reach a solution, implementing that plan, and reviewing and validating the solution through logical and systematic steps that facilitate a smooth transition to the next step [10].

Developing and enhancing students' thinking requires finding ways and means to help them acquire problem-solving skills to deal with the problems they encounter in their daily lives. This task is one of the goals of the modern school. In order for teaching to achieve its goals effectively, facts, concepts, and educational procedures should be treated as means to help learners confront various problems, not as independent goals in themselves. Moreover, developing problem-solving skills is linked to daily life situations and extends to include many professional fields that require thinking and analysis, such as accounting, engineering, and science [11].

Critical thinking is the ability of an individual to express a supporting or opposing opinion on various issues, providing convincing reasons for each viewpoint. Individuals can practice this type of thinking independently or through interaction with others. It helps increase a student's desire and motivation towards thoughtful and reflective behavior [12]. Based on the above, the importance of this research can be summarized in the following points:

1. To demonstrate the impact of the Lees Model strategy on improving the mathematics achievement of fourth-grade science students.
2. To reveal the role of the Lees Model strategy in developing critical thinking skills among fourth-grade science students.
3. To utilize the research findings in developing mathematics teaching methods and improving the educational process.

Research objectives: The current research aims to determine the effect of Lee's strategy on the achievement of fourth-grade science students in mathematics and the development of their critical thinking.

Research hypothesis: In order to achieve the research objectives, the researcher formulated the following null hypothesis:

1. There is no statistically significant difference at the 0.05 level between the mean achievement scores of the experimental group students who studied using Lee's strategy and the mean achievement scores of the control group students who studied using the traditional method.
2. There is no statistically significant difference at the 0.05 level between the mean scores of the experimental group students who studied using Lee's strategy and the control group students who studied using the traditional method on the critical thinking scale.
3. There is no statistically significant difference at the 0.05 level between the mean scores of the experimental group students who studied using Lee's strategy before and after the experiment on the critical thinking scale.

Scope of the research: The current research is limited to:

1. Fourth -grade science students in the intermediate day schools affiliated with the Salah al-Din Education Directorate – Tikrit Education Department.
2. The last three chapters of the mathematics textbook for fourth-grade science students, namely: (Chapter Five: Vectors, Chapter Six: Coordinate Geometry, and Chapter Seven: Statistics).
3. The second semester of the 2025-2026 academic year.

Defining the terms:

1-Lee's Model: This strategy was defined by:

- Badawi: "It is a strategy for solving mathematical problems for those who fall under the concrete operational stage according to Piaget's classification of cognitive development." [10]
- Al-Siraj : "One of the practical applications of Jean Piaget's theory of cognitive development relates to the concrete operational stage and the learner's interaction with the environment through verbal problems and problem-solving. It integrates the theories of Piaget and Vygotsky." [13]
- Lee's Strategy Operationally: This is the teaching method adopted by the researcher in teaching mathematics to fourth-grade science students through the stages of Lee's strategy, which are: presenting the problem, individual thinking, discussion and interaction among students, analyzing and evaluating solutions, and reaching conclusions. This is done throughout the duration of the experiment, and its impact is measured through the students' results in achievement and critical thinking tests.

2-Acquisition: This was defined by:

• Bani Khalid : "A specific level of achievement or performance in school education that is measured by the teacher or through monthly or final exams." [14]

• Rabia : Academic achievement refers to the educational results obtained by a student through cognitive tests administered by teachers. The results of these tests enable them to progress from one educational stage to another. [15]

• Operational definition of achievement: It is the amount of knowledge, skills, and mathematical concepts that a student acquires as a result of learning and studying. It is usually measured through various tests, assignments, and educational activities.

3-Critical thinking: It has been defined by:

- Huitt defined it as "the learner's ability to utilize acquired knowledge and skills in analyzing facts, organizing and structuring ideas, distinguishing opinions, making

comparisons, and arriving at sound conclusions, as well as using this to solve problems." [16]

- Mar'i & Nawfal: "A set of multiple considerations that guide the learner to take others' viewpoints into account and direct them to search for alternative viewpoints in order to form their own viewpoint." [17]
- Jarwan : Critical thinking is defined as a complex educational concept that is linked to an unlimited number of complex educational behaviors and overlaps with other concepts such as logic and problem-solving. [18]
- Operationally, critical thinking is the score obtained by a second-year middle school student on a critical thinking test designed for research purposes, which measures skills in analysis, interpretation, reasoning, evaluating arguments, and inference.

2. Theoretical Framework and Previous Studies

Lee's Strategy (Lee Model): The Lee strategy is a cognitive learning strategy that aims to achieve cognitive development, keep pace with educational objectives, and adapt to the demands of the contemporary environment. This is achieved by creating a positive atmosphere based on classroom interactions, unleashing learners' potential, encouraging them to work and solve problems, and removing constraints that limit their thinking. This contributes to increasing their mental capacity and propelling them in various cognitive directions, with the goal of actively participating in achieving the objectives of the educational situation. This leads to stimulating and encouraging motivation and developing problem-solving abilities [10]. This strategy derives its foundations from Polya's approach to problem-solving and is applied by reformulating methods to suit the chosen verbal problem, taking into account the language used and the degree of complexity of the linguistic structures. Problems are generally unfamiliar situations for students, and their existing knowledge is insufficient to reach solutions directly [13].

Lee's strategic steps: This strategy involves a number of steps, which are:

1- Understanding the Problem: This is the first step in Lee's strategy. Here, the learner works to clearly define and understand the problem by analyzing its elements, uncovering any ambiguities, and identifying the data, related relationships, and influencing factors. This is achieved by asking a series of guiding questions, such as: What is the content of the problem? What are the relationships between its elements? What is the desired outcome or answer? This helps in forming a clear understanding of the problem before embarking on its solution [10].

2- Formulating the Plan: In this stage, the learner works on preparing a plan to solve the problem by gathering the necessary data and information, recalling facts and previous experiences, and searching for the necessary relationships that help in reaching the solution. This also includes identifying missing information, distinguishing between important and unimportant information, and selecting appropriate procedures and activities to implement the plan. The learner is guided by a number of questions, including: Can a diagram or illustration be drawn? Can the information be organized in a table or chart? Has a similar problem been encountered before? [13].

3- Implementing the Plan: In this stage, the previously developed plan to solve the problem is implemented by searching for relationships between known and unknown data, understanding the connections between them, and organizing the available information in a way that helps in reaching the solution. The learner also tests the proposed hypotheses, eliminates the unsuitable ones, and verifies the correctness of the steps followed during implementation. Questions directed at this stage include: Implement the steps that have been determined and verify their correctness. Each step [13].

4- Review and Evaluation: This is the final step in Lee's strategy. It involves verifying the validity and logic of the solution by reviewing the procedures and results, and

exploring alternative solutions by proposing different hypotheses or approaches. It also aims to enhance understanding through the systematic application of reasoning and ensuring the correct answer is reached. Questions addressed in this stage include: Is the solution logical? Can another solution be found? Can a similar problem be formulated? [10].

Critical Thinking: A review of definitions of critical thinking in educational literature reveals their multiplicity, resulting from the differing theoretical starting points of researchers. Each definition focuses on specific aspects of the skill. This diversity is positive because it broadens the scope of research and contributes to producing deeper and more comprehensive knowledge. One of the earliest attempts to define critical thinking was by John Dewey, who defined it as reflective thinking—a type of thinking characterized by activity, persistence, and caution in examining beliefs or assumptions, relying on evidence that supports inferences [19]. Norris defines critical thinking as a set of considerations and mental processes that guide the learner to take others' viewpoints into account and encourage them to search for multiple alternatives in order to construct their own viewpoint based on analysis and reflection [20].

Abdul Aziz states that thinking is the highest and most complex level of mental activity, resulting from brain activity in processing various stimuli [21]. Proponents of the conditioned behaviorist approach view thinking as a response to specific stimuli that is influenced by subsequent reinforcement, while proponents of the operant behaviorist approach view it as a mental process that an individual uses to solve problems or answer questions. Reinforcement leads to the repetition of these responses and their transformation into intrinsic motivation [21].

Critical thinking skills: Critical thinking includes many skills, as indicated by Facione [22].

1. Interpretation: This is the ability to understand situations and data and express their implications. It includes skills such as classification and analyzing observations.
2. Analysis: This is the ability to assess the relationship between concepts, statements, and ideas, whether inductive or deductive. It includes skills in examining opinions, identifying arguments, and analyzing them.
3. Evaluation: This is the ability to judge the credibility of claims and opinions. It includes skills in evaluating arguments and claims.
4. Reasoning: This is the ability to draw logical conclusions from evidence and data. It includes skills in examining evidence, generating alternatives, and arriving at conclusions.
5. Explanation: This is the ability to present and justify the results of thinking based on evidence, concepts, and context. It includes presenting results, justifying procedures, and presenting arguments.
6. Self-Discipline: This is the ability of an individual to monitor, organize, and ensure the accuracy of their thinking. It includes self-testing and organizing thoughts and conclusions.

Steps of critical thinking: Abdul Aziz stated that the steps of critical thinking are as follows [21]:

1. Gather information and data related to the topic.
2. Review different opinions and viewpoints.
3. Discuss and analyze the opinions to distinguish between correct and incorrect ones.
4. Identify the strengths and weaknesses of opposing opinions.
5. Evaluate the opinions and evidence objectively.

Previous studies

1-Studies that addressed Lee's strategy

Study Findings	Statistical Methods	Research Instruments	Sample Type & Size	Methodology	Objective	Research Subject	Researcher & Year	No.
The experimental group taught using the Lee Strategy significantly outperformed the control group taught by the conventional method.	Independent- and paired-samples t-test, difficulty index, discrimination index, and distractor effectiveness.	Achievement test and decision-making scale.	90 students; 45 students in each group.	Experimental method with two groups (experimental and control).	To investigate the effect of the **Lee Strategy** on the achievement and decision-making of second-grade intermediate students in physics.	Physics	[23]	1
The experimental group taught using the Lee Strategy significantly outperformed the control group taught by the conventional method.	Independent- and paired-samples t-test, difficulty index, discrimination index, and distractor effectiveness.	Achievement test and scientific sense scale.	61 female students; 31 in the experimental group and 30 in the control group.	Experimental method with two groups (experimental and control).	To investigate the effect of the **Lee Strategy** on the achievement and scientific sense of second-grade intermediate female students in science.	Biology	[13]	2

2-Studies that addressed critical thinking:

No.	Researcher & Year	Research Subject	Objective	Methodology	Sample Type & Size	Research Instruments	Statistical Methods	Study Findings
1	[24]	History	To investigate the effect of the **Monor and Slater Strategy** and the **McFarland Strategy** on developing critical thinking skills among eighth-grade students in history.	Experimental method with experimental and control groups.	209 male and female students divided into two groups.	Achievement test and critical thinking test.	Two-way ANOVA, Cronbach's alpha, and multivariate analysis of variance (MANOVA).	The experimental group significantly outperformed the control group taught using the conventional method.
2	[25]	Chemistry	To investigate the effect of the **RISK Program** on achievement and the development of critical thinking among fourth-grade scientific students in chemistry.	Experimental method with experimental and control groups.	60 students; 30 in the experimental group and 30 in the control group.	Achievement test and critical thinking scale.	Independent- and paired-samples *t*-test, difficulty index, discrimination index, and distractor effectiveness.	The experimental group significantly outperformed the control group taught using the conventional method.

Research Methodology and Procedures

1- Experimental design: The researcher chose the design called "Two experimental and control groups with a post-test" as it is the most suitable for the research because it includes two equivalent groups, as shown in Figure (1):

Measure of the dependent variable	dependent variable	independent variable	The group
A specific achievement test	Academic achievement	(Lee's) strategy	empiricism
And a critical thinking assessment	Critical thinking	Conventional Method	Control

Figure 1. Experimental design of the research.

2- Research Community: The research community was defined as the fourth-grade science students in the intermediate and secondary day schools affiliated with the Salah al-Din Education Directorate, Tikrit Education Department, for the academic year (2025-2026).

3- Research sample: The Outstanding Boys High School in Salah al-Din/Tikrit was chosen to implement the experiment because it contains two sections for the fourth

scientific grade, which facilitates the researcher's random selection of the two groups and the cooperation of the secondary school administration. The two sections were randomly distributed into two experimental groups (Section A), which will be taught according to Lee's strategy, and the number of its students is (30) students, and control (Section B), and the number of students is (30), taught according to the usual method.

4- Equivalence of the two research groups: Before starting to implement the experiment, the researcher carried out the process of equivalence of the two research groups in some variables that could have an impact on the results of the experiment, where the equivalence variables were as follows: ((Pre-critical thinking test - the general average for the third intermediate stage for the academic year (2024 - 2025) - the age of the students calculated in months - the IQ of the students of the two groups - the educational level of the parents)) and using statistical methods to equivalence the two groups. The following is shown, as shown in Table (1):

Table 1. T-test for the equivalence of the two research groups.

t-value		Standard Deviation	Mean	Sample Size	Research Group	Equivalence Variables
Tabulated	Calculated					
2.021	0.564	3,05	24,8	30	Experimental	**Critical Thinking**
		3,15	23,7	30	Control	
	0.108	7,66	67.36	30	Experimental	**Mathematics Achievement**
		8,20	66.88	30	Control	
	0.861	6.86	152.7	30	Experimental	**Age (Months)**
		7.22	156.5	30	Control	
	0.347	3.620	15.20	30	Experimental	**Intelligence Quotient (IQ)**
		4.309	15.120	30	Control	

5- Parents' Educational Level: Information regarding the educational level of the parents of the students in both research groups was collected from the school administration and the students themselves. Based on this data, the researcher categorized the sample according to the educational level of their parents. The chi-square test (χ^2) was applied to both groups of parents, and the results of the analysis showed no statistically significant differences between the experimental and control groups, as shown in Table (2):

Table 2. / The academic achievement of the father and mother of the students in the research sample and the tabulated and calculated value of (〖π〗^2).

Statistical Significance	Chi-square (χ^2)		University	Institute	Intermediate/Secondary School	Primary School or Above	Sample Size (N)	Group	Variable
	Tabulated	Calculated							
Not significant at the 0.05 level	7,82	0,16	8	5	6	6	25	Experimental	**Father's Educational Attainment**
			7	5	8	5	25	Control	
Not significant at the 0.05 level	7,82	0,08	5	5	7	8	25	Experimental	**Mother's Educational Attainment**
			4	5	6	10	25	Control	

6- Research requirements:

A. Defining the Curriculum: The curriculum included the last three chapters (Chapter 4: Trigonometry, Chapter 5: Vectors, and Chapter 6: Coordinate Geometry) from the fourth-grade science mathematics textbook for the second semester of the 2025-2026 academic year.

B. Formulating Behavioral Objectives: The behavioral objectives for the three chapters were defined according to the levels of Bloom's Taxonomy of Knowledge (remembering, understanding, applying, and analyzing) after analyzing the curriculum content for the three chapters.

C. Preparing Lesson Plans: Two types of lesson plans were prepared for the two groups: a control group using the traditional method and an experimental group using the Leigh Evaluation strategy. These plans were reviewed by experts and referees to benefit from their suggestions and make any necessary modifications.

D. Developing the Research Instrument: The research required the development of two instruments: an achievement test and a critical thinking scale, as follows:

First - The achievement test: Building the achievement test included the following steps:

-Preparing a test specifications table or map, where the researcher specified the number of test items as (30) items as shown in Table (3).

Table 3. Test Map for Achievement Test Items.

Total	Analysis (20%)	Application (23%)	Understanding (27%)	Remembering (30%)	Content Weight	No. of Pages	Chapter
	No. of Items						
11	2	3	3	3	%37	14	**Chapter Five**
10	2	2	3	3	%29	13	**Chapter Six**
9	2	2	2	3	%34	16	**Chapter Seven**
30	6	7	8	9	%100	43	**Total**

- Formulation of Test Items: The researcher formulated the achievement test items in the multiple-choice format, which is an objective test. Therefore, she prepared (30) items.
- Face Validity of the Test: To verify the validity of the achievement test, it was presented to a committee of expert specialists. The test relied on the opinions, suggestions, and guidance of the reviewers, and the agreement rate showed 80%.
- Formulation of the Achievement Test Instructions: These included circling the correct answer, as each question contained four alternatives, one of which was correct. The instructions also included specifying the time allotted for answering the question.
- Test Administration and Item Analysis: The test was administered to a pilot sample of (100) students from various schools. The average time taken to complete the test was calculated, and any unclear items were identified. - Item Difficulty Index: The difficulty index for each item in the achievement test was calculated using its specific formula. The results ranged from 0.35 to 0.67. Bloom considers test items acceptable if their difficulty index is between 0.20 and 0.80, meaning that all test items are acceptable [26].
- Item Discriminatory Power: The formula for discriminatory power was applied by the researcher, and its coefficients ranged from 0.32 to 0.60. Brown indicates that items are acceptable if their discriminatory power is greater than 0.20 [27].
- Effectiveness of Incorrect Alternatives: An incorrect alternative is effective when it attracts more students from the lower group than from the upper group, especially in objective tests of the multiple-choice type. The more negative the alternative's value, the more effective it becomes [28]. After applying the equation for the effectiveness of incorrect alternatives to all items, it was observed that the effectiveness coefficients were negative, thus all incorrect items were considered acceptable.
- Test Reliability: The researcher determined the reliability of the achievement test using the Kuder-Richardson-20 equation. This equation is characterized by its accuracy, and the calculated reliability coefficient indicates the consistency of an individual's performance from one item to another.

Second: Critical Thinking Scale: The researcher adopted the critical thinking scale developed by Al-Saadi as it was suitable for the objectives of the current study [29]. The scale consists of 25 items distributed across five domains: (knowing assumptions, interpretation, evaluating arguments, deduction, and inference), with 5 items in each domain. The scale uses two answer options (true/false), with one point awarded for a correct answer and zero for a false answer. The total score ranges from 0 to 25 points.

The psychometric properties of the scale:

-Face Validity: The scale items and instructions were presented to a group of experts and specialists in educational and psychological sciences, curriculum, and teaching methods. The agreement rate among them reached 86%, indicating the scale's appropriate face validity.

-Reliability: The Kuder-Rigardon 20 coefficient was used to calculate the reliability coefficient, which was 0.86. This is a good coefficient indicating the instrument's stability and applicability.

Pilot Application of the Scale: A pilot application of the scale was conducted with a sample of students outside the research sample in two phases. In the first phase, the researcher administered the scale to a pilot sample of 30 fourth-grade science students to ensure the clarity of its items, the answer instructions, and the time taken to complete each item. The average time was calculated by averaging the time taken by the first five students and the last five to finish answering the scale items.

The researcher administered the scale a second time after ensuring the clarity of its items, instructions, and the time required for completion. This second administration was to a sample of 100 fourth-grade science students. The purpose of this second administration was to perform statistical analysis of the scale items, as follows:

-Item Difficulty Index: This was calculated using the difficulty equation and found to range between 0.29 and 0.66, indicating that the items are of good quality.

-Item Discriminatory Power: The researcher calculated the discriminatory power using the discriminatory power equation, and the coefficients ranged between 0.32 and 0.60. Brown indicates that items are acceptable if their discriminatory power is greater than 0.20 [29].

-Scale Reliability: The Kuder-Rigardon 20 equation was used to calculate the reliability coefficient, which was 0.86. This is a good coefficient, indicating the stability of the instrument and its applicability. Procedures for implementing the experiment: After the research experiment concluded, the researcher administered the final achievement test to the research sample and scored it herself. The post-test for critical thinking was administered after the achievement test and scored by the researcher according to the established guidelines.

Chapter Four: Presentation and Discussion of Results

This chapter includes presenting, discussing, and interpreting the results of this research by calculating the significance of the differences between the calculated means, as explained below:

First: Results related to the first null hypothesis: To verify the first hypothesis, which states that there is no statistically significant difference at the level of (0.05) between the mean achievement scores of the experimental group students who studied according to Lee's strategy and the control group students who studied in the usual way, the t-test for two independent samples was used to compare the means of the two groups in the post-achievement test, as shown in Table (4).

Table 4. Results of the (t-test) for two independent samples for the two research groups in the achievement test.

المجموعة	عدد الطلاب	المتوسط الحسابي	الانحراف المعياري	درجة الحرية	القيمة التائية		الدلالة الاحصائية
					المحسوبة	الجدولية	
الضابطة	25	29.84	6.122	48	4.78	2.021	دال احصائيا
التجريبية	25	42.04	7.641				

Table (4) shows that the calculated t-value (4.78) is greater than the critical t-value (2.021) at a significance level of (0.05) and degrees of freedom of (48), indicating a statistically significant difference in achievement favoring the experimental group. Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted, indicating the effectiveness of Lee's strategy in improving student achievement compared to the traditional method.

-2Results related to the second null hypothesis concerning critical thinking: To verify the second hypothesis, which states that there is no statistically significant difference at the (0.05) level between the mean scores of the experimental group students who studied using Lee's strategy and the control group students who studied using the traditional method on the critical thinking scale, an independent samples t-test was used to compare the means of the two groups on the critical thinking scale, as shown in Table (5).

Table 5. Results of the (t-test) for two independent samples for the two research groups in the thinking scale.

Statistical Significance	t-value		Calculated t-value	Degrees of Freedom (df)	Standard Deviation	Number of Students	Group
	Tabulated	Calculated					
Not Significant	2.021	4.78	48	7.44	59.66	25	**Control Group**
				7.77	62.43	25	**Experimental Group**

Table (5) shows that the calculated t-value (4.78) is greater than the critical t-value (2.021) at 48 degrees of freedom and a significance level of 0.05, indicating a statistically significant difference between the mean scores of the two groups in favor of the experimental group on the post-test.

3- Results related to the third null hypothesis concerning post-test critical thinking, which states, "There is no statistically significant difference at the 0.05 level between the mean scores of the experimental group students who studied using Lee's strategy before and after the experiment on the critical thinking scale."

A paired-samples t-test was used to determine the significance of the difference between the mean scores of the experimental group students on the pre- and post-tests of critical thinking, as shown in Table (6).

Table 6. Results of the paired-samples t-test for the experimental group on the critical thinking scale.

Statistical Significance	t-value		Degrees of Freedom (df)	Standard Deviation	Mean	Sample Size (N)	Group
	Tabulated	Calculated					
Significant	2,021	16.66	48	4,11	10,9		**Experimental Group**

Table (6) shows that the calculated t-value (16.66) was greater than the tabulated t-value (2.021), indicating a statistically significant difference between the pre- and post-tests in favor of the post-test. This suggests the development of critical thinking skills among the students in the experimental group.

Secondly: Discussion and Interpretation of Results: The research results showed the superiority of the students in the experimental group, who studied using Lee's strategy, in achievement and the development of critical thinking compared to the students in the control group, who studied using the traditional method. This can be attributed to several reasons:

1- Lee's strategy contributed to actively engaging students in the learning process, which helped them better understand mathematical topics and develop their ability to analyze different ideas and situations.

2- Lee's strategy helped link learning to understanding and analysis rather than memorization and rote learning. It provided students with opportunities to discuss, interpret, and evaluate mathematical solutions, which positively impacted their academic achievement and simultaneously contributed to developing their critical thinking skills. 3- The nature of the activities included in Lee's strategy encouraged students to participate, interact, and reflect on mathematical problems, which led to an increase in their motivation to learn and an improvement in their academic performance, as well as enhancing their ability to make judgments, inferences, and

evidence-based decisions, which explains their superiority in both achievement and critical thinking.

Conclusion

1. The research results demonstrated the effectiveness of Lee's strategy in raising the academic achievement of fourth-grade science students in mathematics compared to the traditional method.
2. Lee's strategy contributed to developing critical thinking skills among fourth-grade science students by providing them with opportunities to analyze, deduce, discuss, and evaluate mathematical solutions.
3. The strategy helped increase student interaction and positive participation in the learning process, which positively impacted their academic achievement and critical thinking.
4. Lee's strategy provided an active learning environment that encouraged students to learn independently, collaborate, and exchange ideas, which contributed to more effective learning.

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