opción

Revista de Antropología, Ciencias de la Comunicación y de la Información, Filosofía, Lingüística y Semiótica, Problemas del Desarrollo, la Ciencia y la Tecnología

Año 35, 2019, Especial N° 20
Revista de Ciencias Humanas y Sociales
ISSN 1012-1587/ ISSNe: 2477-9385
Depósito Legal pp 198402ZU45

Universidad del Zulia
Facultad Experimental de Ciencias
Departamento de Ciencias Humanas
Maracaibo - Venezuela

Opcion, Año 35, Nº Especial 20 (2019):*2899-2921*
ISSN 1012-1587/ISSNe: 2477-9385

The Effect Of Using Frank Lester's Strategy In The Geometric Thinking Skills Of The Second Grade Intermediate School Female Students In Mathematics

Noor Rahmaan Salal Al-Shouaily
Prof. Dr. Abbas Naji Abd Al-Amer

Abstract
The present research aims to identify the effect of using the strategy of Frank Lester in the skills of engineering thinking (visual, logical, applied) among second graders in mathematics. To verify the research objective, the following hypothesis was developed: "There is no statistically significant difference at the level of (0.05) between the average scores of students studying according to Frank Lester's strategy and the average scores of students studying according to the usual method of teaching the test of engineering thinking skills (visual, logical, applied)."

El Efecto Del Uso De La Estrategia De Frank Lester En Las Habilidades De Pensamiento Geométrico De Las Estudiantes De Segundo Grado De Secundaria En Matemáticas

Resumen

La presente investigación tiene como objetivo identificar el efecto del uso de la estrategia de Frank Lester en las habilidades de pensamiento de ingeniería (visual, lógica, aplicada) entre los estudiantes de segundo grado en matemáticas. Para verificar el objetivo de la investigación, se desarrolló la siguiente hipótesis: "No existe una diferencia estadísticamente significativa en el nivel (0.05) entre los puntajes promedio de los estudiantes que estudian de acuerdo con la estrategia de Frank Lester y los puntajes promedio de los estudiantes que estudian de acuerdo con el método habitual de enseñar la prueba de habilidades de pensamiento de ingeniería (visual, lógica , aplicado)."

The following hypotheses have been derived:

There is no statistically significant difference at the level (0.05) between the average scores of students studying according to Frank Lester's strategy and the average scores of students studying according to the usual method of teaching in visual, logical, applied skills, and each skill alone.

The research sample consisted of (69) female students from the second intermediate grade in the original authenticity for girls of the Directorate of Education of Baghdad / Rusafa II the second semester of the academic year (2018/2019) as one of the two groups was selected to be the experimental group and the number of its students (32) students while the group The second officer (37 students).

The researcher adopted the experimental design of two equivalent groups with post-test. The two research groups were rewarded in variables (previous knowledge test, previous achievement, intelligence test, chronological age calculated in months).

To achieve the objective of the research, the researcher prepared a test consisting of (10 objective paragraphs of the type of multiple choice of four alternatives and 5 paragraphs essay), and has been verified the validity of the test and stability and psychometric characteristics (difficulty factor, discriminatory force, the effectiveness of wrong alternatives).

The results were as follows:

The presence of a statistically significant difference at the level of significance (0.05) between the average scores of students of the experimental group and control in skills (visual, logical, applied) and for the benefit of the experimental group.

First, the research problem

One of the reasons for the difficulty in teaching engineering is due to teachers using teaching methods based on memorization, memorization and giving the student a negative role in keeping laws and rules without giving him the opportunity to research and investigation in addition to the lack of curriculum and books to the element of suspense. Recent Trends in Engineering Teaching Methods.

The researcher surveyed the views of a number of teachers of mathematics in a number of middle schools in the education of Rusafa / 2 of the Directorate of Baghdad being the closest to the educational reality, in the possession of students for engineering thinking and skills and their views that they study mathematics, including vocabulary of engineering confirmed on the indoctrination side, has confirmed There is weakness in engineering thinking and his skills, especially logical, visual and applied skills.

Teachers emphasized that most students leave engineering questions in the monthly or final exams and that the reasons may be due to the lack of students' engineering thinking skills (visual, logical, applied) and their inability to reach skills at higher levels of engineering thinking as well as teaching traditional methods adopted conservation And indoctrination.

Therefore, the researcher considered the need to conduct a study in which she attempts to address the problem of engineering thinking skills (visual, logical, applied) among middle school students (second grade intermediate) by exploring the possibility of using strategies, methods or models, including the strategy (Frank Lester) and identify Its effect on engineering thinking skills. We can put the problem of current research in answering the following question:

What is the effect of using Frank Lester's strategy in engineering thinking skills (visual, logical, applied) among second graders in mathematics?

Second: The importance of research

1. Proposal on how to prepare and teach a second-year teaching module in Intermediate Engineering in the light of Frank Lester's strategy.

2 - deals with an important study stage, as it is no secret to the importance of the intermediate stage, which is a transition from concrete operations

to abstract processes and the transition of students from adolescence to maturity and the impact of this on the success of educational stages later.
3. It may be useful for mathematics supervisors to know the extent of applying geometric thinking skills in mathematics to second grade students.
4. May help officials to take into account the levels of engineering thinking in the construction and planning curricula of mathematics and geometry subject to include those curricula topics to develop engineering thinking skills appropriate to a particular stage or age group.
5. Is one of the rare research in Iraq in the study of the strategy of Frank Lester and engineering thinking skills (to the knowledge of the researcher) as the researcher did not find any previous Iraqi study in mathematics or in other subjects used Frank Lester strategy.
6. May contribute to improving the level of teaching engineering for the better as well as the adoption of modern methods as a strategy in teaching.
Third: The research objective

The present research aims to identify the effect of using the strategy of Frank Lester in the skills of engineering thinking for second grade students in mathematics (visual, logical, applied).
Fourth: Research hypotheses

To verify the research objective, the researcher formulated the following zero hypothesis:

"There is no statistically significant difference at the significance level (0.05) between the average scores of students studying according to Frank Lester's strategy and the average scores of students studying according to the usual method of teaching in the test of engineering thinking skills (visual, logical, applied)."
The following null hypotheses are derived:
1. "There is no statistically significant difference at the level of (0.05) between the average grades of students studying according to Frank Lester's strategy and the average grades of students studying according to the usual method of teaching in visual skills."
2. "There is no statistically significant difference at the level (0.05) between the average scores of students studying according to Frank Lester's strategy and the average scores of students studying according to the usual method of teaching in logical skills."
3. "There is no statistically significant difference at the significance level (0.05) between the average scores of students studying according to Frank Lester's strategy and the average scores of students studying according to the usual method of teaching in applied skills."

Fifth: Limits of research

Current search is limited to:

1. Second grade intermediate students in middle schools affiliated to the Directorate General of Education Baghdad / Rusafa II.
2. The second semester of the academic year (2018/2019)
3. Chapter 5 (Engineering and Measurement), Chapter 6 (Modern Engineering) of the textbook of mathematics scheduled for the second year intermediate students, for the academic year 2018/2019
4. Engineering thinking skills (visual, logical, applied).

Sixth: Definition of terms

The effect was defined by Hassan and Najjar (2003) as "the result of a desirable or undesirable change occurring in the learner as a result of the teaching process." (Hassan and Najjar, 2003: 22)

2. Strategy defined by Tamimi (2010) "a group of teacher movements within the class that occur regularly and sequentially in order to achieve pre-set goals, which is that the definition that although the teacher is going according to his own way to implement a particular method, but it follows a specific strategy steps according to the lesson". (Tamimi, 2010: 29)

3. Frank Lester Strategy (Lester, 1980) "It is a general exploratory method of problem-solving and consists of six stages: attention to the problem, understanding the problem, problem analysis, plan development, implementation, evaluation." (Lester, 1980: 216-220)

4. Geometric Thinking defined Salameh (1995) as a mental activity practiced by the learner to deal with and analyze geometric shapes based on the interrelationships between shapes and determine the properties of shapes through experimentation in addition to the formulation and use of definitions and the ability to deduce by building simple mathematical proofs and the ability to the proof". (Salama, 1995: 56)

5. Skill The Skill defined Saleh (1972) as "speed, accuracy and mastery in the performance of a business with the economy in the effort and time spent to do the work." (Saleh, 1972: 32

6. Skills of Geometric Thinking Defined by Sankari (2003) as "the ability of the learner to explain, understand and practice mental processes quickly and accurately and mastery and practice enables the learner to solve the engineering problems faced by these skills (visual, logical, applied,)." (Sankari, 2003: 23)

Seventh: Theoretical background

Axis I: Frank Lester's Strategy

He identified it as "Al Mughira, 1989" as a problem-solving technique

developed by Frank Lester and consists of six stages. (Al-Mughira, 1989)

Defined by Frank Lester, a general exploration strategy for problem-solving is derived from the four-phase Apulia model and is equipped with a set of exploratory processes to seek to solve engineering problems in each of its six steps. (Frank Lester, 1980)

Stage 1: Attention to the problem

When the learner faces a situation, before considering this situation a problem for them must know that a barrier prevents him from this position, but if he did not pay attention to this obstacle, or if he was not prepared to try to solve; the next stages become meaningless.

Phase II: Understanding the problem

It begins with the learner to understand the problem and try to reach a meaning, and this stage includes two stages: translation and containment.

Translation means rewriting the problem into meaningful things like symbols, terms, mental images, etc.

The containment requires the learner to extract the relevant information, and then determine how to link this information.

Phase III: Goal Analysis

It is meant to recreate the problem again or put it in another form, so that it is more appropriate for the learner who is the solution of strategies, plans or methods.

Phase IV: Development of the plan

Developing the plan means not only identifying effective and appropriate strategies such as finding a specific pattern, or solving a simpler problem related to the problem in question, but also identifying the processes that can be used, and developing hypotheses and steps to address the problem.

Phase V: Implementation of the plan

It is a stage for selecting hypotheses and implementing procedures to obtain solutions to problems. One of the most important obstacles facing students at this stage is to make some mistakes or lapses during implementation, the student may fail to implement the plan after a simple calculation error committed during the solution or may be confused during implementation because of the inability to coordinate parts of the plan with each other.

Stage 6: Evaluation of procedures and solution

This stage includes analysis and evaluation of the solution, as well

as the evaluation of strategies used to solve the problem, success in problem-solving usually results from the regular evaluation of the effectiveness of decisions used during the solution of the problem, and also through careful examination of the result, evaluation is a continuous process starting from the beginning of the second phase And continue even after obtaining the desired solution, and the evaluation of the solution and the plan can be considered a search for answers to certain questions and continuing even after obtaining the answer.

Reasons for choosing the Frank Lester strategy:

The choice of Frank Lester's strategy is the most important:

1. Frank Lester's strategy is one of the most prominent works on interpreting problem-solving in the light of cognitive processes.
2. Frank Lester's strategy is derived from the George Puglia model. The study of Proudfit (1981), Lee (1982) and Payne (1984) proved that using the Puglia model in problem-solving teaching leads to the development of learners' ability to Solving mathematical and engineering problems.
3. Leicester's strategy involves analysis in its steps. My studies by Carroll (1977) and Germain (1987) have shown that the use of analytical method leads to the development of learners' ability to solve engineering and mathematical problems.
4. Leicester's strategy includes the step of attention (awareness of the problem), and attention to the problem is one of the key factors in the process of solving the problem as the first step in solving the problem is that the learner feels the existence of a problem that raises in himself a kind of confusion and astonishment to think about solving it. If the learner does not notice a problem, the remaining steps of the strategy are meaningless.
5. Frank Lester's strategy includes a set of exploration techniques that help learners to gain a solution. Vissa (1985), Joseph (1987) and Muhayyat Abu Amira (1987) have proven that teaching students on prospecting techniques Improve their troubleshooting performance.

• Engineering Thinking Skills

In conjunction with Van Hell's levels of engineering thinking, Allen Hoover identified five engineering thinking skills that learners can develop: visual skills, logical skills, applied skills, verbal skills, and drawing skills. (Robert Morris, 1986 - referenced in Muhammad, 2007)

The following is a breakdown of these skills (Hoffer, 1981)

Visual skills:

It includes the ability to distinguish different geometric shapes unconsciously of their distinctive features or characteristics, to observe parts of a

particular shape and their interrelationships, to distinguish the relationships between different geometric shapes, to classify different geometric shapes according to their observable properties, and to use information from a geometric shape to infer information. Other, use deductive mathematical systems to visualize geometric models based on given information.
Examples of visual skills include:
a. Distinguish the different geometric shapes unconsciously of their distinctive characteristics
- Logical skills:

It includes the ability to distinguish between geometric shapes in terms of similarities and differences, to classify geometric shapes according to their properties, to use the properties of geometric shapes to determine whether a category of shapes is content in another, to use logic rules to develop evidence and to draw logical expressions from information given to favor geometric proofs. And to know the role of deductive curricula and their limits and when the system of universals is absolute, stable and independent.

Examples of logical skills include:
a. The ability to distinguish geometric shapes in terms of similarities and differences
- Example: the extent of similarity and difference between the square and designated in terms of: ribs, angles and diagonals.
b. Use the properties of geometric shapes to determine if a category of shapes contains its content in another category
- Example: Using the properties of both the rhombus and the square determine which belongs to the other? And why?
- Example: Each particular parallelogram, because the rhombus has parallel properties.
c. Use logic rules to deduce logical statements from given information
- Example: deduce the law of interior angles from the table below

Decathlon	Hexagon	Hexagon	Pentagon	Quadrilateral	Triangular	Number of ribs
1140^{O}	900^{O}	720^{O}	540^{O}	360^{O}	180^{O}	Interior corners

3. Applied Skills:

These include the ability to distinguish geometric shapes in nature, to draw or construct geometric models of physical shapes, to recognize the properties of physical shapes through geometric models, to identify the benefits of geometric patterns in physical situations (geometric issues), to develop mathematical models to describe natural and social phenomena, and to use models to solve problems. Engineering.

Examples of the characteristics of applied skills include:

a. Ability to distinguish geometric shapes in nature

- Example: beehives be hexagonal shape as well as the tree triangular and moon circular and others

b. Using models to solve engineering problems

For example, one of the most famous buildings in the world is a building known as the Montreal Dome in Canada, which is a round ball of transparent glass with a diameter of 76 m. Calculate its surface area and size.

Eighth: Previous Studies

- Previous studies on the strategy of Frank Lester

1. Ammar, 2004

The study was conducted in Egypt and aimed at the effectiveness of the Leicester model for problem solving in the performance of first graders to solve verbal engineering exercises and their engineering thinking.

It consisted of 54 students. The researcher was rewarded between the two study groups (experimental and control) in the variables (test to solve verbal geometry exercises, test to measure geometric thinking).

The results were as follows: The presence of statistically significant differences at the level of significance (0.01) between the mean scores of the control and experimental group in the test solution verbal engineering exercises in favor of the experimental group.

The presence of statistically significant differences at the level of significance (0.01) between the mean scores of the control and experimental group in the engineering thinking test in favor of the experimental group.

2. Al-Harbi, 2011

The study was conducted in Egypt and aimed at the effectiveness of using the Frank Lester model to solve problems in the development of mathematical thinking and academic achievement in secondary school students.

The sample consisted of 75 students. The researcher was rewarded between the two study groups (experimental and control) in the variables (mathematical thinking test and test to measure achievement).

The results were as follows: The presence of statistically significant dif-

ferences at the level of significance (0.05) between the mean scores of the control and experimental group in the mathematical thinking test in favor of the experimental group.
The presence of statistically significant differences at the level of significance (0.05) between the mean scores of the control and experimental group in the collection test for the benefit of the experimental group.
3. Quintet, 2014
Conducted in Jordan, it aimed at the effect of using the Frank Lester model to solve the engineering problem of ninth grade students and their beliefs. It consisted of 62 students. The researcher was rewarded between the two study groups (experimental and control) in the variables (the problem solving test, a measure to measure beliefs).
The results were as follows:. The presence of statistically significant differences at the level of significance (0.05) between the mean scores of the control and experimental group in the test solution verbal geometry in favor of the experimental group.
The presence of statistically significant differences at the level of significance (0.05) between the mean scores of the control and experimental group in the scale of beliefs in favor of the experimental group.
- Previous studies dealing with engineering thinking skills
1. Al-Tudari, 1998
Conducted in Saudi Arabia, and aimed at the impact of the use of laboratory teaching method in the performance of third grade students in the area of Baha engineering skills and the development of the trend towards mathematics.
It consisted of 70 pupils. The researcher was rewarded between the two study groups (experimental and control) in the variables (achievement test to measure engineering skills, a measure of the trend towards mathematics).
The results were as follows: - There were statistically significant differences at the level of significance (0.01) between the mean scores of the control and experimental group in the achievement test of engineering skills in favor of the experimental group.
The presence of statistically significant differences at the level of significance (0.01) between the mean scores of the control group and the experimental in the scale towards the direction of mathematics in favor of the experimental group.
2. Samurai, 1999
The study was conducted in Iraq and aimed to use the typical Van Hull and

solve problems in teaching stereoscopic engineering to sixth graders.
The sample consisted of 66 students. The researcher was rewarded between the two study groups (experimental and control) in the variables (pre - test to measure geometric thinking, after test to measure geometric thinking).
The results are as follows: The presence of statistically significant differences at the level of significance (0.05) between the mean scores of the control and experimental group in the pretest test of engineering thinking in favor of the experimental group.
The presence of statistically significant differences at the level of significance (0.05) between the mean scores of the control and experimental group in the post-test of engineering thinking in favor of the experimental group.
3. Sankari, 2003
Conducted in Palestine, it aimed at the effect of Van Heil 's model on the development and retention of engineering thinking skills among ninth grade students in Gaza.
The sample consisted of 95 students. The researcher was rewarded between the two study groups (experimental and control) in the variables (test to measure engineering thinking, test to measure engineering thinking skills).
The results were as follows: There were statistically significant differences at the level of significance (0.05) between the mean scores of the control and experimental group in the engineering thinking test in favor of the experimental group.
The presence of statistically significant differences at the level of significance (0.05) between the mean scores of the control and experimental group in the test of engineering thinking skills in favor of the experimental group.

Ninth: Research Methodology

The researcher adopted the experimental research method to achieve the objectives of the research because it is the appropriate method to verify his hypotheses, which is the way that helps the researcher to reach a new reality and can overcome any mysterious problem.

• Experimental design:

After researching a group of experimental designs, I adopted the experimental design of two equivalent groups with post-test, because it is

the most suitable design to achieve the objectives of the research. Below:

(1) Table

Experimental design

Scale of the dependent varible	The dependent variable	Independent variable	Equal groups	The groups
Geometric thinking test	Geometric thinking skills	Frank Lester's strategy	Collection Previous Previous Knowledge Test the intelligence Age by month	Experimental
		The usual way		Control

Tenth: The research community and its sample

- research community:

The current research community consists of second grade middle school students in the morning schools of the General Directorate of Education Baghdad - Rusafa / 2 for the academic year (2018/2019).

- The research sample:

The original authenticity for girls of the Directorate General of Education Rusafa / 2 was chosen intentionally for the following reasons:

1. The school administration is ready to cooperate with the researcher.
2. The cooperation of the teacher of mathematics with the researcher.
3. The proximity of the school to the residence of the researcher, which facilitated the application of the experience.
4. The students of the school from a socially convergent environment, economically, as most of them live in one district, which makes it easier for the researcher to fix some variables between the two groups.

By random selection, two divisions were selected out of (6 divisions) for the second intermediate grade, representing (F) experimental group and (G) control group. The number of female experimental group (40) female and the number of female control group (43) female. Previous experience in the subjects to be studied during the experiment and may affect the dependent variable (engineering thinking skills) and the accuracy of the results, the number of (14) students, so that the final total of the two groups (69) students, note that the researcher excluded students failing statistically from the results of equivalence And post test results but kept They must be in class to maintain the school system.

Eleventh: Control Procedures

Research variables were confirmed by parity between the experimental group and the control group in some variables (chronological age calculated in months, previous knowledge test, intelligence test, previous achievement in mathematics) as shown below.

(2) Table

Parity variables for research groups

ficance at indication level 0.05	value at 67 degrees		Control (37 students)			Experimental (32 students)			groups
	ibular	ulated	ariance	Standard deviation	Arithm mean	ariance	Standard deviation	Arithm mean	iables
Not function	2.000	0.333	2.199	4.836	11.324	2.185	4.774	11.500	Previo Knowl
Not unction	2.000	0.085	12.343	152.350	70.784	11.735	137.710	71.031	Previo Collec
Not unction	2.000	0.076	3.521	12.397	17.865	4.406	19.413	17.938	IQ test
Not unction	2.000	1.135	5.644	31.855	164.75	5.722	32.741	166.31	in month

Twelfth: Research Requirements

• Determine the educational material (content):

The teaching material that was studied during the experiment was determined from the mathematics textbook to be taught in the second semester of the academic year 2018/2019 for the second intermediate grade.

Chapter Five: Engineering and Measurement

2. Chapter Six: - Coordinate Engineering

Thirteenth: Search Tool

• Preparation of engineering thinking skills test clauses: (15) test items were prepared and distributed (10) of the objective questions of multiple choice type, four alternatives, where each paragraph has four alternatives (one alternative is true and the remaining alternatives are wrong) and (5 paragraphs of essay questions distributed over three skills are (visual, logical, applied).

• Validity test: I use two types of honesty, namely: -

1 - apparent honesty: that the test of engineering thinking skills is appar-

ently honest to measure the dependent variable.
2. Building validity: Building validity refers to the degree to which a test measures a construct, theoretical, or a particular trait, or the ability of that test to validate a hypothesis. (Kubaisi, 2011: 267)
• Statistical analysis of the test items: To perform the statistical analysis of the items, the following was followed:
- Paragraph difficulty coefficient: The difficulty of the paragraphs was found from the equation, and the difficulty of paragraphs (0.31 - 0.69).
- Paragraph recognition factor: The coefficient of discrimination of each test paragraph was calculated, and found that its value (0.31 - 0.61).
- The effectiveness of the wrong alternatives: The effectiveness of the wrong alternatives was calculated, and found that the wrong alternatives have attracted more students from the lower group than the upper group, and thus returned all the wrong alternatives effective.
- Stability of the test: The concept of stability refers to the degree of control and accuracy in the measurement process, and is defined as the degree of consistency and homogeneity in the results of two scales in the assessment of behavior or adjective, ie, the test or the scale gives the same results if re-applied to the people themselves and under the circumstances itself. (Al Nabhan, 2004: 299)

Stability was extracted to test the engineering thinking skills by adopting the vakropnach equation, which is suitable for both objective and essay paragraphs, which is an indicator of the internal homogeneity of the test.It reached (0.88). (Nabhan, 2004: 240
Fourteenth: Procedures for applying the experiment
• Equivalence procedures:

Before starting the experiment, the researcher carried out a set of procedures to determine the equivalence of the two research groups in some of the variables that the researcher may consider affecting the dependent variable as follows:
A - The previous knowledge test was conducted on Wednesday, 21/2/2019 and corrected the answers of students and extracted the total scores of the test and organized in tables for the purpose of statistical processing.
B - The test of intelligence (Otis-Lennon) on Thursday, 22/2/2019 was corrected the answers of students and extracted the total scores of the test and organized in tables for the purpose of statistical processing.
C - information on the ages of female students was obtained and organized in special tables for the purpose of statistical processing.
Information about the grades of female students in the first intermediate

grade of the second semester was obtained and organized in special tables for the purpose of statistical processing.

• Application Procedures:

The experiment was applied in the second semester of the academic year 2018/2019.

B- The experiment started on Tuesday 20/2/2019 and lasted until Thursday 18/4/2019.

The experimental group was taught by adopting the strategy of (Frank Lester) and the control group was taught using the usual method of teaching.

• Search Tool Application:

The Engineering Thinking Skills Test was applied on the corresponding day and the students were informed of a test to measure their engineering thinking skills one week before the scheduled date.

Fifteenth: Presentation of the results

Validate the null hypothesis which states that:

(There is no statistically significant difference at the 0.05 level between the average scores of students studying according to Frank Lester 's strategy and the scores of students studying according to the usual method of teaching in engineering thinking skills (visual, logical, applied)).

The total engineering thinking test scores were calculated for the students of the two research groups (experimental and control) as well as the arithmetic mean and standard deviation for each group as shown in table (3) below:

Table (3)

The result of the T-test to find out the significance of the difference between the mean scores of the experimental and control groups in in the test of geometric thinking skills

Significance at indication level 0.05	T- value		Variance	Standard deviation	Arithmatic mean	The number	The group
	Tabular	Calculated					
Function	2.00	4.82	31.38	5.60	26	32	Experimental
			21.96	4.69	16.5	37	Control

Table (3) indicates that there is a statistically significant difference between the students of both groups (experimental and control), in favor of the experimental group. He studied according to the usual method of teaching in the test of engineering thinking skills (visual, logical, applied) for the experimental group.

The impact value was (2.13), which is why the impact of Frank Lester's strategy on the test of engineering thinking skills (high).

To verify the secondary hypotheses derived from the basic hypothesis, the researcher:

a. (There is no statistically significant difference at the 0.05 level between the average scores of students studying according to Frank Lester's strategy and the scores of students studying according to the usual method of teaching in visual skills of engineering thinking skills).

Visual skills scores were calculated for the students of the two research groups (experimental and control) as well as the mean and standard deviation for each group as shown in Table (4) below:

Table (4)

The result of the T-test to find out the significance of the difference between the mean scores of the experimental and control groups in the visual skills in the test of geometric thinking skills

Significance at indication level 0.05	T- value		Variance	Standard deviation	Arithmatic mean	The number	The group
	Tabular	Calculated					
Function	2.00	2.16	1.52	1.23	2.65	32	Experimental
			1.16	1.07	2.05	37	Control

Table (4) indicates that there is a statistically significant difference between the students of both groups (experimental and control), in favor of the experimental group. Those who studied in the usual way of teaching visual skills of engineering thinking skills for the benefit of the experimental group.

The magnitude of the impact of visual skills was (0.56).

B. (There is no statistically significant difference at the 0.05 level between the average scores of students studying according to Frank Lester's strat-

egy and the scores of students studying according to the usual method of teaching in logical skills of engineering thinking skills).

The logical skills scores were calculated for the students of the research groups (experimental and control) as well as the arithmetic mean and standard deviation for each group as shown in table (5) below:

Table (5)

The result of the T-test to find out the significance of the difference between the mean scores of the experimental and control groups in the logical skills in the test of geometric thinking skills

Significance at indication level 0.05	T- value		Variance	Standard deviation	Arithmatic mean	The number	The group
	Tabular	Calculated					
Function	2.00	5.15	1.79	1.34	5.63	32	Experimental
			1.75	1.32	3.97	37	Control

Table (5) indicates that there is a statistically significant difference between the experimental and control groups in favor of the experimental group. Therefore, the zero hypothesis rejects that there is a statistically significant difference at the level of significance (0.05) between the average scores of students studied according to Frank Lester's strategy and female students' grades. Those who studied in the usual way of teaching in logical skills of engineering thinking skills for the benefit of the experimental group.

The volume of impact of logical skills was (1.26).

T. (There is no statistically significant difference at the 0.05 level between the average scores of students studying according to Frank Lester's strategy and the scores of students studying according to the usual method of teaching in applied skills of engineering thinking skills).

The applied skills scores were calculated for the students of the research groups (experimental and control) as well as the mean and standard deviation for each group as shown in table (6) below:

Table (6)

The result of the T-test to find out the significance of the difference between the mean scores of the experimental and control groups in the logical skills in the test of geometric thinking skills

Significance at indication level 0.05	T- value		Variance	Standard deviation	Arithmatic mean	The number	The group
	Tabular	Calculated					
Function	2.00	5.18	7.28	2.69	5.43	32	Experimental
			1.93	1.39	2.81	37	Control

Table (6) indicates that there is a statistically significant difference between the students of both groups (experimental and control) in favor of the experimental group. Those who studied according to the usual method of teaching in applied skills of engineering thinking skills for the benefit of the experimental group.

The impact size of applied skills was 1.88, which is why the impact of Frank Lester's strategy on applied skills is high.

XVI: Interpretation of results

From the review of the results of the current research the researcher can give an explanation of his findings as follows: It was clear from the results presented in table (3) that there is a statistically significant difference between the students of both groups (experimental and control) and for the benefit of the experimental group who studied using the strategy (Frank Lester at the significance level (0.05) in the test of engineering thinking skills and in all his skills (visual, logical and applied).

This result is consistent with the study (Samurai, 1999), (Todari, 1998), (Al-Harashah, 2016), (Khalaf Allah, 2013), which showed a statistically significant difference in skills (visual, logical and applied).

This superiority can be attributed to Frank Lester's strategy for several reasons that the researcher can summarize as follows:

1. Frank Lester's new strategy on the learning environment has increased the excitement of female students for math classes.
2. A strategy that arouses intellectual curiosity and curiosity.

3. Strategy means to convey the life situations of students to the inside of the school for training to solve.
4. A means for the student to use different sources and references for learning and not content with the book.
5. Frank Lester's strategy is equipped with a set of exploration techniques that help the teacher to teach engineering thinking skills.
6. Solving engineering problems in particular depends on analyzing the problem and trying to understand the relationship between the data. It also requires clear identification and precise organization and the relationship between the data in the problem and the strategy of Frank Lester based on those characteristics.

Seventeenth: Conclusions

In the light of the findings of the researcher I concluded the following:
Frank Lester's strategy provided an opportunity for all students to participate in the lesson.
2. Frank Lester's strategy allowed students to practice engineering thinking skills (visual, logical, applied) and apply them in their life situations.
3. It had a positive effect in raising the level of engineering thinking skills of second grade students.
4. The use of the Frank Lester strategy led to interaction between the school and the students themselves.
5. The strategy greatly encouraged students to think freely and express their questions and answers, identify and correct mistakes, and actively participate in the lesson.
6. Teaching in accordance with Frank Lester's strategy has been instrumental in increasing students' awareness and awareness of what they think.
7. Develop the attention of students through the use of Frank Lester strategy.

Eighteenth: Recommendations

In the light of the findings of the researcher recommends the following:
1. The Directorate of Preparation and Development at the Ministry of Education should hold training courses for teachers and teachers on how to use different methods that help to develop their engineering thinking skills.
2. Teachers of mathematics to adopt strategies, including the strategy of Frank Lester that helps to develop engineering thinking and skills and levels of teaching and raise awareness of them and not confined to methods that rely on memorization and indoctrination.
3. Enriching the mathematics textbooks with various activities that motivate students to think geometry and his skills and not be limited to exam-

ples books.
4. Encourage teachers and teachers to pay attention to teaching and teaching students to think as a mental activity that helps to transfer the impact of education to life situations.
5. The need to include practical education programs in colleges of education (Department of Mathematics) on training in the use of strategies that address problem-solving, including the strategy of Frank Lester
Nineteenth: Proposals
The researcher suggests conducting research that seeks to:
1. Compare the use of Frank Lester's strategy with another problem-solving strategy.
2. Conduct a study to identify the impact of using the strategy of Frank Lester in the knowledge of its impact on thinking (critical, reflective, creative, mathematical) and in correcting mathematical concepts.
3. Conduct a similar study to the current study and to other stages and subjects.
Twenty: Sources
1. Tamimi, Awad Jassim Mohammed (2010): general methods of teaching familiar and new, Dar Hawra, Iraq.
2. El-Todary, Awad Hussein Mohamed (1998): The effect of using the teaching method in the performance of third grade students in Baha area for engineering skills and developing the trend towards mathematics, Assiut University, Egypt.
3. Al-Harbi, Abdullah Bin Tarish Bin Sabeel (2011): The Effectiveness of Using Frank Lester Model to Solve Problems in the Development of Mathematical Thinking and Academic Achievement among Secondary School Students, Hail University, Egypt.
4. Al-Harahsheh, Wissam Omar (2016): The effect of using interactive teaching strategy in the achievement of tenth grade students in engineering and in developing their engineering thinking skills, Al-Bayt University, Jordan.
5. Khalaf Allah, Marwa Mohamed (2013): Effectiveness of employing mathematics lab in developing engineering thinking and achievement skills among seventh grade students in Rafah governorate, Master Thesis, Islamic University, Faculty of Education, Gaza.
6. Al-Khumasiya, Abdullah Musa Mohammed (2014): The Effect of Using Frank Lester Model in Solving the Engineering Problem of Ninth Grade Students and Their Beliefs, University of Jordan, Jordan.
7. Al-Samarrai, Faeq Fadhil (1999): The use of typical Van Hul and prob-

lem solving in the teaching of stereoscopic engineering among sixth grade students, Ph.D. thesis, unpublished, University of Baghdad, College of Education / Ibn al-Haytham, Baghdad.
8. Samarrai, Faek Fadel and Mahmoud Shafik Hamid (2002): Levels of thinking in engineering among sixth grade students, Journal of the opening, No. (13), University of Diyala, Teachers College.
9. Salama, Hassan Ali (1995): Methods of Teaching Mathematics between Theory and Practice, 1st Floor, Dar El Fagr, Cairo.
10. Al-Sankari, Bader Mohammad Bader (2003): The Effect of Van Heil Model on Developing and Retaining Engineering Thinking Skills in the Ninth Grade Students in Gaza, Master Thesis (Unpublished), Islamic University, Faculty of Education, Gaza.
11. Shehata, Hassan and El-Naggar, Zeinab (2003): Dictionary of Educational and Psychological Terminology, 1st Floor, Egyptian Lebanese House, Cairo.
12. Saleh, Ahmed Zaki (1972): Educational Psychology, 2nd Floor, Egyptian Renaissance Library, Cairo.
13. Ammar, Mohamed Khalaf Ahmed (2004): The Effectiveness of the Leicester Model for Problem Solving in the Performance of First Secondary Students to Solve Verbal Engineering Exercises and their Engineering Thinking, Minia University, Egypt.
14. Al-Kubaisi, Abdul Wahid Hameed and Tahrir Mahdi Awwad (2011): Teaching Mathematics Modern Visions, 1st Floor, Arab Society Library, Amman.
15. Muhayyat, Mahmoud Hafez Abu Omira (1987): A Proposed Program in Problem Solving for the Pupils of the Second Cycle of Basic Education in the Light of Mathematical Thinking Paths, PhD Thesis (Unpublished), Ain Shams University, Egypt.
16. Mohammed, H (2007): Teaching and learning mathematics in non-traditional methods, i 2, Al-Rashed Library, Riyadh.
17. Al-Mughira, Abdullah (1989): Methods of Teaching Mathematics, Deanship of Library Affairs, King Saud University, Riyadh.
18. Al-Nabhan, Musa (2004): Fundamentals of Measurement and Evaluation in Behavioral Sciences, 1st Floor, Dar Al-Shorouk for Publishing and Distribution, Jordan.
19. Nabhan, Musa (2004): Inferential Statistics and its Applications in Computer Using Statistical Packages, 1st Floor, Wael Publishing House, Jordan.
20. Nabila, Zaki Ibrahim and others (1993): Mathematics Education,

Center of the Language of the Age, Egypt.
21. C. Dennis Carroll (1977): The Relative Effectiveness of the three Geometric proof construction strategies, JRME.
22. Frank Lester (1980): Selected Issues in Mathematics Education.
23. Ghukwa Joseph (1987): a study of Heuristic strategtes and Their Use in soling Mathematical problems, D.A.I.
24. Jeanne Marie Vissa (1985): Inductive Pattern Search problem for Seventh and Eighth Grade: A study of Skills and Processes, D.A.I.
25. Kil, S. Lee (1982): Fourth Grade's Heuristics problem solving Behaviors, JRME.
26. Lind a Ann, Proudfit (1981): The Examination of problem solving processes by Fifth Grade Children and Effect on
27. Mc Carthy Yvelyne, Yves Germain (1987): The Analysis And Instruction of the Heuristic: Think of Simpler problem, D.A.I.
28. Hoffer, Alan (1981): Geometry is more than proof, Mathematics Teacher.
29. Thomas R. Post and Michaell. Brennan (1976): An Experlmental study of the Effectivenss of a Formal Versus an Informal presentation of General Heuristic process on problem solving Tenth Grade Geometry, JRME.

UNIVERSIDAD
DEL ZULIA

opción
Revista de Ciencias Humanas y Sociales

Año 35, N° 20, (2019)

Esta revista fue editada en formato digital por el personal de la Oficina de Publicaciones Científicas de la Facultad Experimental de Ciencias, Universidad del Zulia.
Maracaibo - Venezuela

www.luz.edu.ve

www.serbi.luz.edu.ve

produccioncientifica.luz.edu.ve