

Effectiveness of the triangle of listening strategy in the creative thinking of chemistry for fifth graders (bio)

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Abstract

The current research is aiming at identifying the effectiveness of teaching via (listening triangle strategy)in the creative thinking of chemistry for students in the fifth grade of science (biology), by verifying the following hypothesis:

There is no statistically significant difference at the level of 0.05 between the average scores of the students of the experimental group that studied withthe listening triangle strategy and the average scores of the control group students that were taught with the traditionalmethodin creative thinking of chemistry.

The targeted sample consisted of 75 students of the fifth scientific grade, as they were distributed into two groups, the control group, and the experimental group. The two groups were equivalent in the following variables:

(Age in months, previous information in chemistry, previous achievement in chemistry, and the scale of creative thinking). The researcher prepared the teaching plans in accordance with this strategy, besides, the researcher adopted the creative thinking scale, the Torrance Test for the Iraqi environment by (Khairallah, 1975).

The study indicated that there is a statistically significant difference for the group that studies according to the listening triangle strategy in the creative thinking of the fifth-grade scientific (biological) students of chemistry in relation to the control group.

Therefore, The researcher recommended the use of the (listening triangle) strategy in teaching chemistry and suggested conducting other studies for other stages as well as different study materials to identify the effectiveness of the (listening triangle) with other dependent variables such as (problem-solving, scientific reconnaissance, motivation, and scientific enlightenment).

Keywords: Triangle listening strategy - creative thinking

Chapter One: Introduction

First: the research problem

Teaching chemistry is characterized by rigidity because teachers follow the traditional methods of teaching. This, in turn, negatively impacted the creative thinking of students and resulted in their distance from following methods that help students obtain cognitive information and organize it in a way that they can benefit from at the right time, and the student's dependence on the teacher in the lesson without sharing with his colleagues in clarifying the lesson to increase their self-confidence and makes the relationship between them stronger and more social.

The stereotyping of the traditional teaching process has resulted in a clear shortcoming in the students' understanding of the scientific content that achieves the purpose of knowledge and thus limits students' ability, thus, students memorize without applying that knowledge in daily life, and this was confirmed by a study (Al-Tamimi, 2016).

It has therefore become necessary to use new methods to strengthen relations between students on the one hand and help their creative thinking to grow and develop, and this is provided in the listening triangle strategy.

From the above, the problem of research can be determined by the following question:

What's the effectiveness of the Listening Triangle in the creative thinking of chemistry for fifth-grade biologists?

Second: the research importance

The importance of the research can be summarized in the following:

1. The research shows the importance of paying attention to students' personalities, improving chemistry teaching methods, and creating the appropriate circumstance for using such (strategy).
2. The current research is concerned with studying middle school, which is one of the important academic stages because this stage prepares students for the university stage.
3. The current research spots light on the importance of using interactive strategies with the students themselves, and their ability to communicate verbally and intellectually and raise the level of thinking in problems that obstacle the educational process.

Third: the research objective

The objective of the current research is to identify the effectiveness of the (listening triangle) strategy in the creative thinking of chemistry for fifth-grade science students (bio).

Fourth: Research hypothesis:

To achieve the objective of the research, the following null hypothesis has been formulated:

There is no statistically significant difference at the level (0.05) between the average scores of the experimental group students who were taught according to (the listening triangle strategy) and the average scores of the control group students who studied classically in the creative thinking test for the fifth-grade scientific (biological) students in chemistry.

Fifth: the research limits

The current research is limited to students of government morning schools of the General Directorate of Education in Baghdad / Al-Karkh/3:

1. Fifth-grade scientific students in high school and morning government preparatory schools of the Directorate.
2. The first and second semesters of the academic year (2019-2020).
3. All chapters of the chemistry book for the fifth grade of science approved for teaching by the Iraqi Ministry of Education - the Republic of Iraq, 7th edition, 1439 AH - 2018 AD for the academic year (2019-2020).

Sixth: terminology identification

Effectiveness identified by:

1. (Zaytoun, 2003) as: “the ability to achieve goals and inputs to

achieve the desired results, and reach them to the maximum extent possible.” (Zaytoun, 2003: 55)

2. Shehata and al-Najjar (2003): “The extent to which a factor or some independent factors influence a factor or some dependent factors” (Shehata and al-Najjar, 2003: 76).

Theoretical definition: The researcher adopts a definition (Zeitoun, 2003)

Operational definition: (The positive achievement achieved by (the listening triangle strategy) in the creative thinking of the fifth-grade scientific students of chemistry)

The listening triangle strategy was defined by:

1. (Al-Nashef, 2001), “The approach, the plan, the procedures, the maneuvers, and the methods that the teacher uses to reach specific learning outcomes including mental, cognitive, performance, or psychomotor.(Al-Nashef, 2001: 110).
2. (Al-Shammari, 2011) as: "A strategy that encourages speaking and listening skills and is done through three groups" (Al-Shammari, 50:2011).

Theoretical definition: The researcher adopts a definition (Al-Shammari, 2011)

Operational definition: It's a combination of the successive processes that the teacher conducts by dividing the students into three groups and giving each student a specific role, the first delivering the listening text, the second asking questions that increase the clarity of the information, and the third providing feedback.

Creative thinking is defined by:

1. (Jarwan, 2009) "A complex and purposeful mental activity directed by a strong desire to search for solutions, or to reach original results that were not known" (Jarwan, 2009: 255).
2. (Abu Allam, 2010) "Thinking that is used to produce the new valuable thing and includes inventing something new in various fields, discovering new relationships, or reaching a solution to problems.(Abu Allam, 223: 2010)

Theoretical definition: The researcher adopts (Jarwan, 2009) definition

Operational definition: "The ability of fifth-grade students, the research sample, to understand and produce ideas, as measured by the total score they obtain on the creative thinking scale adopted in this research, by collecting degrees of fluency, flexibility, and originality."

Theoretical framework

Active learning:

Active learning depends on the student's positive philosophy of the educational

situation, and this philosophy depends on all the processes and activities that the student adopts to reach his goal and form values and trends, as he does not depend on memorization or the classic method of teaching, rather on developing his thinking, solving problems and modern cooperative teaching methods (Ali, 2011:234).

Active learning modifies the teaching method from "what you as a teacher should teach or communicate to students" to "what students want to be able to do through the curriculum" (Badawi, 2010: 332).

1. Listening Triangle Strategy

Constructive learning strategies are based on how the student is placed with real problems, not illusory or hypothetical, as the student tries to search for the solution through experiment, discussion, and exploration. The introduction of the constructivist theory into the classroom is a recent scientific development in this field.

Besides, the constructivist theory indicates that students can build their knowledge by using new experiences that lead to building their knowledge, concepts, and meanings. Contemporary educational trends emphasized the need for active learning based on activity, which depends on the ability of students to learn by themselves by providing an environment rich in experiences that increase students' opportunities for learning and understanding, as they are interactive and active, and one of the

learning theories that achieve this is the constructivist theory (Haidar, 2016: 112).

What is the listening triangle strategy?

It is one of the most important active learning strategies that use reading, writing, speaking, listening, thinking, and reflecting, which are strategies that encourage speaking and listening skills, and it is done through cooperative tripartite gatherings (Al-Kaabi, 2016).

This strategy relies on the interaction between students through active talk and discussion, exploring solutions, and linking their answers to what they learn in their practical lives. Thus, it facilitates their understanding of the topics and removes the difficulty of understanding that they had previously formed (Haidar: 125, 2016).

Listening triangle strategy characteristics:

The (listening triangle) strategy has the following characteristics:

1. It provides an opportunity for students to be active and allows everyone to participate in forming positive attitudes towards the curriculum and supports some productive habits of mind such as: listening with understanding, impulse control, collaborative thinking, and helping students to build their knowledge through their group discussions and have positive and

effective results through the integration of students with superior levels of achievement with low and medium levels, which motivates them to learn and enjoy the same importance and status, and have a major role in the development of social and educational aspects (Qarni: 235, 2013).

Steps of the listening triangle strategy:

1. The teacher divides the students in the class into three cooperative groups, each group includes three students.
2. Each of the three group students has a specific role in this strategy as follows:
 - a. The first student in the group of three: a speaker, explaining the lesson, idea, concept, or topic to be learned.
 - b. The second student: a good listener, and asks questions to the first student to get more details about the topic, and to clarify the idea, or the concept being presented.
 - c. The third student: who is the observer of the group, and he follows the conversation that takes place between his two colleagues (the first and the second), and provides them with feedback, as he records the discussion that takes place between the two students (the first and the second), by diagnosing the questions that are

raised from the (second) request, and the clarification provided by the student (the first) about the subject, idea, concept, or topic to be learned, and it is similar to the basis within the triple group work when his turn comes, he reads his blog of points, and references about what his colleagues mentioned, so he says the student Ahmed said such-and-such, and the student Muhammad mentioned such-and-such.

3. Take turns: the teacher switches roles among the students in each group, in new educational situations when dealing with new topics, ideas, and concepts.(Al-Shammari, 2011).

The educational foundations on which the listening triangle strategy is based:

Attia (2008) believes that there are some foundations on which the listening triangle strategy depends, which are:

1. Develop social values through mutual interest among students.
2. Encouraging students to learn increases their self-confidence.
3. Increasing enthusiasm and interaction among students by exchanging information related to the study subject.
4. Students test their ideas and compare those ideas with the ideas of other students.

Creative thinking:

Turner (1994) defined it as an attempt to search for unfamiliar ways to solve a new or old problem, and this requires

fluency, flexibility, originality of thought, and the ability to develop, detail, or expand solutions to problems.

Hoying (2001) defined it as divergent thinking that includes previous ideas and makes connections that break down and divide previous ideas, make new connections, expand the boundaries of knowledge, introduce amazing and wondrous ideas, and generate new ideas (Al-Atom, 224: 2004).

The researcher believes that the student needs to reformulate the answers to arrange his thoughts and get feedback in more creative, understanding, and comprehensive terms.

Creative thinking skills:

The educational literature has agreed on the following skills: (fluency, flexibility, originality, sensitivity to problems and details) in more than one source, and accordingly, they will be described as skills for creative thinking in the current research:

1. Fluency

It means the ability to produce several ideas in response to an open-ended problem or dilemma, and ideas may be verbal or non-verbal. (Davis & Rimm, 2004: 210).

Whereas (Nofal and Muhammad, 2011) viewed it as “the ability to produce the largest amount of creative ideas.”The ability to produce the largest amount of creative ideas.” The student's outperformance depends on the size of the vision that he presents in a specific number and time in relation to other

students. A person who gives ten ideas in one minute is considered more fluent than a person who gives seven ideas in one minute because he possesses a high degree of ideas that are easy to generate (Nawfal and Muhammad, 2011: 95).

Guilford's research summary indicates that there are four components or factors for fluency:

- Fluency in words

It means the speed of the individual in giving words and generating them in a good format, and this fluency as (Therson) calls it fluent words. This fluency is limited to generating several words in which the individual relies on his knowledge stock in memory to achieve simple demands. It is defined as the speed of generating sentences or words with specific features and within a specific template and includes fluency in words and fluency in numbers (Abu Jadu and Muhammad, 2010: 159)

- Fluency in ideas and meanings

It is the speed of formulating correct ideas or issuing a large number of ideas in an educational situation, provided that these ideas are rich, diversified, overwhelming, and manageable. This type of fluency can be developed by asking specific questions that are consistent with the level of cognitive development of the individual (Hassan, 2014: 71).

- fluency of association

It is the ability to produce new ideas in a situation that requires the least ability to control, these ideas and responses do not

have to be useful, and perhaps a few of them are suitable, but the important thing is that the examinee does not dismiss new ideas, criticize it or find it difficult to accept, but rather he should collect as many ideas as possible. Then he compares them, differentiates between them, and tests their benefits (Zaytoun, 1987: 22).

- Fluency in shapes

Putting additions to complete the specific shapes to create real drawings (Al-Titi, 2004: 53). In the current research, fluency means the student's ability to present and generate a stream of creative ideas in a specified period of time.

2. Flexibility

It is the ability to change the thinking that distinguishes creative people from ordinary people whose thinking freezes in a certain direction (Guilford, 1959:471).

Torrance (1971) defines it as: "The ability to think in several directions that include different categories of responses, provided that its production includes multiple types of ideas, as well as the possibility of transferring the learner's thinking from one entry to another" (Torrance, 1971: 57).

(Davis & Rimm, 2004) he defined it as: "the ability to deal with the problem in more than one way or think of ideas that have several characteristics, or see the situation from several sides." (Davis & Rimm, 2004: 210)

Flexibility is divided according to Guildford's direction into two parts:

- Automatic Flexibility

It includes in its meaning the issuance of the largest possible number of ideas related to situations or influences. The creative student is the one who issues new ideas with diversity in all fields and directions (Al-Afwan and Muntaha, 2012:131)

- Adaptive flexibility

Solving a problem or facing any situation, in light of the feedback that comes from that situation. Therefore, flexibility is dependent on the answers in a qualitative way and is measured by the diversity of these responses. (Al-Titi, 2007: 53).

In the current research, flexibility means: the student can develop his state of mind according to the situation and find other ways at a specific time.

3. Originality

It means novelty and uniqueness, and it is more related to creative thinking, and the common factor among most definitions that are based on creative outcomes as a criterion for judging the level of creativity. It should be noted that the human and environmental trends adopt the view that "Reliance on the individual's previous personal experience as a basis for judging the quality of his outputs," meaning that originality is not an absolute quality, but rather it is specified within the framework of the subjective experience of the individual (Jarwan, 2013: 79).

(Al-Omariya, 2008) emphasized that the original thinker is: "The person who is averse to repetition and traditional solutions to problems." If we look at originality in the factors of fluency and flexibility, we find that it differs from them in the following:

- The value and quality of those ideas that the student generates, not their quantity.
- It does not contain conditions related to the environment at the same time, it does not need many conditions for self-criticism so that the creative thinker can do his work in the best way.
- It refers to aversion due to what is repeated by others by comparison to the aversion of the same person from repeating his perceptions.
- Finally, originality can be defined as: "The birth of rare and new ideas, which transcend the boundaries of the usual ideas" (Al-Omariya, 2008: 14) (Abu Jadu and Muhammad, 2010: 164).

Thus, originality means renewal and singling out ideas, i.e., that the student's ideas are renewable in relation to the ideas of his colleague, and the less the idea spreads the more original it is.

Previous studies:

Studies related to the listening triangle strategy

- a. Haider's study in Iraq.
- b. Al-Kaabistudy 2016 Iraq.

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Research name Year Country	Study Title	Study objective	Research community	Statistical means	Study tools	Results
Haider Iraq 2016	The impact of using the listening triangle on the achievement of middle school students in the subject of history	Recognition of the impact of the use of the listening triangle on the achievement of second graders in history	67 female students of the second grade of middle school	t-test of two samples, Spearman's correlation coefficient, and analysis of variance	achievement test	The experimental group that was taught using the listening triangle outperformed the control group
Al-Kaabi 2016, Iraq	The impact of the use of the listening triangle on the achievement of geography subjects and the development of thinking skills among first-grade medium	Recognition of the impact of the use of the listening triangle on the achievement of geography and the development of the thinking skills of first-grade medium students	75 female students in the first year in middle school.	t-test of two samples, Spearman's correlation coefficient, analysis of variance, and Keuder-Richard's equation	Achievement test and scientific thinking skills test.	The experimental group who were taught using the listening triangle method outperformed the control group.

	students.					
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Studies related to creative thinking: 1. Study of Abu Galala (2003) 2. Al-Mamouri study (2004)

Research name Year Country	Study Title	Study objective	Research community	Statistical means	Study tools	Results
Abu Jalala in the United Arab Emirates 2003	The impact of academic achievement on the creative abilities of middle school students in the United Arab Emirates.	Identifying the impact of educational achievement on the creative abilities of preparatory students in the United Arab Emirates.	94 middle school students.	t-test of two samples, Spearman's correlation coefficient, and analysis of variance	creative thinking test	There is a positive impact of educational achievement in science on creative thinking abilities, and there are statistical differences between male and female students in creative thinking abilities in favor of girls.
Al-Mamouri 2004, Iraq.	Providing an educational program based on the relationship between science and technology	Identifying the impact of the proposed program on developing creative work capabilities and its	23 male and female students of the third grade – electronic.	T-test of two samples, Spearman's correlation coefficient, analysis of variance,	Scientific thinking skills test	There are statistically significant differences at the level (0.05) between the students' scores in the pre-and

	in physics.	outcomes for students of the Vocational Training Center for Electrical and Electronic Industries.		and Keuder-Richard's equation.		post-test in favor of the post-test, in each of the sense of problems, the ability to reorganize, fluency, the total sum of creative work abilities.
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Advantages of previous studies:

1. Use of terminology for theoretical framework on study variables before starting research work.
2. Take advantage of building research tools.
3. Use appropriate statistical methods.
4. Review the results and recommendations of previous studies.

Accordingly, the previous studies played an important role in enhancing the current research and distinguishing it from it in employing the (listening triangle) strategy in the creative thinking of fifth-grade scientific (biological) students in chemistry.

Research Methodology and Procedures:

Experimental design: The researcher adopted the experimental method with partial uncontrolled, with a post-test for two equal and not equal groups, as in Scheme No. (1).

Chart (1)

(Experimental design of the two research groups)

Group	Equivalences	Independent variable	dependent variable
Experimental	1. Age in months. 2. Previous information in chemistry.	listening triangle strategy	Creative thinking.
Control		Traditional method	

	3. Previous achievement in chemistry.		
	4. Creative thinking.		

Second: the research community

The research community included all students of the fifth scientific (biological) for all government morning secondary schools in the Directorate of Education Baghdad Al-Karkh/3, for the academic year, (2019 - 2020 AD), specifically Al-Noor Preparatory for Boys for the following reasons:

There are five classes for the fifth scientific stage (the biological branch), which prepares the researcher to choose two classes, the third is experimental and the fourth is control.

The research sample:

The researcher chose the experimental and control groups randomly, thus, class (D) is the control group, and class (c) is the experimental group. The researcher performed statistical work on the number of students of the two classes (C and D), and the number of students for the two groups was (75), (38) students for (c) class for the experimental group, and (37) students for (d) class for the control group, see table (1).

Table (1)

Distribution of the students in the two research groups

Group	Class	Student number
Experimental	C	38
Control	D	37
Total		75

Group equivalence procedures:

Age of students in months:

The researcher calculated the students' age in months after obtaining the students' birth date from the official school cards, and it was calculated from the date of birth to Tuesday 1/10/2019, which is the date of the start of the experiment. To verify the age equivalence in the experimental and control groups, the t-test was used for two independent samples. The t-test reached (0.940), which is less than the tabular value which is (2), at a degree of freedom (73), and significance (0.05), and therefore there are no statistically significant differences between the average ages in months for the two

groups. The two groups are considered equivalent in the age variable, as shown in Table (2):

Table (2)

Arithmetic means and standard deviations of the experimental and control groups in the age variable calculated in months

Group	Student number	Arithmetic means	standard deviations	Variance	degree of freedom	T-value		Significance (at the 0.05 level)
Experimental	38	157.9222	12.505	152.388	73	Calculated	Tabular	Not significant
Control	37	160.6033	13.010	165.233		0.940	2	

Previous achievement in Chemistry:

The equivalence of the two groups in the chemistry scores was adopted in the final test for the previous stage of the academic year (2018-2019), which was obtained from the school records using the T-test of two independent, unequal samples to indicate the differences between the scores of the students of the two research groups in the final test of the previous year. It was found that the calculated t-value is (0.180), which is less than the tabular value (2) at the degree of freedom (73) and the level of significance (0.05). Accordingly, there are no statistically significant differences between the averages of the previous achievement of chemistry for the two groups, and thus the two groups are considered equivalent in the variable, as in Table (3).

Table (3)

Arithmetic mean and standard deviation of the experimental and control groups in the previous achievement of chemistry

Group	Student number	Arithmetic means	standard deviations	Variance	degree of freedom	T value		Significance (at the 0.05 level)
Experimental	38	67.366	13.991	177.920	73	Calculated	Tabular	Not significant
Control	37	67.422	14.899	190.031		0.180	2	

Previous information test

To achieve equivalence in this variable, a four-choice objective test in chemistry was adopted, consisting of (30) test items covering the information that had previously been studied for students for the previous academic years related to the subject of the experiment. The test was submitted to a group of specialized arbitrators to verify the integrity of the test, where the percentage of agreement (80%) or more was relied upon from their opinions, after taking notes and making the appropriate modification.

The test was conducted on Wednesday 2/10/2019 on the same day on both research groups. The answers were corrected using the standard answer key, giving a score for each correct answer and zero for the wrong or left out the answer, or in which more than one option was chosen. Then, all the scores obtained by the students were arranged in descending order, and the T-test was adopted for two independent samples. It appeared that there were no statistically significant differences, as the t-value calculated for two unequal independent samples was (0.66), which is less than the tabular value (2) at a degree of freedom (73) and a level of significance (0.05). Accordingly, there is no statistically significant difference between the averages of the previous information test for the two groups, and thus the two groups are considered equivalent in this variable, as in Table (4).

Table (4)

The arithmetic mean and standard deviation of the experimental and control groups in the previous information test

Group	Student number	Arithmetic means	standard deviations	Variance	degree of freedom	T value		Significance (at the 0.05 level)
Experimental	38	13.044	3.570	12.688	73	Calculated	Tabular	Not significant
Control	37	13.051	3.699	13.599		0.77	2	

Creative thinking test:

The test was conducted on the research sample before the actual teaching began on October 3, 2019, the Torrance Test of Creative Thinking in its formal form. The students' answers were corrected and the arithmetic mean was calculated. The results showed that the calculated T-value (0.144) is less than the tabular value (2) at the significance level (0.05) and the degree of freedom (73), which indicates that there is no statistically significant difference in the creative thinking variable as indicated in Table (5).

Table (5)**Arithmetic mean and standard deviation of the experimental and control groups in the creative thinking test**

Group	Student number	Arithmetic means	standard deviations	Variance	degree of freedom	T value		Significance (at the 0.05 level)
Experimental	38	14.6656	4.5541	21.233	73	Calculated	Tabular	Not significant
Control	37	14.3254	4.7495	22.145		0.144	2	

Procedures for adjusting some extraneous (non-experimental) variables:

The researcher carried out several procedures to control the extraneous (non-experimental) variables that could affect the results of the study:

Experiment application time

Represents the time required by the researcher to conduct the study. The duration of time for both groups was the same, extending from Tuesday, corresponding to October 1, 2019, to Wednesday, corresponding to October 20, 2020.

Experimental extinction:

No loss occurred among the sample students during the application period of the experiment.

Subject teacher:

The researcher taught the two groups (experimental and control) himself to avoid the difference resulting from his teaching to students by more than one teacher.

Physical conditions

The physical conditions of the two groups were identical, as the teaching process was in the same laboratory, and thus the characteristics of the classroom for both groups were similar.

Research tool:

The researcher applied the creative thinking test to the two groups at the same place and time.

Scientific subject:

The two groups studied the same subject in the Chemistry Book for the Fifth Grade Scientific (Biology), 7th Edition, 2018, Republic of Iraq / Ministry of Education, to ensure equal information for students.

Daily schedule:

The researcher taught the two groups according to the schedule of daily lessons prepared by the school administration in agreement with the researcher. The number of classes was (8) classes, (4) classes for each class per week, to ensure equal class times for the two groups, as shown in the following table (6):

Table (6)

Daily lesson schedule for the experimental and control groups

	Sun.	Mon.	Tus.	Thur.
Fourth class	C	D	C	D
Fifth class	D	C	D	C

Study requirements:

Determine the scientific subject:

The scientific subject that he taught during the probation period was specified in all the chapters of Chemistry for the fifth scientific grade, 7th edition, 2018, for the academic year 2019-2020.

Preparing teaching plans:

Based on the chemistry curriculum for the fifth scientific grade, the researcher presented (48) a teaching plan for the experimental group according to the (listening triangle) strategy, and (48) a teaching plan for the control group according to the usual method. A model of both plans was presented to a group of experts and arbitrators to show the validity of the teaching plans. The researcher took their opinions, directions, and modifications.

Research tool

The researcher adopted the Creative Thinking Scale of (Torrance), which was modified by Khairallah (1975), and was characterized by objectivity, honesty, and consistency. It was applied to the students of the two research groups simultaneously.

Test validity

Studies indicate that the test has high validity coefficients, as in the study (Mayouf, 2009) and the study (Al-Zubaidi, 2012). To ensure the validity of the test, the researcher submitted it to a group of arbitrators and experts who supported the validity of its use in measuring the creative thinking of the students of the research sample.

The first exploratory application of the test:

To verify the clarity of its instructions, paragraphs, and method of answering, the test was applied to a random, exploratory sample of (36) students from Al-Noor Preparatory students from the classes who did not participate in the experiment on 10/1/2019, and it was found that its instructions, paragraphs, and method of answering were clear and understandable.

The second exploratory application of the test:

The test was applied to a second exploratory sample, other than the research sample, consisting of (150) students from the New Iraq High School on 10/2/2019, to calculate:

Test stability:

Cronbach's alpha equation was used for the reliability of the test, and it reached (0.822), and it is considered good stability and an acceptable indicator of the reliability of the test. (Ali, 2011) stated that stability of (0.50-0.60) is satisfactory and sufficient (Ali, 2011: 91).

Correction stability:

The stability of the correction was demonstrated by the method of re-marking the test with itself and with a teacher. Ten papers were chosen randomly from the answer sheets and were corrected and then re-corrected with a time difference of (15) days. The same papers (after withholding the degree of correction) were presented to the teacher to re-correct them, using Pearson's equation. The stability value between the researcher and the corrected was 0.94, and the researcher with herself overtime was 0.97, which is high stability.

Correction of the test: Correct the test based on its components, which are:

1. Fluency degree: It is calculated by the number of appropriate answers for the student, as one point is given for each answer.
2. Degree of flexibility: it depends on the quality of the answers, the more varied the answers, the higher the score.
3. Originality: It depends on the student to mention unspoken answers and the novelty of the proposed idea (Al-Zayyat, 2009: 216).

Experiment application:

The experiment was implemented on Tuesday, October 1, 2019, and ended on Wednesday, May 20, 2020. The procedures for implementing the experiment included several stages according to the purpose of each stage.

Statistical means:

Several appropriate statistical methods were used, including (the Alpha-Cronbach equation, Kewder-Richardson-20 equation, and T-test).

Results interpretation

Validation of the null hypothesis:

The creative thinking post-test was applied to both groups, and the students' scores were statistically analyzed to extract the arithmetic mean of the two groups. By adopting the t-test for two independent, unequal samples, it was found that the calculated t-value is (3.033) which is the largest value of the tabular value (2) at the degree of freedom (73) and the level of significance (0.05). Accordingly, there is a statistically significant difference between the averages of the creative thinking test for the two groups in favor of the experimental group, as shown in Table (7):

Table (7)

Arithmetic means, standard deviations, and T-value of the two groups in the creative thinking test

Group	Student number	Arithmetic means	standard deviations	Variance	degree of freedom	T value		Significance (at the 0.05 level)
Experimental	38	22.4842	2.6314	7.8574	73	Calculated	Tabular	significant
Control	37	18.9545	3.7108	14.8240		3.033	2	

Results

The results showed that the students of the experimental group who studied using the listening triangle strategy outperformed the students of the control group who studied according to the usual method in the creative thinking test. This outperformance may be due to:

The listening triangle strategy has a great role as a strategy of expression with understanding, as it represents a self-

activity that is refined through mental processes to confront or solve a problem facing the individual for adaptation, balance, and continuity in the environment because it is a strategy concerned with meaning, understanding, and clarification.

This strategy has affected the creative thinking of students and finds multiple appropriate solutions to reveal appropriate trends to choose the most

appropriate solutions to a single problem.

Conclusions:

This strategy positively affected the creative thinking of fifth-grade science students through the clear statistical difference that emerged from the statistical analysis of the results.

Recommendations

In light of the results, the following recommendations were made:

1. Encouraging and urging male and female teachers of chemistry at all academic levels to use the (listening triangle) strategy.
2. Conducting training courses for male and female chemistry teachers during the job service on the application of the listening triangle strategy and how to employ it in teaching chemistry.
3. The need to include in the curriculum of the Faculty of Education's chemistry training program modern teaching strategies as the listening triangle strategy due to its positive impact on the development of creative thinking among students.

Suggestions:

1. Conducting a similar study on other study subjects (such as physics and mathematics) at different academic levels.

2. Conducting a study of this strategy on other variables such as: (scientific sense, types of thinking (divergent and systemic)...etc).
3. Comparing the listening triangle strategy with other models and strategies to find out the extent of its impact on the creative thinking of secondary school students

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