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**THE EFFECTIVENESS OF A PROGRAM BASED ON THE THEORY OF TRIZ IN  
THE SUBJECT OF PHYSICS TO DEVELOP THE SKILLS OF CREATIVE THINKING  
AND CRITICAL THINKING AMONG THE SECONDARY SCHOOL STUDENTS OF  
THE SOUTHERN AL-MAZAR**

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**Abstract**

**Purpose:** The study aimed to learn about the effectiveness of a program based on the Theory of TRIZ in the subject of physics to develop the skills of creative thinking and critical thinking among the high school students of the Southern al-Mazar Brigade, the study used the design like experimental, and was represented the tools of study in the Torrance test for creative thinking and the test of California for critical thinking, as a training program was built based on the theory of creative solution to problems.

**Methodology:** The sample of the study consisted of ( 81) students of the first high school scientific which was chosen in the method of intent and the students are distributed on two randomly assigned school divisions as exacts and pilots, one (40) students and the exact group, and the other (41) students represented the experimental group.

**Findings:** The results of the study showed that there are statistically significant differences in favor of the experimental group that indicates the effectiveness of the program in developing the skills of creative thinking and Critical thinking among the students.

**Keywords:** *Theory of TRIZ, creative thinking , critical thinking.*

**INTRODUCTION**

What distinguishes the present era is the search for a special methodology for the development of problem solving in a way that contributes to the design of creative plans and the adoption of extraordinary solutions in solving the problems facing individuals, and the importance of creativity in various areas of life is the main lever in the advancement of human thought and the development of individual performance. The civilization and progress of nations are measured by the number of creators. Thinking education is one of the important areas in the formation of the student's personality, as the ultimate goal of education is to prepare the citizen to become more effective in his society and more able to meet the requirements of different stages of life, so when he trains the student to manage the wheel of his mind and increase the speed of this wheel in order to be able to keep up Cognitive and technological development, we contribute to the formation of a character adapted together that feels confident (Qatami, 2003).

**Creative solution to problems:**

The traditional view of creativity was that it is inspired and inspired and that whoever possesses this inspiration is a creative person and, on this basis, many believe that creativity is an unconscious act that emanates from the subconscious or after the stage of fermentation of the idea. (Zoukan Obeidat & Sohaila Abu Al-Seemed, 2007).

Torrance points out that creativity is a force that helps students to dwell on fluency, originality and flexibility in the face of open-ended problems. (Whitelaw, 2007: 8) . Erdoğan points out that creativity is the ability of the individual to excel with fluency, originality and flexibility when producing new solutions to problems. (Erdogan et. All, i.e. ,2009 : 3) .

Cropley believes that creativity is the ability to achieve more ideas, especially those of originality and novelty (Sternberg, 2005:754). Creativity is a multidimensional human behavior that results in unique, novelty, original or non-common ideas, actions or products. (Ayman Amer, 2003: 337).

It is the generation of a unique and new product by transforming the existing product, and this product must be unique to the creator, as it must achieve the value, interest and goal set by the creator (Safaa al-Asher, 2000:20) which is to work and produce without an example of any previous innovation and originality in the ideas of the individual (Faraj Abdelkader, 2009: 21).

A theory emerged in the Soviet Union known as Creative Problem Solving, the initials representing the name known as TRIZ, and corresponded to it in English (Teoria, Resheniqy Izobreatatelskikh, Zadatch Theory of Inventive Problem) Solving, a modern theoretic, although its roots date back to the 1940s, and the original research into this theory was conducted by Henry Altshulle, to whom this theory is attributed (Loebmann, 2002).

The theory was defined by BERTOLUCI,2001 as a set of principles, questions, techniques, and tools, which help the individual solve the problem. Apart from this recognition, remember (2006GORIA), this is a theory organized methodology consisting of a set of principles, methods or methods and tools that help enable the individual to access creative solutions to problems. Savransky( 2000:40) sees it as a systematic, human-oriented methodology based on a knowledge base that aims to solve problems in a creative way.

Groan (2002) states that the creative solution to problems is a complex process that involves the use of both critical thinking skills and creative thinking, where it requires the capabilities of convergence thinking and the capabilities of divergence thinking together in specific logical steps in order to reach a decision of the best solutions to a problem.

Jarwan (2002) states that the creative solution to problems is a complex process that includes the use of both critical thinking skills and creative thinking, where it requires the capabilities of convergence thinking and the capabilities of divergence thinking together according to specific logical steps in order to reach a decision of the best solutions to a problem. While Amer, (2003) emphasizes the final product, he states that the creative solution to problems is the process of thinking creatively while searching for new and problem-appropriate solutions.

**There are three sources of Therese's theory: (2007):**

- 1- Patents and technical information are among the most important sources in Therese's theory, and researchers at Therese have analyzed more than 2 million patents to develop the theory.
- 2- Analysis of the problem-solving process itself, to show the area where psychological barriers occur in problem solving.
- 3- Accumulated human knowledge about nature and various scientific fields such as physics, chemistry, biology, etc.

Therese's theory is based on several key assumptions, including: (Abu Jado, p. 23, 2003)

1. The ideal design is the desired end result.
- 2- Technical and physical contradictions play a key role in solving problems in a creative way
- 3- Creativity is a systematic process that proceeds in regular steps and not in a random manner.
4. Most technical systems evolve according to predetermined models
5. Evolution models can be detected and used to accelerate the development of these systems.
6. The stages of the development of systems can be determined and the associated stereotypes can be predicted.

Therese's theory concepts are used by inventors and specialized engineers, taught in colleges and universities, and the principles of Therese's theory have been successfully taught and applied to primary school students. Secondary is a technical-based Therese theory (Cal & Victoria, 2006).

Therese's theory enables the individual to focus his attention on finding real and non-false potential solutions, compared to searching for ideas that might work by accident, it is a distinctive methodology that helps reduce the time used to solve the problem, encourages creativity, discovery and innovation, and leads the individual to The right direction of the solution more quickly, appropriately and effectively (Scott & Victor, 2007).

The process of creative lycée of problems under Therese's theory goes through the following key stages:

- 1- The stage of identifying the problem, by eliminating contradictions, improving partially useful functions or those that are totally unhelpful.
- 2- The selection phase of several corresponding problems solved in a creative way, and identifying the appropriate theoretical tools to solve the current problem.
- 3- The stage of using the corresponding solutions to solve the problems in which the current problem has been placed, and to allocate the appropriate solution to them using the appropriate creative principles.
- 4- Calendar phase to make sure that the problem has been resolved without new problems Mann, ( Apte, 2001)

### **Strategies:**

The research carried out by Schiller revealed 40 creative strategies as mentioned (Al Amer, 2009) preferred some researchers (MONTMAIN & MICHEL,2003:96) and (Abu Jado, 2005) called them creative principles and names in the eyes of the two researchers' favors because they can be used in the development of ability It should be noted that these 40 principles are reached by the Schler.

The principle of division/fragmentation, the principle of separation, the principle of spatial quality, asymmetry, the principle of linkage, the principle of inclusiveness, the principle of containment and overlap, the principle of balancing power, the principle of counter-preliminary procedures, the principle of tribal preliminary procedures, the principle of pre-confrontation of imbalances, the principle of equality in Voltage, the principle of the heart or vice versa, the principle of bending, the principle of dynamic (flexibility), the principle of partial or exaggerated work, the principle of the other dimension, the principle of vibration, the principle of the work of the useful work, the principle of the continuation of useful work, the principle of rapid impulse, the principle of turning the harmful into a beneficial, the principle of feedback, the principle of the Yit, principle of self-service, the principle of copying, the principle of the use of cheap alternatives, the principle of replacing mechanical systems, the principle of the use of air construction, the principle of permeable materials, the principle of color change, the principle of homogeneity, the principle of rejection and renewal of life, the principle of change, the principle of flexible membranes characteristics, the principle of selectivity From one stage to another, the principle of thermal expansion, the principle of strong oxidants, the principle of inactive atmosphere, the principle of composite materials.

### **Critical thinking:**

The development of general thinking skills and critical thinking skills are particularly one of the general objectives that science teaching seeks to achieve, where scientific educators emphasize that one of the objectives of teaching science is to teach students how to think, not how to memorize courses and curricula by heart without understanding and understanding them and Employed in life (Zaytoun, 2004).

He knows it (Qatami, 2007) as a mental process in which the learner develops through the interaction processes in which he engages with materials, experiences, attitudes, environmental events, and reaching conclusions, assumptions, new Gloss and expectations.

He also defines him (Ghanem, 2004) as a set of skills that can be learned, trained and mastered, namely the ability to evaluate information, and to examine opinions taking into account different perspectives on the subject in question.

And Affana and Obaid, (55:2003) Ali launched Altefkir al-Mabi.

1. The skill of predicting assumptions hypotheses prediction skill: a capability related to the examination of incidents or facts that are available and judged in the light of data or evidence.
2. Expository skill: the ability to draw a certain conclusion from proposed facts with a reasonable degree of certainty.
3. The skill of evaluating discussions: the ability of the learner to distinguish between strengths and weaknesses in judging a case.
4. Inference skill: the ability of the individual to draw conclusions about the relationships between the facts given to him so that he or she is judged on the extent to which the result of what is derived from those institutions is genuinely linked or not, regardless of the validity of the facts given or the position of the individual at the end.

5. The skill of deductive skill is the ability of the individual to distinguish between the degrees of probability of health or error as a result depending on the degree of association with certain given facts.

McKeller Maclure (2002) points out that critical thinking is like a process of breathing individually, because the individual needs to breathe to live, he also needs to think, because thinking is like a natural activity that cannot be dispensed with in his daily life, so the individual needs to learn the skills of thinking. As a result of the scientific, technological and cognitive development witnessed and witnessed by the world, and the resulting challenges, it must depend on the amount of knowledge as much as it depends on how knowledge is used and applied, especially what the individual learns in school and university is not enough for a bright future.

Brookfield (2005) identified a set of key characteristics of critical thinking:

- Positive activity that increases the value and self-confidence of the individual.
- Simultaneous process and product, reflecting the mental process based on understanding, inference, outcome and decision-making
- Implicit internal behavior that is difficult to distinguish unless it is in the form of results, consisting of words, pros, deeds, or in the form of immediate decisions or a quick resolution.
- Provoked by positive or negative attitudes, the different attitudes to which individuals are exposed, whether positive or negative, prompt them to reconsider, evaluate and take appropriate measures to help them adapt to them.
- Tends to emotional aspects, when an individual is exposed to a situation, it requires him to reassess some of the specific aspects associated with his or her ideas, beliefs and lifestyles.

### **Creative thinking:**

Creative thinking is the highest level of thinking, including the ability of the individual to remember, understand, apply, analyze, install, evaluate and create a new material that was previously unknown (Al-Muhaysin, 2001). Judge (2010) states that creative thinking is a complex and multi-step process in which many factors overlap, influence and influence it. This has led to a multiplicity of definitions, as al-Ghanim (2004) defines it as a multifaceted mental activity, involving a new and original production of value.

Bernardo and Zhang, 2002, mention a group that advocates for creativity, namely the rapid change that societies are experienced in all areas, which requires the exploitation of human creativity to solve problems and face them properly. The interest in creativity also comes to meet an important need among creative individuals, such as the tendency to independence, reconnaissance, curiosity, discovery, anonymous access and experimentation, as well as provide students with an internal motivation that exceeds in its quality and external effectiveness all motives, besides that interest in creativity, development. The creativity of students contributes to improving their mental health because the practice of creative activity contributes to meeting some of their needs, and satisfying the tendencies associated with them.

### **Creative Thinking Skills Are the Following:**

1. Fluency means the skill to generate a large number of alternatives, synonyms, ideas, problems or uses, when responding to a particular trigger, namely, speed and ease in generating alternatives, synonyms, ideas, problems or uses, which are essentially a process of recall and recall. Optional information, experiences or concepts already learned, (Groan, 2008).
2. Flexibility: Is the skill to think in different and unusual ways, and to look at the problem in different dimensions, which is the degree of ease with which a person expresses a certain position or point of view, and not intolerance of an idea in itself, and flexibility differs from fluency that the main test of the skill of fluency is the amount of ideas Or the correlations that an individual is able to generate, while the key test of flexibility is the diversity and divergence of these ideas, i.e. The characteristics of how ideas are based on diversity (Pleasure, 2000).
3. Originality is the ability to come up with new, rare, useful ideas that are not associated with the repetition of previous ideas. It is an unusual and far-reaching production (Pleasure, 2000). From repeating his perceptions or ideas personally as in flexibility, it suggests moving away from what others do. This sets it apart from the flexibility factor, (Qatami, 2001).
4. Elaboration is the ability to add new and varied details of an idea or solution to a problem that will help develop, enrich and implement the idea, (Groan, 2008).
5. Sensitivity to The problems awareness of the existence of problems, needs or elements of weakness in the environment or situation, which are the first elements of solving the problem, clearly identify the problem, develop hypotheses or preliminary solutions to the problem, experience these solutions, and begin implementing the solution, (Baham, 2007).

### **PREVIOUS STUDIES**

Khamis (2010) conducted a study entitled "The effectiveness of a proposed program in the light of The Theory" "To develop thinking for creativity and academic achievement in the course of the subject of revival for the first grade students of high school and the aim of the study to measure the effectiveness of a proposed program based on the theory of Therese (TRIZ) on the development of thinking and achievement Creative in the first grade students secondary in the material revival, the student applied to the eye consisting of (58) students of the first grade secondary in Jeddah city, and the results of the study showed that the proposed academic program was active in the development of first year high school students in creative thinking and creative achievement, and that There are statistically significant differences between the control group and the experimental group, in the tribal test in creative academic achievement and creative thinking.

In Sabri's study (2011) the study aimed to use a new strategy of teaching strategies, which is the strategy of fragmentation according to the study (TRIZ) in the field of physics, in order to facilitate students' understanding of the physical concepts that they suffer from, which is the problem of research. Zero, which says there are no statistically significant differences between the average score of the group studied according to the retail strategy and the average score of the control

group that is studied according to the usual method at the level of significance ( $\alpha = 0.05$ ). The research community is made up of middle schools and the middle section of secondary schools in the Directorate General of Education in Erbil. The research sample consisted of (64) by (32) students for each of the experimental and control groups and using the independent test (test- t) samples showed statistically significant differences between the averages of creative thinking and its dimensions and in favor of the experimental group.

Ibrahim's study (2013) revealed the effectiveness of a proposed program to teach science in the light of Therese's theory for first-graders in the development of conceptual assimilation and creative thinking skills, and to achieve that the researcher used the experimental method, where the researcher applied the study to a sample Made up of (31) first-grade students, the study's tools were to test conceptual assimilation and test creative thinking skills, and the data was processed using the (t) test for independent groups, and one of the most important results of the study was the effectiveness of the program in the development of Conceptual assimilation and creative thinking skills in the sample of the study.

In the study (Zaidi,2014) which revealed the effectiveness of teaching theory (TRIZ) in the achievement of middle second graders in physics and their decision-making ability. The study sample consisted of 53 female students divided into two groups: the pilot group of 29. And the exact group of (24) students and the study tools were in the achievement test and decision-making test, and one of the most important results of the study was the superiority of the students in the experimental group who studied according to the theory of TRIZ on the students of the control group in the tests of achievement and take Decision, and that teaching with TRIZ theory (effective in both achievement and decision-making ability.

In the Study of Eagles and Slim (2018), this study aimed to demonstrate the effectiveness of the computerized TRIZ program in the development of creative problem-solving skills among students in the ninth grade of jubilee school, and the sample of the study consisted of (84) students divided into two groups, a group of exacts consisted of (41) students A student and an experimental group consisted of (43) students and used the study semi-experimental curriculum, and the test of creative problem solving was used to measure the performance dimension as a tool for study, and the study found the following differences statistically significant for the performance of the study sample on the test of solving creative problems As a whole, the group's variable is attributed to the experimental group, and there are no statistically significant differences in the performance of the study sample on the creative problem solving test as a whole due to the sex variable, this study recommended the development of computerized training programs based on the Theory of TRIZ to solve problems and expand the solution Problems in creative ways.

### **The study problem and its questions**

Through the researcher's work in the educational field, I have noticed that there is a problem in absorbing the subject matter of physics, low achievement and creative and critical thinking among students, and that there are negative trends about students' understanding of the nature, concept, and goals of physics, especially since some students resort to preserving theories and not caring about skills The basic, and the absence of the ability to demonstrate theories, and neglect some of the issues and exercises that help to develop creative and critical thinking. Other science branch



tests. Therefore, it was necessary to carry out the current study to know the effectiveness of the TRIZ program in the subject of physics on creative and critical thinking among high school students of the Southern Mazar Brigade.

### **Study questions:**

**The first question:** Are there statistically significant differences between the control group and the experimental group on the creative thinking test due to the effectiveness of the program?

**The second question:** Are there statistically significant differences between the control group and the experimental group on the critical thinking test due to the effectiveness of the program?

### **Study personnel**

The sample of the study, which is its society, consisted of (81) female students from the first scientific secondary school students, who were chosen in the intentional manner in which the researcher works, and the female students are divided into two study divisions that were randomly assigned as a control and experimental one of them (40) female students and the control group, and the other (41) female students represented Experimental group.

### **Study tools**

To collect data, the following tools were used:

First, the Torrance oral image test (a) was used in this study and consists of six sub-tests that measure the following skills:

-Fluency: The number of possible answers to the situation is in a fixed time unit.

-Flexibility: The variety of categories of possible answers to the situation are in a fixed time unit.

-Originality: The number of new and unique answers is represented in a fixed time unit.

### **Virtual Honesty:**

The clarity of the paragraphs and their suitability to the Jordanian environment have been verified, five faculty arbitrators at the Faculty of Education at Jordanian universities have been tested, and in the light of the results of the arbitration, the initial image of the subject metric, and some modifications have been made to some of the Paragraphs, and some adjustments have been made to the language of some of the paragraphs that are ambiguous. Thus, the test preserved the number of its paragraphs, which consisted of a paragraph divided into the three dimensions of creative thinking.

### **Stability:**

The stability of the creative thinking test was verified using the Kronbach Alpha equation of internal consistency and Table 2 showing this:

(1)

Dimension	Stability
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Fluency	0.85
Flexibility	0.83
Originality	0.80
Total	0.90

It is noted from Table 1 that stability coefficients ranged from (0.80-0.85) to the three dimensions, and for the whole the stability coefficient (0.90). How to correct the Torrance test for creative thinking

The method of correcting the Torrance test for creative thinking went as follows:

1. Develop response correction models and dump models to monitor grades.
2. The examination is obtained from the total score of the Torrance verbal image test in terms of the total score it receives in dimensions: fluency, flexibility, and originality.
3. The examination receives degrees of fluency, flexibility and originality on the verbal image (a) of the sum of the sub-degrees of fluency, flexibility and originality obtained in each of the six tests of the verbal image "A".
- 4- The tester is given the degree of fluency, according to the number of ideas on each test and the number of tests, and for the degree of flexibility given to the tester based on the number of response categories to which the tester responded in each test and the number of three categories, and the sub-degree of authenticity is calculated from the total score of authenticity obtained Examined on each response, where a score of authenticity is given ranging from zero to three degrees as follows: (zero: if there are no definitive answers, or if the answers are meaningless. To be included in the answers of most students).

Second: California's Measure of Critical Thinking

### **Virtual Honesty:**

To verify the clarity of the paragraphs and their suitability to the Jordanian environment, five faculty members of the Faculty of Education at Jordanian universities were presented with a test of the results of the arbitration, and in the light of the results of the arbitration, the initial image of the subject scale was reviewed, and some modifications were made to some Paragraphs, and some adjustments have been made to the language of some of the paragraphs that are ambiguous. Thus, the test preserved the number of its 34 paragraphs divided into the five skills of critical thinking.

### **Stability:**

The stability of the critical thinking test was verified using the Kronbach Alpha equation of internal consistency and table2 shows this:

(2)

Stability	Number of points	Skill
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Analysis Skill	6	0.83
Induction skill	6	0.80
Skill Inference	4	0.77
Inference skill	12	0.84
Rating skill	6	0.81
Total	34	0.88

It is noted from table 2 that stability coefficients ranged from (0.77-0.84) to the five skills, and for the whole the stability factor (0.88).

**Correct the critical thinking test:**

The California test consists of (34) multiple-choice paragraphs, each paragraph has four alternatives, and some paragraphs have five alternatives, one score per correct answer, and a score of zero for the wrong answer, so the total test score ranged from (0-34) degrees,

The level of the two groups was confirmed by the use of a (t) test for independent samples of the study sample members of the control and experimental groups in tribal measurement and table3 showing this:

(3)

Dimension	Group	Degree Of Freedom	Computational Circles	Standard Deviations	(T) value	Number	Value Indication Level
Flexibility	exact	79	4.67	1.74	-.021	40	.984
			4.68	1.69	-.312	41	
Fluency	Experimental		2.95	.93	-.573	40	756.
			3.02	1.19	-.271	41	
Original	exact		.12	.33		40	568.
			.17	.38		41	
Total	Experimental		7.75	2.06		40	787.
			7.88	2.18		41	

The results in table 3 show that there are no statistically significant differences at the level of significance ( $\leq \alpha 0.05$ ) between the averages of the grades of the experimental and control groups

in tribal measurement, where the values of (T) calculated on the total creative thinking test =(-271) and their level of significance were equal (0.787) For the three dimensions (fluency, flexibility, originality) the calculated (t) values =(-0.021, -0.312, -0.573) respectively, indicating an equivalence between the control and experimental groups on the creative thinking test. (4)

(T) Value	Indication Level	Degree Of Freedom	Standard Deviations	Computational Circles	Number	Group	Dimension
454.	651.	79	.80	2.15	40	exact	Analysis Skill
			.72	2.07	41	Experimental	
354.	724.		.67	2.05	40	exact	Extrapolation Skill
			.59	2.00	41	Experimental	
089.	930.		.49	1.40	40	exact	The skill of the conclusion
			.49	1.39	41	Experimental	
381.	704.		.87	3.05	40	exact	Inference skill
			.88	2.97	41	Experimental	
.354	.724		.67	2.05	40	exact	The rating skill
			.59	2.00	41	Experimental	
.525	.601		2.32	10.70	40	exact	Total
			2.14	10.44	41	Experimental	

The results in table 4 show that there are no statistically significant differences at the level of significance ( $\leq \alpha 0.05$ ) between the averages of the grades of the experimental and tribal measurement groups, where the (t) values calculated on the total critical thinking test =(.525) and their level equal to (0.601), For the five dimensions (analysis, extrapolation, inference, inference,

assessment) the calculated (t) values =(0.454, 0.354, 0.089, 0.381, 0.354) respectively, indicating an equivalence between the control and experimental groups on the critical thinking test.

### Response rate

Response	Frequency	Percent
Returned	174	77.3%
Unreturned	51	22.7%
<b>Total</b>	<b>225</b>	<b>100%</b>

### RESULTS:

Are there statistically significant differences between the control group and the experimental group on the creative thinking test due to the effectiveness of the program?

To answer the question, a (T) test was used for two independent samples as in table5:

The results in table 5 show statistically significant differences at the level of significance ( $\alpha \leq 0.05$ ) between the averages of the grades of members of the experimental and control groups in the dimensional measurement. where the values of (T) calculated on the total creative thinking test =(-14.032) and their level of significance equal to (0.787), For the benefit of the students of the experimental group, and for the three dimensions (fluency, flexibility, originality) were the calculated. (t) values = (-11.359, -6.614, -4.248) respectively, indicating the effectiveness of the program in the development of creative thinking among female students.

(5)

Value Indication Level	(T) value	Degree Of Freedom	Standard Deviations	Computational Circles	Number	Group	Dimension
.000	-11.359	79	1.79	5.77	40	exact	Flexibility
			3.06	12.12	41	Experimental	
.000	-6.614		1.22	3.45	40	exact	Fluency
			1.41	5.39	41	Experimental	
.000	-4.248		.74	.60	40	exact	Original
			.92	1.39	41	Experimental	

.000	- 14.03 2		2.24	9.82	40	exact	Total
			3.44	18.90	41	Experimental	

Question 2: Are there statistically significant differences between the control group and the experimental group on the critical thinking test due to the effectiveness of the program?

To answer the question, a (T) test was used for two independent samples as in table 6:

(6)

Value Indication Level	(T) value	Degree Of Freedom	Standard Deviations	Computational Circles	Number	Group	Skill
.000	- 10.54 8	79	.71	2.17	40	exact	Analysis Skill
			.91	4.22	41	Experimental	
.000	- 11.25 3		.50	1.45	40	exact	Extrapolation Skill
			.89	1.83	41	Experimental	
.021	- 2.349		1.01	3.30	40	exact	Conclusion Skill
			2.07	6.54	41	Experimental	
.000	- 8.878		.67	2.10	40	exact	Inference Skill
			.86	4.17	41	Experimental	
.000	- 12.02 8		2.40	11.25	40	exact	Rating Skill
			3.38	21.05	41	Experimental	
.000			2.32	10.70	40	exact	Total

	- 14.99 1		2.14	10.44	41	Experiment al	
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The results in table 6 show statistically significant differences at the level of significance ( $\alpha \leq 0.05$ ) between the averages of the grades of members of the experimental and control groups in the dimensional measurement, where the values of (T) calculated on the total critical thinking test =(-14.991) and their level of significance equal to (0.000), For the benefit of the students of the experimental group.

## **DISCUSSION OF RESULTS**

Analysis of the results of the first question shows that there is a positive effect of the program prepared according to Therese's theory in the development of creative thinking among female students in physics, as the average calculation of female students indicates this and the values of "T" confirmed that the differences are statistically functioning in the answers of the students and in favor of the dimensional test, This is confirmed by previous studies and can justify the improvement in creative thinking and its three skills (fluency, flexibility, and authenticity) to the nature of the program and its various and enjoyable training activities, where the environment is equipped with the necessary tools to training activities and what enriches them, and also due to that The researcher's use of open questions that provoke the ability to solve problems in a scientific way and with new and non-routine types of thinking where the program helps to increase the abilities and mental processes by going through the stages prepared for the program, as the application of the theory of Therese led to the push of students towards research The survey contributed to the increased motivation of female students towards raising issues and employing information, which played a positive role in the development of creative thinking. In addition to providing a psychological environment characterized by spontaneity, self-confidence, automaticity, lack of complexity and rigidity of positions, the results of this study are consistent with the study of Thursday (2011) and Ibrahim (2013) and this enhances the effectiveness of the existing program. On The Theory of TRIZ in physics and its positive impact on the development of creative thinking skills.

Analysis of the results of the second question shows that there is a positive effect of the program prepared according to The Theory of Therese in the development of critical thinking among female students in physics, as the average calculation of female students indicates this and the values of "T" confirmed that the differences are statistically functioning in the answers of the students and in favor of the dimensional test, This is confirmed by previous studies and this result can be explained by the nature of the training program based on the theory of creative solution to problems, where the student is expected to employ a variety of types of thinking to solve the problem facing him, as well as require dialogue and discussion, evaluation of arguments and interpretation of ideas Others are thinking about the solution, which implies employing higher thinking skills, such as analysis, extrapolation, inference, inference and evaluation skills, and these competencies can greatly help develop critical thinking among students.

Directly, but employ dialogue, discussion and debates Among students and ask a series of interrelated questions and view educational films and videos related to and see the websites identified by the researcher so that the students reach new information and ideas in their minds and minds.

And This situation requires the use of thinking skills at different levels. The presentation of illustrations and images related to each concept or problem lead to a greater clarification of problems and a critical view of them. The results of this study are consistent with the Hegers study (2015) and the study of Abu Jado, Asha and Absi (2012), which enhances the effectiveness of the Program based on the Theory of TRIZ in the subject of physics and its positive impact on the development of critical thinking.

### **RECOMMENDATIONS**

- 1- Holding training courses and workshops for physics teachers and other science disciplines and clarifying the mechanisms of teaching theory (TRIZ) in physics and other branches of science.
- 2- Providing secondary school students with the appropriate and functional basic principles of The TRIZ theory with the aim of increasing cognitive achievement, creative thinking and critical thinking.
- 3- Conduct a study to identify the trends of teachers about the application of the training program based on the theory of TRIZ and other thinking programs, and conduct other studies on this program.
- 4- Experimenting with the principles of Therese's theory in teaching physics and science to students of other stages
- 5- Conducting studies to compare teaching based on Therese's theory and other modern teaching methods in the development of learners' skills

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