

The Effect of the Tarsia - Mental Triangles and the Sand Clock Scheme Strategies in the Achievement of Chemistry and Cognitive Failure for Female Students of the Fourth Scientific Preparatory Stage

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The aim of the research is to examine the impact of the two strategies of the mental triangles and the hourglass chart in the academic achievement of chemistry and cognitive failure among students of fourth grade science. The research was applied to a sample of 180 female students of junior high school students for girls within the second Karkh Education Directorate for the morning study. To achieve the aims of the research, the three-group experimental approach was used, where the research sample was divided into three groups (a control group studied according to the usual method, a first experimental group studied according to the strategy of Tarsia, and a second experimental group studied according to the Hourglass chart strategy); in order to apply the research, the researcher developed the research tools represented in the achievement test in the chemistry course, the Arabisation and codification of the cognitive failure scale of Broadbent and his colleagues in 1982. The tools were applied to the experimental groups and the control group, then the grades of the students were analysed on the test and scale. For the appropriate statistical means to reach the differences of statistical significance, the research reached a number of results, the most important of which are: the positive impact of the two strategies of the mental triangles and the hourglass chart in improving and raising academic achievement in chemistry and in reducing cognitive failure of the fourth grade students.

Key words: *Strategies, Achievement of Chemistry, Female Students*

Introduction

The chemistry subject is one of the subjects about which there is a lot of controversy among students with each other and between the teachers themselves, due to the difficulty of that subject due to its laws, concepts, equations, symbols, terms, etc.; the researcher sensed this through her experience in teaching the subject, and she confirmed several studies on the low level of students in the achievement of chemistry, including those studies (Al-Zahawi, 2005), (Al-Fadhli, 2010) (Al-Musawi, 2012) (Noman, 2014). Some studies also indicated that chemistry teachers in Iraq follow the usual teaching methods and that it is the main reason for the low achievement of students in Alma. This includes the studies of Razuki, (2012) and Al-Masari, (2014); accordingly the current research problem lies in its application of recent strategies in teaching chemistry that were not applied within the scope of Arab studies. There was a desire to raise achievement in chemistry and eliminate cognitive failure, through the investigation of the impact of these strategies on academic achievement and cognitive failure among fourth-grade students. Therefore, the research seeks to answer the following question:

- What is the effect of the Tarsia and the hourglass strategies on the achievement of chemistry and cognitive failure among fourth-grade students?

Research Importance

First: Theoretical Importance of the Research

- 1- The research is a good contribution to the Arab and Iraqi educational literature.
- 2- The research presents profiles of two completely new strategies within active learning strategies that were not previously covered by any Arabic research before this research (according to the researcher's knowledge)
- 3- The research reveals the effect of these strategies on raising achievement and eliminating cognitive failure in a subject known to be difficult for students.

Second: The Applied Importance of Research

- 1- Its application of two modern strategies in teaching chemistry, and then examining their impact on two dependent variables: academic achievement and cognitive failure.
- 2- The research contributes to preparing application tools (academic achievement test in chemistry - Arabisation of the scale of cognitive failure of Broadbent, Cooper, FitzGerlad & Parkes 1982) for application in other future studies.
- 3- The research draws the attention of faculty members, curriculum developers, and others in the need for chemistry teachers and their decisions to stay away from the indoctrination methods and the need to follow active and cooperative learning methods.



4- The approved teaching plans within the research according to the two proposed strategies, are considered as a reference for the chemistry teachers later.

Research Aims

The current research aims to:

- Learn about the effect of the two strategies of mental triangles (Tarsia) and the hourglass chart on the chemistry achievement test for fourth-grade students.
- Knowing the effect of the two strategies of the mental triangles (Tarsia) and the hourglass chart in a (questionnaire) measure of cognitive failure among fourth-grade students.

Research Assumes

The First Hypothesis: There is no statistically significant difference at the level of significance (0.05) between the mean scores of the first experimental group that was studied according to the strategy of Tarsia and the control group that was studied according to the usual method in the academic achievement test.

The Second Hypothesis: There is no statistically significant difference at the level of significance (0.05) between the mean scores of the first experimental group that was studied according to the strategy of mental triangles Tarsia and the control group that was studied according to the usual method in the questionnaire (scale) of cognitive failure.

The Third Hypothesis: There is no statistically significant difference at the level of significance (0.05) between the mean scores of the second experimental group that was studied according to the hourglass chart strategy and the control group that was studied according to the usual method in the academic achievement test.

The Fourth Hypothesis: There is no statistically significant difference at the significance level (0.05) between the mean scores of the second experimental group that was studied according to the hourglass chart strategy and the control group that was studied according to the usual method in the cognitive failure questionnaire.

The Fifth Hypothesis: There is no statistically significant difference at the significance level (0.05) between the mean scores of the first experimental group that was studied according to the strategy of mental triangles Tarsia and the second experimental group that was studied according to the hourglass chart strategy in the academic achievement test.

Sixth Hypothesis: There is no statistically significant difference at the significance level (0.05) between the mean scores of the first experimental group that was studied according to the strategy of mental triangles Tarsia and the second experimental group that was studied according to the hourglass chart strategy in the cognitive failure questionnaire (scale).

Search limits :

Spatial Limits: The research was conducted in the second Al-Karkh educational district of the General Directorate of Education in Baghdad / Morning Study.

Human Boundaries: The limits of research are determined in the fourth-grade students in the prep for girls.

Thematic Limits: The boundaries of the objective research are united in its discussion of the

Variables: The strategies of the Tarsia and the hourglass chart (two independent variables), academic achievement and cognitive failure (two dependent variables)

Time Limits: The academic year 2017-2018 (first semester).

Research terms and concepts

Strategy: is a series of well-planned actions to achieve a goal (Longman, 2001, p).

These are all the teaching procedures that the teacher plans in advance to help him implement the teaching in light of the available capabilities to achieve the teaching goals, including various dimensions of goals, teaching methods, and information. They include the objectives and classroom organisation of the lesson class, the stimuli used, and student responses resulting from those stimuli that he organises. The Teacher and Planned (Attia, 2006, 57) It is procedurally defined in the current research as a set of steps or stages used to teach female students and a desire to increase their educational attainment and eliminate their cognitive failure.

Tarsia Brain Triangle Strategy

A strategy based on learning through Tarsia's puzzles, which are the puzzles of cropped images made up of triangular pieces, part or all of which are a specific puzzle, and students collect images together to reach a correct solution, and for the student to complete the puzzle, he must match each correct answer on the question to reconfigure the basic shape (solution) (Twinkle, 2018).

It is known procedurally in the current research as "an active cooperative learning strategy based on the use of mental triangles called Tarsia in order to facilitate the learning of chemistry among fourth-graders".

Hourglass chart strategy: Hour-Glass graphic

Both (Ambo Saeedi and Hoda, 2016) defined it as "one of the active learning strategies whose idea is based on linking between what-if-questions based on previous knowledge of a specific topic or idea, and it aims to provide students with the skills of formulating hypothesis questions N, scientific hypotheses and scientific principles" (Ambo Saeedi and Hoda, 298,2016)

It is procedurally defined in the current research as "one of the active learning strategies that follow steps that take the form of an hourglass chart linking previous knowledge and new topics among students."

Academic Achievement

Al-Fakhiri defines this as the outcome of the knowledge, information, and experience that a student acquires from the educational process, and as a result of his effort during school learning or study at home (Al-Fakhiri, 2005, 164)

Academic achievement refers to the indicator or set of indicators that indicate the achievement of the educational goals or outcomes expected to be achieved, and thus represents the student's ability to absorb the study materials through the application of knowledge, skills and attitudes she has acquired, which can be measured with different evaluation tools (Al-Ghawi, 2011, 26)

It is defined procedurally in the current research as: the amount of correct information and knowledge that the student acquires during her study of a subject by following my strategic steps (Tarsia and hourglass chart) and is measured by the degree she gets in the achievement test prepared for this purpose.

Cognitive Failure

This is the individual's failure to deal with the information he deals with, whether it is a failure to perceive it, or remember the experiences and associated experience, or the process of using it to finish a task (Wright & Osborne, 2005, p103).

Martin also defined it in 1983 as an error that occurs to the average person while performing a task, and this cognitive error includes slips in perception, recall (i.e. information retrieval) and in motor functions (performance) (Marten, 1983,97)

It is procedurally defined as "the student's failure to acquire new information as a result of her failure to pay attention and have awareness of that information or remembering previous information or her failure to apply that information and is measured to the degree that the student gets in the questionnaire (scale) approved for this purpose"

Theoretical Framework

Active Learning and Strategies

Active learning based on activities and sharing among students has become one of the modern global trends adopted by most countries of the world now, and active learning is known as "the effective participation of learners in the educational process through their practice of some activities that encourage them to think, and interact with what they learn, in order to Reaching the desired goal under the supervision and guidance of the teacher "(Al-Qanu ', 13, 2017)

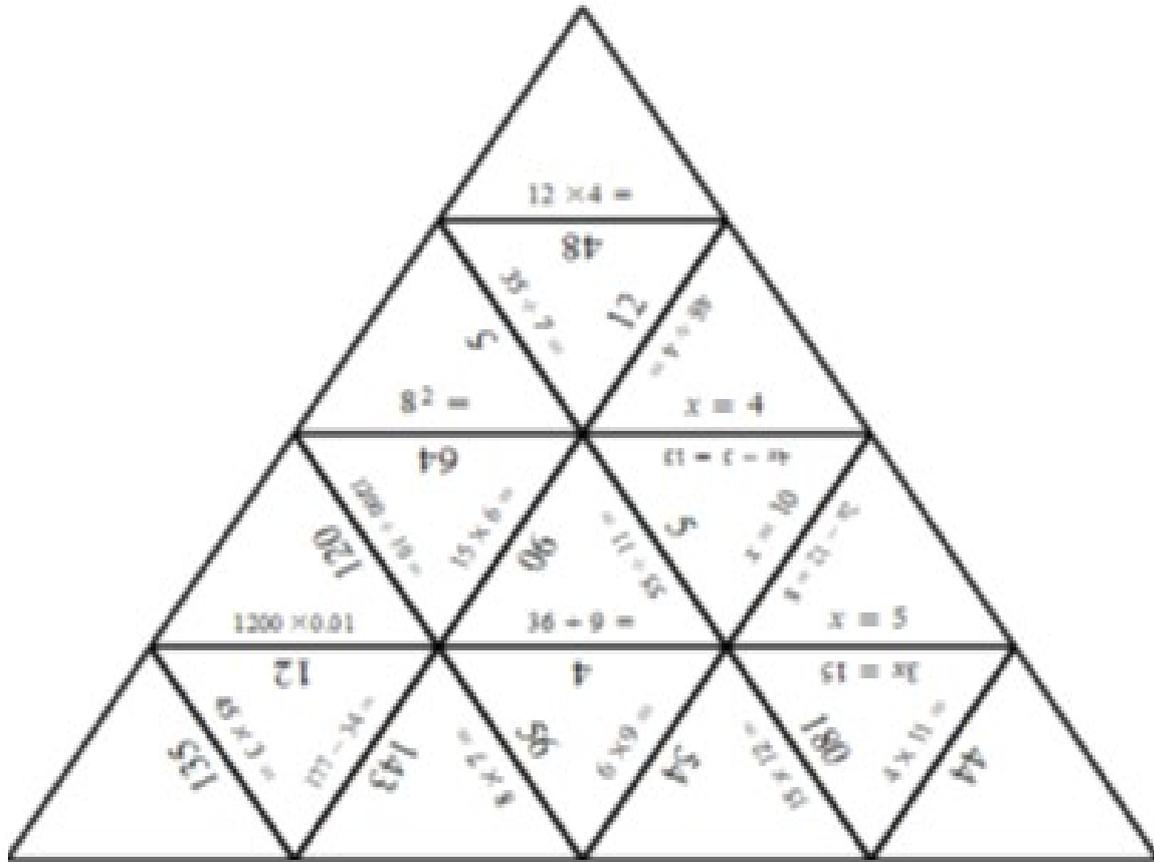
Given the importance of the principles of active learning and their close relationship to learning materials that need experiments and practices such as chemistry, the research adopted two new strategies of active learning:

Tarsia Brain Triangle Strategy

This is an active cooperative learning strategy, based on cooperation between only three students. The term Tarsia is due to one of the free computer programs available on computers in schools, which is an open program that can be downloaded, which is also easy to use, and provides a pattern of clipped images in less than 10 minutes. After entering the information to the computer, the program creates a puzzle automatically Then these puzzles can be printed for students to solve, and students must match the sides of the triangles to complete the shape or reshape the images, and binary groups usually work on them for 25 minutes to solve the puzzle; students can also participate in the teacher cutting the triangles, which is an important strategy to evaluate Druk students' key concepts or their application of the concept of what is usually applied in the secondary grades of the second fifth (Grifth & Burns, 2012, p187).

The cropped triangles collectively represent a large triangle and each small triangle holds a specific puzzle solution (question); the following figure represents one of Tarsia's triangles.

Figure 1. One of Tarsia's triangles

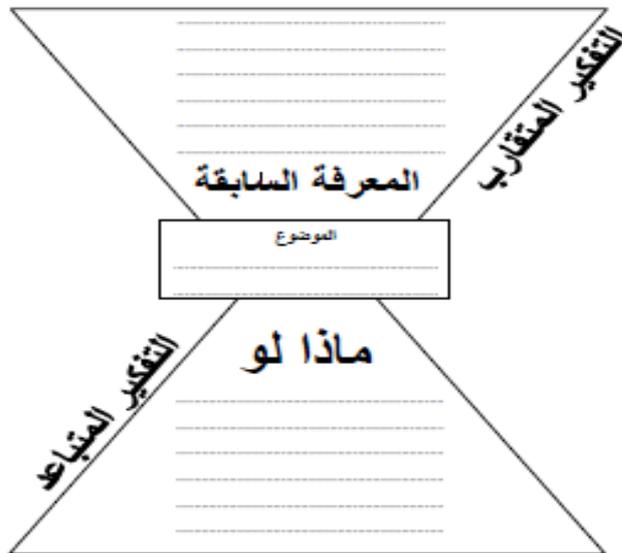


The strategy of mental triangles (Tarsia) is of importance in teaching scientific concepts as it:

- 1- is used to facilitate students' understanding of the content of a particular topic, and its steps are a reflection of Culp's model.

The following figure shows this diagram:

Figure 2. Hourglass chart



Academic Achievement

The academic achievement is one of the most important indicators of the occurrence of learning and the acquisition of information, so we find the interest of educators all the time in preparing achievement tests in various subjects and conducting them in a desire to know the levels of understanding and learning among their students; academic achievement means reaching a certain level of information gathering and performing the required tasks. Mastering the necessary skills is measured by standardised tests or teacher reports (Ahmed, 2010, 29).

Previous Studies

Due to the lack of Arab studies related to the hourglass chart strategy or the Tarsia mental triangle strategy, some international studies and experiences will be presented as follows:

First Studies Dealt with Tarsia Mental Triangles

A study was made to facilitate learning of organic chemistry, especially polymers, where each puzzle in the Tarsia represents a name for monopolymers and their collection leads to reach the larger polymer compounds; students have been evaluated structurally through the peer using Tarsia scraps, which require students to work together to match monolymers with its number of polymers; each side of the triangle represents a correct solution. Students



worked in small groups of three students. The strategy has proven successful in facilitating learning of the polymer lesson and raising students' achievement of the lesson.

Hamid Study 2013-2018

This is a study program proposed by Dr. Yusuf Hameed throughout India as it has been applied in a number of Indian states in solidarity with the Royal Organisation of Chemistry RSC) in the United Kingdom.

The initiative mainly promotes cooperative learning through activities. 8,000 teachers have been trained in the use of collaborative learning strategies including Tarsia, and over the five years of the educational initiative or project, Tarsia has proven successful in applying collaborative learning in chemistry and its apparent impact on student achievement for the article.

This study aimed to know the extent of students' involvement in cooperative learning when using the Tarsia mental triangle strategy for eighth grade students and in mathematics. The study was applied to 26 students and three types of Tarsia were used; data was collected from direct observation. It was an open questionnaire and conversations were held with some students. The study showed that students' involvement in Tarsia-based activities was good and that conversations between students about the answers, were to ensure the correct answer and the places of the triangles were fruitful. The study confirmed that this strategy activates the student's previous knowledge and encourages her to higher thinking skills.

The Study of Chemistry Teachers in India (2018), where the organisation approved the holding of workshops and conferences on cooperative learning with the involvement of students under the supervision of Cambridge University; there was a need to use strategies to activate cooperation between students and peer learning, including Tarsia's strategy because that strategy has an effective impact on learning and teaching chemistry.

Second: Studies on the Hourglass Chart Strategy

Hu 2010 study:

The study aimed to use the hourglass scheme in teaching foreign languages, especially poems in universities, where the hourglass scheme was applied to teach English to Chinese students in universities, where the plan included two receptive and productive parts; the model has proven its effectiveness in transferring learning from learning directed by the teacher to self-directed learning (self-learning).

Mind Champs 2019 study:

This is an educational institute in Singapore that employs a group of educational experts from several international countries such as America, Britain and Australia, and the institute has applied the hourglass scheme to a group of students in light of an educational program initiative entitled Model M "hourglass plans for learning", where knowledge was developed. Previous to students at the top of the chart - while the lower part of the diagram included higher-order skills and enabled students to create and process information. The results of this study have proven that the hourly chart strategy has helped students to balance between controlling and acquiring information and solving problems and innovation and that it has become a preferred method for students to deal with information.

Three Studies Dealing with Cognitive Failure

- Study (Al-Saadi, 2017)

The study aimed at: measuring the level of cognitive failure and the level of creative teaching among university students, and revealing the relationship between cognitive failure and creative teaching at the university's request. The researcher applied the research tools together and extracted their psychometric criteria (honesty and reliability). For a measure of cognitive failure and a measure of creative teaching (on the research sample of 200 students, they were chosen in a simple random method. The researcher reached the following results: The university students do not have the skills of creative teaching. The high level of cognitive failure among university students. An inverse relationship between cognitive failure and creative teaching. The lower the level of cognitive failure, the higher the level of creative teaching and vice versa.

Comment on Previous Studies

- Reviewing previous studies shows that there is a global trend towards cooperative learning activities
- Previous studies indicate the importance of the two strategies proposed in the current research.
- Previous studies have proven the effectiveness of using the Tarsia strategy in teaching chemistry
- Previous studies have proven that using the hourglass chart strategy has a positive effect in enhancing student achievement by moving from previous knowledge to experiences and acquiring new ideas and information
- The current research benefited from previous studies in adopting the experimental method.

Research Methodology and Procedures

First, the research methodology: The research relied on the experimental method with partial control of three groups (two experimental groups and one control group) with the post test.

Second: The research community and its sample: The research community included preparatory schools for girls in the second Karkh region of the General Directorate of Education in Baghdad, and the study sample was randomly selected, which consisted of 180 students from the fourth grade scientific students in the prep for hope for girls.

Equivalent Research Groups

The researcher has made sure of the equivalence of the three control groups and the first and second experimental groups, with the aim of controlling the variables related to the research. The following chart represents the research design and the factors that have been taken into account for the equivalence of the three groups before applying the research:

Table 1. Research design

Tests used (pre and post)	Dependent variables	Independent variables	Valence	set
Achievement test in chemistry	-Academic achievement	Tarsia Brain Triangle Strategy	Age in months Intelligence -Previous academic achievement in chemistry. The level of cognitive failure among female students	The first pilot
		Hourglass chart strategy		The second pilot
		Normal way		Control

Third: Research Tools: In order to verify the effect of the proposed strategies (hourglass - Tarsia) on the dependent variables (achievement - cognitive failure), the researcher prepared an achievement test in the course of chemistry for the fourth grade scientific, and Arabisation of the famous Broadbent (scale) questionnaire for failure of knowledge, and I have taken the following steps in preparing the two mentioned research tools:

1- Achievement test:

The achievement test was prepared in the subject of chemistry. The test included 30 items that measure the achievement of female students according to Bloom's classification of educational goals in the cognitive field, including remembering, understanding, applying, and analysing. The researcher followed the following steps to prepare the test:

2- Cognitive failure questionnaire:

The research adopted a questionnaire or measure of cognitive failure of Broadbent et al. (1982) for the following reasons:

- It is used and experimental in many international and Arab studies and has proven its effectiveness

His agreed scientific reliability

Ease and clarity of questionnaire statements

Their suitability for the age group of students (fourth grade scientific)

It measures four areas:

Attention or perception failure can be measured by the phrases (1, 2, 4, 5, 15, 19, 21, 22, 25).

Memory failure is measured by answering (3, 6, 12, 13, 16, 17, 18, 23).

Failure to handle information or a behavioural response to it can be measured by answering the phrases (8, 9, 10, 11, 14).

Failure to remember names is measured through paragraphs (7, 20).

- Measuring the level of cognitive failure through a quadruple Likert scale for four options which are never, very rare, sometimes, most of the time, provided that the answers range according to the options from zero to 4. Broadbent and his colleagues have proven the validity of the questionnaire for the application where I gives a value to the coefficient of stability (Alpha Kronbach Estimated at 0.901)

- Verify the apparent honesty of the questionnaire after translating it into Arabic

The researcher has Arabised and legalised the questionnaire so that it is suitable for application to students (research sample).

Then it was presented to a group of experts for arbitration (experts in the Arabic language - experts in psychology and its standards) in order to know the validity of the phrases and the extent of their affiliation to the questionnaire or the scale as a whole, which reflects its suitability for the application.



Carrying Out a Search Experience

The research was applied by applying it to three groups:

The first experimental group that was studied using the Triangle Mindset Strategy (Tarsia), the second experimental group which was studied using the hourglass chart strategy Control group, which was studied in the usual way.

The researcher took into consideration the equivalence of the three groups in the factors (previous academic achievement - the age in months - intelligence - the level of knowledge failure of the students) where the information was obtained from the school records, while the equivalence of intelligence was achieved through the application of the Otis - Lennon test of mental capabilities standardised by Al-Quraishi (1990), which consists of 50 items.

The experiment was applied for three months, with three weekly classes.

The experiment was applied in parallel so that the teaching of the three groups began at the same time and ended at the same time

- The achievement test was conducted on the three groups after the end of the experiment. The scores for the test were emptied and statistically processed to find the statistically significant differences between the groups.
- A questionnaire (scale) of cognitive failure was distributed among the students in the three groups before and after the experiment. Then the questionnaire data (the scale) was analysed, and the values of (T) was calculated for two independent samples and the percentages of female students before and after.

The following table displays the results of the statistical analysis of female students' scores on the Broadbent Scale of Cognitive Failure of the three groups prior to knowing the level of their cognitive failure:

Table 2. Statistical analysis of female students' scores on the Broadbent Scale of Cognitive Failure of the three groups prior to knowing the level of their cognitive failure

Significance level	Failure percentage	Standard deviation	Expected mean on the scale as a whole	Arithmetic mean over the four areas of the questionnaire (scale(set
Not function	45.95%	14.34	50	50.1	The first pilot
Not function	47.91%	13.2		51.6	The second pilot
Not function	51.82%	12.6		51.82	Control

It appears from the previous table that the arithmetic mean of the questionnaire or the measure of cognitive failure of Broadbent and his colleagues that was Arabised and legalised by the researcher calculated theoretically, is 50, and we see that the average of the first three experimental groups, the second experimental, the control, respectively: 50.1, 51.6, 51.82 and the percentages of cognitive failure are estimated at: 45.95%, 47.91%, and 51.82%, respectively; it is also noticed that there are no statistically significant differences between the three groups in the level of cognitive failure, which indicates the convergence of the level between the three groups on the scale or questionnaire. The researcher re-applied the scale to the three groups, after applying the experiment to them, then knowing the effects of the Tarsia strategy and the hourglass chart strategy on cognitive failure.

Show Search Results

In this part of the research, its results are presented after statistical analysis and what is necessary for that, according to the research hypotheses as follows:

1- Results related to the first hypothesis and its text:

- "There is no statistically significant difference at the level of significance (0.05) between the mean scores of the first experimental group that was studied according to the strategy of the mental triangles Tarsia and the control group that was studied according to the usual method in the academic achievement test".

For the purpose of validating the hypothesis, the researcher conducted a test:

(C) For two independent groups (the first experimental studies that were studied according to the strategy of mental triangles Tarsia) and the control group that was studied according to

the usual method, with the arithmetic mean, and standard deviations, and the following table displays these data:

Table 3. Post-test results in the achievement of chemistry for the first two experimental and control groups

Indication Statistics	Value t calculate	standard deviation	SMA	The group
function	30.71	2.6	21.2	Control
		6.2	48.7	Experimental

It is clear from the previous table that the calculated value of (T) is higher than the tabular (1.980) and that it is statistically significant at the degree of freedom (118) and the level of significance (0.05), which indicates the rejection of the first hypothesis and indicates that teaching using the Tarsia mentality strategy has led to raising and improving the academic achievement of female students in the first experimental group, which is better than teaching in the usual way.

2- Results related to the second hypothesis and its text:

"There is no statistically significant difference at the level of significance (0.05) between the mean scores of the first experimental group that was studied according to the strategy of Tarsia and the control group that was studied according to the usual method in the cognitive failure questionnaire."

For the purpose of validating the hypothesis, a test (T) was performed for two independent groups (the first experimental studies that were studied according to the strategy of mental triangles Tarsia) and the control group that was studied according to the usual method, with the arithmetic mean, standard deviations and percentages related to the scale of cognitive failure and the following table shows that data:

Table 4. Mathematical averages, standard deviations, and percentages of scores (scale) of cognitive failure between the first and the experimental groups

Indication Statistics	Value t test	Percentage of cognitive failure	Standard deviation	Overall average score for the actual survey	The group
function	13.41	35.6%	11.26	35.6	The first pilot
		52.2%	13.4	53.2	Control

It is clear from the previous table that the mean of the responses of the students of the control group on the four domains of the scale has reached 53.2 with a standard deviation of 13.4, or a percentage of 52.2%, while the calculated average (theoretically) was 50, meaning that the control group has recorded that cognitive failure exceeds the expected percentage; this means

that teaching in the usual way has no significant effect in reducing cognitive failure among female students of the control group, while students of the first experimental group that studied using a strategy of mental triangles (Tarsia) scored an arithmetic mean of 35.6 with a standard deviation of 11.26. The percentage of failure: The cognitive group have 35.6%, i.e. less than the calculated or expected failure, which indicates the positive effect of the Tarsia mental brain strategy in reducing cognitive failure among female students from the first experimental group.

Also, a difference of statistical significance appeared at the level of significance (0.05), which confirms the presence of the difference between the two groups in the decrease of cognitive failure in favour of the first experimental group.

3- Results related to the third hypothesis, which reads:

- "There is no statistically significant difference at the significance level (0.05) between the mean scores of the second experimental group that was studied according to the hourly chart plan strategy and the control group that was studied according to the usual method in the academic achievement test."

For the purpose of validating the hypothesis, the necessary statistical methods were performed, including testing for two independent groups (the second experimental study that was studied according to the hourglass chart strategy) and the control group that was studied according to the usual method, with the arithmetic mean, and standard deviations, and the following table shows these data:

Table 5. Post-test results in the achievement of chemistry for the second experimental and control groups

Indication Statistics	Value t calculate	Standard deviation	SMA	The group
function	14.023	2.34	5.7	Control
		3.1	24.7	Experimental

It appears from the previous table that there is a statistically significant difference at the degree of freedom (118) and the level of significance (0.05) where the calculated T value (14.023) was higher than the tabular (1.980) between the average scores of students of the second experimental group that was studied according to the hourglass chart strategy. Among the degrees of female students of the control group that were studied according to the usual method in favour of the experimental group, indicates a positive impact of the proposed strategy in improving the level of female students' achievement in the chemistry subject.

4- Results related to the fourth hypothesis, which reads:

- "There is no statistically significant difference at the level of significance (0.05) between the mean scores of the second experimental group that was studied according to the hourly chart plan strategy and the control group that was studied according to the usual method in the cognitive failure questionnaire".

For the purpose of validating the hypothesis, a test (T) was performed for two independent groups; the second experimental group was studied according to the hourglass chart strategy, and the control group was studied according to the usual method, with arithmetic averages, standard deviations, and percentages related to the questionnaire / scale terms and the following table showing these data:

Table 6. Mathematical Averages, Standard Deviations, and Percentages for Questionnaire (Scale) of Cognitive Failure between the Two Experimental and Control Groups

Indication Statistics	Value t calculate	Percentage of cognitive failure	Standard deviation	Overall average score for the actual survey	The group
function	12.6 1	32.6%	11.26	32.6	The second pilot
		51.2%	13.4	51.2	Control

It is clear from the previous table that the mean of the responses of the students of the control group on the four areas of the scale has reached 51.2, with a standard deviation of 13.4, or a percentage of 51.2%, while the calculated average (theoretically) was 50, meaning that the control group has recorded cognitive failure which exceeds the expected percentage; this means that teaching in the usual way has little effect in reducing cognitive failure among students of the control group, while students of the second experimental group that studied using the hourglass chart strategy recorded an arithmetic mean of 32.6 with a standard deviation of 11.26 and the ratio reached Centenary of failure to have 32.6% less than the calculated failure or the expected failure, indicating the positive impact of the strategy of the hourglass scheme in reducing cognitive failure among female students from the second experimental group.

Also, a statistically significant difference appeared at the significance level (0.05), which confirms the difference between the two groups in the decrease in cognitive failure in favour of the second experimental group.

5- Results related to the fifth hypothesis, which states:

"There is no statistically significant difference at the level of significance (0.05) between the average scores of the first experimental group that was studied according to the strategy of

mental triangles Tarsia and the second experimental group that was studied according to the hourglass chart strategy in the academic achievement test."

For the purpose of validating the hypothesis, arithmetic averages, standard deviations and T values were calculated, and then the statistically significant differences were obtained between the scores of the first experimental group and the scores of the second experimental group in the achievement test and the following table illustrates this:

Table 7. Post-test results in the achievement of chemistry for the first and second experimental groups

Indication Statistics	Value t calculate	Standard deviation	SMA	The group
Function	3.94	0.84	25.07	The first pilot
		0.86	19.34	The second pilot

It is clear from the above table that the calculated T value has reached 3.94, that is, it is greater than the tabular of 1.980, at the level of significance (0.05) and degree of freedom (118), which indicates that there are statistical differences between the mean scores of the first experimental group that was studied according to the strategy of the mental triangles Tarsia and the mean of the degrees of the second experimental group that were studied according to the hourglass chart strategy, and therefore rejects the fifth hypothesis; this indicates that there are differences in favour of the experimental group that was studied according to the strategy of mental triangles Tarsia, which indicates a positive impact of the proposed strategy in improving the level of students' achievement in chemistry.

6. Results related to the sixth hypothesis, which reads:

- "There is no statistically significant difference at the level of significance (0.05) between the mean scores of the first experimental group that was studied according to the strategy of mental triangles Tarsia and the second experimental group that was studied according to the hourglass chart strategy in the cognitive failure questionnaire (scale)."

For the purpose of validating the hypothesis, arithmetic averages, standard deviations, percentages, and T values were calculated, and then the statistically significant differences were obtained between the degrees of the first experimental group and the degrees of the second experimental group in the scale of cognitive failure; the following table illustrates this:

Table 8. Mathematical averages, standard deviations and percentages for scores (scale) of cognitive failure between the first and second experimental groups

Indication Statistics	Value t calculate	Percentage of cognitive failure	Standard deviation	Overall average score for the actual survey	The group
Not function	1.494	% 27.79	0.88	27.79	The first pilot
		%26.12	0.86	26.12	The second pilot

It is clear from the above table that the calculated T value has reached 1.494, that is, it is less than the tabular value (1.980), at the level of significance (0.05), while the calculated average (theoretical) of cognitive failure was 50, meaning that the first experimental group and the second experimental group has recorded a knowledge failure that exceeds the expected percentage; this indicates that there are no statistical differences between the degrees of the first experimental group that was studied according to the strategy of mental triangles Tarsia and the degrees of the second experimental group that were studied according to the hourglass chart strategy, which indicates the acceptance of the sixth hypothesis; this means the effect of est Atijitan evenly matched for the reduction of cognitive failure among students fourth grade science.

Second: Interpretation of the Results

1- Results related to the first independent variable (Tarsia):

A- Regarding academic achievement in chemistry (first dependent variable):

The results of the research and the analysis of its data showed the clear effect of the Tarsia strategy on improving and raising the level of academic achievement in the chemistry subject. The researcher believes that these results may be attributed to:

- This strategy worked to involve the student in learning and was directed towards self-learning and not learning directed by the school and thus stimulated the acquisition of knowledge and concepts of this student.

The strategy helped students to innovate, encouraged sharing of information between peers, and allowed immediate feedback and evaluation by group members together.

- Solving the puzzle of triangles by combining them in a way that gave the correct solution helped to retain the information of female students.

The strategy of mental triangles Tarsia helped the students more in achieving the subject of chemistry because it depended on their behavioural and cognitive participation and gave them

confidence in forming concepts based on cooperative learning; these behaviours were necessary to obtain the subject of chemistry.

- The students' insistence on completing the puzzles related to the Tarcia strategy helped to consolidate the information expressed in the puzzle, thus helping to raise their achievement.

B- For cognitive failure (second dependent variable):

- The results of the research and the analysis of its data showed the clear effect of Tarsia's strategy of reducing cognitive failure among female students studying the strategy. The researcher believes that these results may be attributed to:

Collecting triangles for the purpose of reaching a correct solution develops the memory of students and helps them to properly handle the information given, as they complete the puzzle for each triangle.

2- Results related to the second independent variable (hourglass chart strategy):

A - Regarding academic achievement in chemistry (first dependent variable):

The results of the research and the analysis of its data showed the clear effect of the hourglass chart strategy on developing academic achievement in chemistry. The researcher believes that these results may be due to:

The step to infer previous knowledge and information helped students remember everything related to the subject of the lesson (top part of the chart).

The default questions step helped students prepare for the new lesson and linked it to their previous information.

B- With regard to cognitive failure (second dependent variable):

Receiving peer notes helped students develop behavioural responses and deal with various information.

- The cooperative work encouraged female students to exchange information and quickly pay attention to it, thereby enhancing their awareness.



Conclusions

In light of the previous results, we can reach the following conclusions:

- The strategy of mental triangles (Tarsia) has a positive effect in raising the level of academic achievement in chemistry
- A strategy of mental triangles helps reduce cognitive failure.
- The hourglass chart strategy contributed to improving the level of academic achievement of fourth-grade students.
- Active cooperative learning strategies with small student groups help reduce the level of cognitive failure in the areas of attention, memory, and information handling.

Recommendations

In light of the previous results, the researcher recommends the following:

- The need to adopt modern strategies and apply them to students, especially in chemistry
- Holding workshops to introduce the latest active learning strategies, including the Tarsia strategy and the hourglass chart strategy.
- Conducting more research by applying the two strategies, but by changing the dependent factors such as creative thinking, problem solving, visual intelligence ... etc.

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