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The Effectiveness of the Dual Situated Learning Model (DSLM) for Middle School Students in Their Flexible Thinking

Hanan Saad Jassem
Asst. Prof. Dr. Hiyam Mahdi Jawad Al-Kadhimi
University of Baghdad / College of Education for Pure Sciences (Ibn Al-Haytham) / Department of Mathematics,;hiyam.m@ihcoedu.uobaghdad.edu.iq,Hanan.Saad2203@ihcoedu.uobaghdad.edu.iq

Research Abstract

The research aimed to determine (the effectiveness of the Dual Situated Learning Model (DSLM) for middle school students in their flexible thinking). In line with the research objectives, the researcher adopted the analytical research method to analyze the scientific material and the experimental research method. A true experimental design with two equivalent groups and a post-test for flexible thinking was used. To verify the research objective, the following null hypothesis was formulated:

- *There is no statistically significant difference at the (0.05) level between the mean scores of the experimental group students who studied according to the Dual Situated Learning Model (DSLM) and the scores of the control group students who studied using the traditional method in the flexible thinking test.*

$$H_0 : \bar{x}_1 = \bar{x}_2 \quad , \quad H_1 : \bar{x}_1 \neq \bar{x}_2$$

The research population was defined as second-grade middle school female students in day middle and secondary schools affiliated with the General Directorate of Education of Baghdad / Rusafa Third. The research sample consisted of (82) female students from (Al-Maw'itha Middle School for Girls), distributed into two groups:

- *An experimental group that studied using the Dual Situated Learning Model (DSLM), consisting of (40) students.*
- *A control group that studied using the traditional method, consisting of (42) students.*

Equivalence was established for the two groups in a number of variables believed to affect the dependent variables along with the independent variable, namely (intelligence, prior achievement, prior knowledge, age in months). To achieve the research objectives and collect relevant data, a research tool was constructed as follows:

A flexible thinking test consisting of (20) essay items, based on the types of flexible thinking (spontaneous flexibility, adaptive flexibility.The tools were applied to a pilot sample to verify the clarity of the test items, test instructions, and time limit. Appropriate statistical analyses were conducted, and psychometric properties were confirmed, making the tools ready for application to the research sample. After applying the test to the two research groups, the results were analyzed using statistical tools including (t-test, Levene's test, Pearson correlation coefficient, Spearman-Brown formula, Cooper's equation, Eta-squared). This was achieved using the Statistical Package for the Social Sciences (SPSS) version 22Through the results, the researcher reached key conclusions, including:

The model's application was uniform in the thinking of the experimental group students, and the lack of differentiation during its use for the experimental group led to the equality of students in both groups in answering the flexible thinking items.In light of the conclusions, a number of suggestions and recommendations were put forward, as will be mentioned later.

Keywords: *Dual Situated Learning Model (DSLM), Flexible Thinking*

Firstly: Research Problem

Mathematics is a prominent subject compared to other subjects, in addition to the importance of the methods used in teaching mathematics, which are still predominantly represented by lecturing, relying on rote learning.
(Al-Kadhimi & Al-Uqabi, 2023, p. 2)

The lack of flexibility in thinking is not an inherited trait of students; rather, it is acquired gradually over days and years through upbringing, socialization, and the combined contribution of family and society in instilling these traits.
(Barakat, 2009, p. 4)
Therefore, the researcher believes that it is important to review and develop educational objectives to a degree that pushes students towards sound thinking and to utilize this thinking in modern teaching methods to enable students to connect phenomena, recognizing that the learning process does not occur in isolation from the social environment.
(Majeed & Hammadi, 2023: 2)
Furthermore, students should be able to deduce facts and laws, solve problems, and critique everything they encounter in a coordinated and purposeful manner. However, what the researcher observed in her work in teaching mathematics for no less than five years is that most of the students' solutions were characterized by a procedural approach, meaning memorizing steps to solve questions and applying them without problem-solving that requires thinking in general, and flexible thinking in particular. This is largely due to most students relying on a single method rather than multiple methods, which may lead to a weakness in their acquisition of flexible thinking skills.
Flexible thinking and its skills are particularly linked to mathematics because it helps students find solutions to the problems they face, and they realize that there is more than one way to solve a mathematical problem.
(Na'am, 2016, p. 10)
Generally, mathematics is considered a field that represents a system of intricate interconnections.
(Jawad, L.F, 2022: 421)
Based on the foregoing, the research problem is crystallized in the following question:
What is the effectiveness of the Dual Situated Learning Model (DSLM) for middle school female students in their flexible thinking?
Secondly: Importance of the Research
Working with this model through experimentation allows students to learn by interacting with tangible objects that belong to their real world.
(Al-Maayouf & Ghaoui, 2011, p. 316)
Furthermore, the importance of the study can be identified as follows:
Theoretical Importance:
The theoretical importance lies in the following:
The current research represents a response to international trends in adopting educational models through which the process of understanding mathematical concepts can be emphasized.
To the best of the researcher's knowledge, this is the first study in Iraq that addresses the effectiveness of the Dual Situated Learning Model (DSLM) in teaching mathematics.
The research may provide data that serves the educational process in the middle school stage by focusing on correct concept understanding and emphasizing flexible thinking in its two domains (spontaneous flexibility and adaptive flexibility.
Practical Importance:
The practical importance of the research can be summarized in the following points:

1. It lies in the benefit it offers to students in education based on a new model they have not previously encountered.
2. Adopting modern trends in the educational process by employing new educational models and activities.
3. If the null hypotheses of the current research experiment are refuted, it will support the importance of the used model, which can benefit teachers and education away from traditional methods.
4. It provides a diagnostic test in mathematics for second-grade middle school students and is considered an evaluation tool that teachers can benefit from. It also has utility in preparing tests for other academic levels and tests for flexible thinking. Those concerned with educational matters, such as teachers, supervisors, and curriculum developers, may also benefit.

5. The Dual Situated Learning Model (DSLM) translates constructivist theory into practice, which is not an easy task and requires perseverance and continuous effort to make this model applicable, thereby providing teachers with clear teaching objectives that make learning more effective.

Thirdly: Research Objective

The current research aims to determine the effectiveness of the Dual Situated Learning Model (DSLM) in:

- Flexible thinking among middle school students.

Fourthly: Research Hypothesis

- There is no statistically significant difference at the (0.05) level between the mean scores of the experimental group students who will study according to the Dual Situated Learning Model (DSLM) and the scores of the control group students who will study using the traditional method in the flexible thinking test.

$$H_0 : \bar{x}_1 = \bar{x}_2 \quad , \quad H_1 : \bar{x}_1 \neq \bar{x}_2$$

Fifthly: Research Delimitations

1. Female students of the middle school stage in governmental day middle and secondary schools affiliated with the General Directorate of Education of Baghdad / Rusafa Third for the academic year (2024-2025.(
2. The second semester of the academic year (2024-2025.(
3. The prescribed mathematics textbook from the Ministry of Education, including chapters (Fifth: Geometry and Measurement, Sixth: Coordinate Geometry, Seventh: Statistics and Probabilities), 6th revised edition 2024 AD, for the second-grade middle school.
4. Stages of the Dual Situated Learning Model (DSLM).

Sixthly: Definition of Terms

- **Effectiveness:**
- Defined as: "The ability to influence, achieve goals, and accomplish desired results in the best possible way." (Ibrahim, 2009, p. 745(
- Operationally defined by the researchers as: The use of the stages of the Dual Situated Learning Model (DSLM) in teaching topics from the prescribed mathematics textbook for the second-grade middle school, and measuring the change that occurs in the performance and flexible thinking of second-grade middle school students.
- **Model**:
- Defined as: "An educational plan based on psychological theoretical foundations that has been applied to a certain community, providing the learner with effective experiences and mental capabilities within the educational community, and helping to achieve the highest levels of understanding." (Zayer & Samaa, 2014, p. 138).

Dual Situated Learning Model (DSLM)

Defined as: "An educational model based on the nature of concepts and learners' beliefs about these concepts, which requires designing learning events sufficient to destabilize and unbalance existing understanding by creating a gap or flaw in the learners' prior knowledge, thereby pushing them into a state of cognitive disequilibrium to overcome previous knowledge and thus achieve conceptual change." (She, 2004: 146)

Operationally defined by the researchers as: A model followed by the researcher in teaching the experimental group students of the second-grade middle school, consisting of six stages: examining the characteristics of the scientific concept, sensing students' misconceptions about the concept, analyzing scientific concepts where students have deficiencies, teaching through dual situated learning events, and stimulating challenge for situational learning events.

(Guilford, 1970) defines it as "the ability to create a flow of ideas while changing direction or correcting information".

(Eden, 2000:3 & Passig)

Operationally defined by the researchers as: The total score a student obtains by answering the flexible thinking test constructed by the researcher for this purpose, by choosing appropriate methods to solve

mathematical puzzles with the ability to change the solution method according to the question's requirements.

Firstly: Theoretical Framework

First Axis: Constructivist Theory

Constructivist theory is an educational philosophy that views learning as an active construction of knowledge. (Hasan, 2018: 7) In this theory, the learner relies on developing their self-knowledge based on their current knowledge and previous experiences. This theory emphasizes the active role of the learner under the guidance, support, and assistance of the teacher in constructing meaning in a way that best supports learning. (Faraj, 2015, p. 121)

Second Axis: Dual Situated Learning Model (DSLM)

Concept

The way knowledge acquisition is understood by the learner is considered one of the important issues in education and science teaching, especially in mathematics. Many studies and theories have discussed how learning occurs, and among the most prominent is constructivist theory, which has garnered significant attention and praise from all researchers and theorists. The essence of this theory lies in individuals actively constructing their knowledge by comparing new information with their prior information and understanding, and using this to work through cognitive differences to achieve comprehension.
(Akpinar, 2007, 16)

Its Philosophy:

The philosophy upon which the Dual Situated Learning Model (DSLM) is based is that learning, according to this philosophy, occurs through the interaction of a new perception with existing understanding. If there is conformity and balance between the new perception or understanding and the existing understanding, learning proceeds smoothly. However, if there is no conformity between them, learning requires reconstructing the existing understanding and replacing it to fit what the new situation entails.
(Zietsman and Hewson, 1986: 24)
It is considered a new educational philosophy based on enhancing student positivity in various educational environments.
(Yousif & Majeed, 2024: 40)

Stages of the Dual Situated Learning Model (DSLM:(

Stage One: Examining the characteristics of the scientific concept: This stage provides information about the important mental state that needs to build a scientific viewpoint related to the concept.
Stage Two: Revealing students' misconceptions about the scientific concept to be learned: This stage aims to detect students' perceptions about the scientific concept.
Stage Three: Analyzing the mental topics in which students have deficiencies: This stage requires precisely identifying the number of mental concepts in which students have deficiencies to rebuild a more scientific conviction towards the scientific concept.
Stage Four: Designing Dual Situated Learning Events: This design for dual situated learning events is based on the results from the third step, which indicate the cognitive topics in which students have deficiencies.
Stage Five: Teaching with Dual Situated Learning Events: This focuses on giving students opportunities to make predictions, provide explanations and interpretations, address discrepancies, and build a more scientific conviction.
Stage Six: Teaching with Challenge for Situational Learning Events: This provides students with opportunities to apply the cognitive topics they have acquired in new situations to verify that successful conceptual change has occurred.
(She H & Lee, 2008: 726)

Characteristics of the Dual Situated Learning Model (DSLM:)

1. The model requires clarifying the flaw in students' prior knowledge or the existence of a contradiction, which arouses students' curiosity and interest and challenges their ideas. Once they are prompted to participate in predicting the event and understanding what actually happens, the opportunities to reconstruct their ideas about the concepts increase.

2. The model emphasizes identifying students' misconceptions that have been acquired from various sources.
3. It provides students with age-appropriate challenging opportunities to ensure their ability to apply the modified or formed mental foundations in different contexts, leading to conceptual change.
4. The model includes cognitive relationships between scientific concepts and links them to fundamental concepts.
5. The model supports the effectiveness of students in learning processes based on the cognitive system. (She H, 2004: 176)

Benefits of Teaching in the Dual Situated Learning Model (DSLM:)

a) The Dual Situated Learning Model raises the motivation level of middle school students and also their comprehension of concepts and sound scientific thinking.

b) The model activates existing concepts in students' prior knowledge and provides them with correct concepts to achieve cognitive change.

c) It supports students' contribution through interactive learning activities, and it is important in identifying prior knowledge about the concept to be learned before starting learning. It provides learning structures for problem-solving as a temporary framework to support learning.

(Suhail & Faris, 2024: 4)

d) The Dual Situated Learning Model can facilitate fundamental conceptual change, which includes understanding content and mental skills in many concepts.

e) It facilitates radical change in concepts that involve knowing students' initial beliefs about scientific concepts, and the nature of these concepts, especially those related to inference to reach the truth.

(Al-Rabat B, 2015, 743)

Third Axis: Flexible Thinking:

Flexible Thinking:

It is considered one of the most important pillars of thinking and represents the ability to think distinctively after exploring all possibilities and options that achieve the goal, seeing them, and encompassing them with multiple answers.

(Al Murshid, 2012, p. 1)

The ability to think flexibly has become increasingly important for success in academic and practical life in the twenty-first century. Flexible thinking enables students to overcome their fixed ideas and generate ideas and find solutions to mathematical problems they encounter.

(Li, 2020: 9)

Flexible thinking consists of two parts: (thinking and flexibility). Thinking is considered one of the important factors in human life because it helps individuals face problems and find solutions for them, while flexibility refers to an individual's ability to produce many diverse ideas.

(Umbach, et al., 2017)

People with flexibility are characterized by using logic to solve the problems they face.

(Magid, 2018: 486)

Types of Flexible Thinking:

a) Spontaneous Flexibility: Represents an individual's ability to adapt intellectually when facing a specific problem.

b) Adaptive Flexibility: Related to an individual's ability to move from one idea to another and adapt to the conditions of the problem to find a solution.

(Al-Khalili, 2005, p. 140)

Characteristics of Flexible Thinking:

1. The best way to possess flexible thinking is the ability to adapt to continuous changes and adjust to new conditions.
2. It strengthens creative ability, as an individual's mental flexibility makes achieving personal and collective goals successful and beneficial.
3. It provides the individual with the ability for proper adaptation and evaluation, as a mind with a high degree of flexibility has the ability to analyze correctly and adapt to diverse activities.

Flexibility is linked to stimuli, and environmental shifts, conditions, and responses usually affect the way of thinking.

4. It makes the individual avoid narrow thinking, as flexible thinking moves the individual away from narrow thought patterns to broader fields and narrow possibilities.
5. It is essential for efficiently achieving educational goals. (Tracy, et.al., 2011: 106)

Rules of Flexible Thinking:

1. People with flexible thinking are known for their ability to effectively influence and guide.
2. Reaching a solution to problems requires overcoming the methods that led to their inception.
3. The need for multiple means and purposes used to solve problems.
4. The necessity of immediately switching to a different method when it is proven that the desired result is not being achieved.
5. A person who is unable to see all dimensions of the problem they are currently facing should listen to others.
6. It is necessary to consider all factors of flexible thinking, whether they are specific to individuals or groups. (Al-Mufleh, 2008, p. 15).

Traits of an individual with flexible thinking:

1. Ability to interpret problems, grasp all their dimensions and influencing factors, and discuss them to reach a suitable solution.
2. Ability to create new ideas and innovative insights within a specific time frame. (Al-Sulaiman, 2003, pp. 7-8(
3. Flexibility in facing changes and unforeseen circumstances in the social environment one lives in.
4. Ability to provide highly feasible and innovative contributions to the work one is engaged in. (Hammoud, 2008, p. 82>
5. All the above means that unifying features enhances performance by ensuring equal contribution. (Abdulalsalam & Majeed, 2025: 11)

Secondly: Previous Studies

Firstly: Studies that addressed the Dual Situated Learning Model (DSLM)

1. Study by (Al-Rabat, 2018): This study aimed to determine the effectiveness of integrating the Thinking Maps strategy and the Dual Situated Learning Model (DSLM) in developing some 21st-century skills in geometry for first-grade preparatory students.
2. Study by (Majhool, 2022): This study aimed to determine the effect of the Dual Situated Learning Model (DSLM) on the achievement of fourth-grade scientific female students in biology and their scientific thinking.

Secondly: Studies that addressed Flexible Thinking

1. Study by (Al-Kubaisi, 2016): This study aimed to determine the effectiveness of the Jigsaw strategy in achievement and developing thinking flexibility among middle school students.
2. Study by (Al-Khafaji, 2024): This study aimed to determine the effect of the Triple Bridging strategy on mathematics achievement and flexible thinking skills among second-grade middle school students.

RESEARCH METHODOLOGY AND PROCEDURES

Firstly: Research Methodology

The researcher chose a true experimental design with two equivalent randomized groups, using a post-test for flexible thinking.

Secondly: Research Population

The population of this research includes second-grade middle school female students in day middle schools for girls affiliated with the General Directorate of Education of Baghdad / Rusafa Third, for the academic year (2024-2025). The researcher intentionally selected the General Directorate of Education of Baghdad / Rusafa Third as the population for her research.

Thirdly: Research Sample

Al-Maw'itha Middle School for Girls was intentionally selected from among the schools affiliated with the General Directorate of Education of Baghdad / Rusafa Third to be the research sample and for the experiment to be conducted there. Thus, the number of female students in the two research groups after exclusion reached (82) students, with (40) students for the experimental group and (42) students for the control group. The researcher took into account establishing equivalence between the experimental and control groups in a number of variables believed to potentially interfere with the effect of the independent variable on the dependent variables, such as (intelligence, prior achievement, prior knowledge, age in months). This was done through the normality of distribution represented by the arithmetic mean, standard deviation, standard error, and estimation of a 95% confidence interval for the population mean, in addition to the validity of the hypothesis test for equality of variances according to Levene's F-test and the validity of the hypothesis test for equality of correlation according to the t-test for all equivalence indicators.

Table (1)

Statistical description of the experimental and control groups for the variables (Intelligence, Prior Achievement, Prior Knowledge, Age in Months

Table (1): Statistical description of the experimental and control groups in the variables (intelligence, prior academic achievement, prior knowledge, age in months).

Variable	Levene's Test for Equality of Variances		t-test For Equality of Means		Degree of Freedom	Statistical Significance at the 0.05 Level
	F	Significance	T	Significance		
Intelligence	1.720	0.193	0.535	0.594	80	Not Function
Prior Academic Achievement	0.741	0.392	0.329	0.743	80	Not Function
Prior Knowledge	0.182	0.671	1.149	0.254	80	Not Function
Age in Months	4.602	0.035	1.366	0.176	80	Not Function

Fourth: Research Tool

1- Defining the Concept of Flexible Thinking:

After defining the concept of flexible thinking based on the terms and theoretical framework presented, two main types were identified:

a) **Spontaneous Flexibility:** Producing the greatest possible number of different types of thought directions related to a problem or a stimulating situation.(Qutami, 2009, p. 144)

b) **Adaptive Flexibility:** The ability to generate an unusual solution to problems.(Glover et al., 2013, p. 256)

After consulting the opinions of experts and reviewers in mathematics teaching methods, measurement and evaluation, and psychology, the researcher prepared the Flexible Thinking Test based on literature and previous studies by adopting Guilford's (1967) definition of flexible thinking, which consists of two types: **spontaneous flexibility** and **adaptive flexibility**.

Table (2): Distribution of the Number of Items for Types of Flexible Thinking

Types of Flexible Thinking	Paragraphs	No.
Spontaneous Flexibility	1,2,3,4,5,6,7,8,9,10	10
Adaptive Flexibility	11,12,13,14,15,16,17,18,19,20	10

The researcher relied on the following steps to prepare the Flexible Thinking Test, as outlined below:

1- **Defining the Test Objective:**

The test aims to measure flexible thinking that is appropriate for the age group of female students in the second intermediate grade.

2-**Formulating theTest Items:**

The flexible thinking test items were formulated after reviewing test construction sources and referring to the theoretical framework. Using the definition and identifying the main types, and taking into

account the opinions and expertise of specialists in mathematics teaching methods, as well as onsidering the characteristics of the research community (female students in the second intermediate grade), a total of **20 essay-type items** were developed: (10) items for spontaneous flexibility and (10) items for adaptive flexibility.

- Items were written in clear, simple, and understandable language for the students and were free of errors.
- The test items are suitable for the characteristics of the research community.
- The items are varied so that each item expresses a specific problem or situation.

3- **Test Instructions:**a) **Answer Instructions:**Instructions were prepared specifically to facilitate students' understanding of what is required in the test.

- Student data (name, grade, section, subject, school)
- Number of test items and the test objective
- An example illustrating to the student how to answer the test items

b) **Test Scoring Instructions:**The test consists of **20 items**: items (1–10) are spontaneous flexibility essay-type questions, each worth 4 points; items (11–20) are adaptive flexibility essay-type questions, each composed of two parts, with 2 points per part, making a total of 4 points per item. Accordingly, the total score for the test is **80 points**.

4- **Presenting the Test Items to the Reviewers:**The Flexible Thinking Test was presented to a number of reviewers specialized in mathematics teaching methods, educational sciences, and psychology. There were no comments suggesting the deletion or modification of any test item.

1. **First Pilot Sample for the Test:**To assess the clarity of the instructions and the time needed to answer, the test was applied to a random sample of **45 female students** from the second intermediate grade (Um Mousa Intermediate School for Girls) on Monday, 10/2/2025, during the morning session. After recording the response times for the first and last five students, the result ranged between **55 to 65 minutes**. Calculating the average time showed that **60 minutes** is an appropriate time to answer the test items, which is considered a good amount of time. The pilot results also indicated the clarity of the items and instructions, as the students did not ask any questions about how to answer or seek clarification on any ambiguous items.
2. **Second Pilot Sample for the Test:**The statistical analysis sample was selected after confirming the clarity of the items, instructions, and response time, and to identify difficult or weak items and the items' ability to discriminate between students. To exclude invalid items from the test, the preliminary version was applied again on a sample of **120 female students** from the second intermediate grade at (Kulna Al-Iraq Intermediate School for Girls) on Monday, 10/2/2025, during the afternoon session (since the school follows a rotating schedule). This school was outside the primary research sample and the first pilot sample. The researcher supervised the test administration herself, assisted by the administration and some teachers.
3. **Statistical Analysis of Flexible Thinking Items:**a) **Item Difficulty and Ease Coefficient:**After counting the number of correct answers for each item, a formula considering partial knowledge in scoring was used. The results ranged between **0.26 and 0.51**. Test items are considered acceptable if their difficulty ranges between **0.20 and 0.80** (Al-Dhaher et al., 1999:129). This indicates that the test items are acceptable and their difficulty coefficients are appropriate.

b) **Discriminative Power of Items:**

The researcher used the formula for the discrimination index of items that accounts for partial knowledge in scoring answers. When calculating the discrimination power for each test item, it was found to range between **0.32 and 0.57**. An item is considered good if its discrimination power is **20% (0.20) or more** (Amtanious, 1997, p. 100). This is a good indicator for accepting the items based on their discriminatory ability, and none of the items were deleted.

Verifying the Psychometric Properties of the Test:

1. **Test Validity:**

a) **Face Validity of the Flexible Thinking Test:**Face validity refers to the overall appearance of the test or its external form in terms of the type of items, how they are phrased, and the clarity of those items (Al-Jalabi, 2005, p. 92).

b) **To assess the appropriateness of the test items,** the researcher presented the preliminary version of the test, consisting of 20 items, to experienced professors specializing in educational sciences, psychology, and teaching methods to provide their opinions and comments regarding the suitability of the test for its intended purpose. Based on the reviewers' feedback, some items were modified, and a few were deleted. Most of the test items were approved.

c) **Construct Validity:**This refers to the extent to which the test measures the hypothetical construct it was designed to assess, verified abstractly by matching the test scores with the concept on which the test was based. Lack of validity occurs when the test's empirical results do not align with its theoretical assumptions (Al-Kubaisi, 2010, p. 267). Construct validity for the Flexible Thinking Test was confirmed by finding the correlation between:

- The correlation of each item with the total test score:The correlation coefficient was calculated using Pearson's correlation between each item score and the total test score. The results showed that all test items were statistically Function, with correlation coefficients ranging between **0.315 and 0.548**, which is a good indicator of construct validity for the Flexible Thinking Test.

Table (3): Relationship Between Each Paragraph and the Total Test Score

S. No.	Pearson coefficient	Degrees of Freedom	p-value	Significance Level	Statistical Significance
1	0.487	119	0.000	0.05	Function
2	0.466	119	0.000	0.05	Function
3	0.495	119	0.000	0.05	Function
4	0.315	119	0.000	0.05	Function
5	0.384	119	0.000	0.05	Function
6	0.390	119	0.000	0.05	Function
7	0.318	119	0.000	0.05	Function
8	0.369	119	0.000	0.05	Function
9	0.467	119	0.000	0.05	Function
10	0.380	119	0.000	0.05	Function
11	0.359	119	0.000	0.05	Function
12	0.500	119	0.000	0.05	Function
13	0.356	119	0.000	0.05	Function
14	0.411	119	0.000	0.05	Function
15	0.468	119	0.000	0.05	Function
16	0.548	119	0.000	0.05	Function
17	0.484	119	0.000	0.05	Function
18	0.486	119	0.000	0.05	Function
19	0.393	119	0.000	0.05	Function
20	0.401	119	0.000	0.05	Function

Relationship of Each Item with Its Domain: The correlation coefficient was calculated based on the correlation between the score of each item and the total test score, using Pearson's correlation coefficient. The results showed that all test items were statistically Function. The correlation values for the spontaneous flexibility domain ranged between **0.329 and 0.536**, and for the adaptive flexibility domain ranged between **0.349 and 0.603**, which is a good indicator of construct validity for the Flexible Thinking Test. Tables (4) and (5) illustrate this.

First: Spontaneous Flexibility

Table (4): Relationship Between Each Item and Spontaneous Flexibility

Spontaneous Flexibility					
S. No.	Pearson coefficient	Degrees of Freedom	p-value	Significance Level	Statistical Significance
1	0.536	119	0.000	0.05	Function

2	0.506	119	0.000	0.05	Function
3	0.509	119	0.000	0.05	Function
4	0.371	119	0.000	0.05	Function
5	0.459	119	0.000	0.05	Function
6	0.457	119	0.000	0.05	Function
7	0.329	119	0.000	0.05	Function
8	0.454	119	0.000	0.05	Function
9	0.577	119	0.000	0.05	Function
10	0.434	119	0.000	0.05	Function

Second: Adaptive Flexibility

Table (5): Relationship Between Each Item and Adaptive Flexibility

Adaptive Flexibility					
S. No.	Pearson coefficient	Degrees of Freedom	p-value	Significance Level	Statistical Significance
11	0.349	119	0.000	0.05	Function
12	0.576	119	0.000	0.05	Function
13	0.428	119	0.000	0.05	Function
14	0.447	119	0.000	0.05	Function
15	0.550	119	0.000	0.05	Function
16	0.603	119	0.000	0.05	Function
17	0.499	119	0.000	0.05	Function
18	0.505	119	0,000	0.05	Function
19	0.512	119	0,000	0.05	Function
20	0.559	119	0,000	0.05	Function

1. **Reliability of the Flexible Thinking Test:**The split-half method was used to calculate the reliability of the Flexible Thinking Test by dividing the test items into two equal halves. The reliability for half of the test was calculated using Pearson's correlation coefficient, which was **0.54**. After applying the Spearman-Brown formula for correction, the reliability coefficient for the entire test reached **0.70**, which is considered good and acceptable if the coefficient is **70% or higher** (Al-Kubaisi, 2010, p. 297).
2. **Scoring Reliability for the Essay Items of the Flexible Thinking Test:**The researcher randomly selected **25 answer sheets** from the statistical analysis sample to calculate scoring reliability. The researcher rescored them ten days after the first scoring, using Cooper's formula. The results showed that the agreement between the first and second scorings reached a reliability coefficient of **0.88**. Then the papers were rescored again by another mathematics teacher using Cooper's formula, where the agreement between the researcher and the teacher was **0.90**. This reliability is considered good and acceptable if the coefficient is **75% or higher** (Majid & Yaseen, 2012, p. 93). Thus, all test items became ready for application.

Presentation, Discussion, and Interpretation of Results:

- **Presentation, Discussion, and Interpretation of Results Related to the Flexible Thinking Test:** There is **no statistically significant difference** at the **0.05 level** between the mean scores of the experimental group students, who were taught according to the Dual Situational Learning Model (DSLM), and the control group students, who were taught using the traditional method in the Flexible Thinking Test.

$$H_0 : \bar{x}_1 = \bar{x}_2 \quad , \quad H_1 : \bar{x}_1 \neq \bar{x}_2$$

- **Test of Sample Equivalence Based on the Flexible Thinking Test Indicator:** After scoring the Flexible Thinking Test answer sheets and comparing the arithmetic means of

the experimental and control groups, the results showed that the mean score of the experimental group was **49.30** with a standard deviation of **15.47**, while the control group had a mean score of **42.98** with a standard deviation of **18.30**, as shown in Table (6):

Table (6): Descriptive Statistics for the Two Research Groups in Flexible Thinking Scores

Group	No. of Students	Arithmetic Mean	Standard Deviation	Standard Error of the Mean	95% Confidence Interval for the Mean	
					Upper Limit	Lower Limit
Experimental	40	49.30	15.47	2.45	13.788	1.140-
Control	42	42.98	18.30	2.82	13.759	1.111-

Using Levene's test, the results showed that the mean score of the experimental group was **49.30** with a standard deviation of **15.47**, while the control group had a mean score of **42.98** with a standard deviation of **18.30**. After applying the independent samples t-test at a significance level of **0.05** and degrees of freedom of **80**, the calculated t-value was **1.686**, which is less than the critical t-value of **1.990**. The significance level (p-value) was **0.096**, which is greater than the significance level **0.05**. These results indicate that there is no statistically significant difference between the experimental and control groups in the final application of the Flexible Thinking Test. Therefore, the null hypothesis is accepted.

Table (7) illustrates this:

Table (7): Results of the t-test for Comparing the Two Research Groups

Variable	**Levene's Test for Equality of Variances**		**t-test For Equality of Means**		**Degree of Freedom**	**Statistical Significance at the 0.05 Level**
Flexible Thinking	**F**	**Significance level**	**T**	**Significance**	**80**	**Not statistically significant**
	1.271	**0.263**	**1.686**	**0.096**		

As a result, the null hypothesis is accepted (there is no statistically significant difference at the 0.05 level between the mean scores of the experimental group, which will be taught according to the Dual Situational Learning Model (DSLM), and the mean scores of the control group, which will be taught using the traditional method, in the Flexible Thinking test).

The researcher used the Eta squared (η^2) formula, which represents the specific value of the differences, to determine the effect size of the independent variable (the model) on the dependent variable (Flexible Thinking). This was done to ensure that the differences found using the t-test are true differences caused by the independent variable (the model) and not by other variables, and then to find the value of (D) that expresses the effect size.

Table (8)

The specified value of $(n^2)$for differences and the value of (D) representing the effect size in the diagnostic test for conceptual change for the experimental and control research samples

Independent Variable	Dependent Variable	DF	T	n^2	D	Effect Size
Dual Situational Learning Model (DSLM)	Flexible Thinking	80	1.686	0.03	0.35	Weak

The research results concerning flexible thinking showed no statistically significant differences between the scores of the experimental and control groups. This contradicts the findings of studies by (Al-Kubaisi,

2016) and (Al-Khafaji, 2023), which showed a difference in favor of the experimental group students over the control group students. The reason for this discrepancy is that those studies did not use the Dual Situated Learning Model (DSLM) as an independent variable. The researcher attributes this to the following reasons:

1. The complex intellectual tasks, such as solving problems represented by the flexible thinking test items.
2. The flexible thinking test items were not linked to the content of the scientific material; that is, they were not taught within the classroom, as is the case with mathematics. This led some students to answer based on their personal perspective rather than based on what they gained from the model.
3. There are certain aspects that influence flexible thinking, such as genetic predispositions and personal and environmental factors like attitudes, tendencies, and mental values, which are reflected in the students' answers on the flexible thinking test items.
4. The model's creation of cognitive dissonance for previous information, to integrate it with new information, led to an equalization between the two groups in thinking.
5. Thinking takes forms that express how students acquire knowledge and does not occur in isolation; it is a concept linked to circumstances and the interaction of environmental components and their factors.

Conclusions:

1. The effective impact of the independent variable (Dual Situated Learning Model (DSLM)) on the interaction of the experimental group students with the model's stages was clear and had a primary effect on teaching.
2. The model's operation was unified in the thinking of the experimental group students, and the lack of differentiation during its use for the experimental group led to the equality of students in both groups in answering the flexible thinking items.
3. The importance of the flexible thinking test, prepared by the researcher in its two types, in enriching the scientific library of educational institutions.
4. The balanced effect of the model in the flexible thinking test for the experimental group led to both groups (experimental and control) achieving a more precise level of flexibility in thinking.

Recommendations:

1. The necessity of directing the attention of mathematics teachers to the importance of using modern teaching strategies and models in their teaching so that the effect of these strategies and teaching models transfers to subsequent stages, including this model.
2. Conducting training courses for science teachers to train them on how to use and apply modern teaching models in the classroom that align with the developments in curricula.
3. Adopting the flexible thinking test as a reference test for the variable, which is useful in discovering the level of flexibility and spontaneity among students, enabling it to eliminate individual differences between students.

Suggestions:

1. Conducting a similar study that includes a training program using this teaching model.
2. Conducting a similar study using this model in other academic stages, especially the basic education stage or the preparatory stage.
3. A similar research study to clarify the importance of the model in other cognitive and thinking variables.

References (Arabic Sources):

1. Al-Murshid, Mohammed (2012). Flexible Thinking and the Fifth Dimension. Economic Electronic Posts.
2. Ibrahim, Bassam Abdullah Taha (2009). Learning Based on Real-Life Problems. 1st ed., Dar Al-Maseera, Amman.
3. Amtanius, Mikhail (1997). Measurement and Evaluation in Modern Education. Damascus University Publications, Syria.
4. Barakat, Ziad (2009). Mental Rigidity and Its Relationship with Problem-Solving Ability, Academic Achievement, and Gender among Basic and Secondary Stage Students (Master's Thesis), Al-Quds Open University, Tulkarm Educational Region.
5. Al-Jalabi, Sawsan Shakir (2005). Fundamentals of Constructing Psychological and Educational Tests and Scales. 1st ed., Alaa Al-Din Publishing and Distribution, Damascus, Syria.

6. Hammoud, Muthanna Faleh (2008). Holistic Thinking and Its Relationship to Idea Generation among University Students. Unpublished Master's Thesis, University of Baghdad, College of Arts.
7. Al-Khafaji, Haidar Neama Kadhim (2024). The Effect of the Triple Bridging Strategy on Mathematics Achievement and Flexible Thinking Skills among Second Intermediate Grade Students. Unpublished Master's Thesis, Al-Mustansiriyah University, College of Basic Education.
8. Al-Khalili, Amal Abdul Salam (2005). The Child and Thinking Skills. 1st ed., Dar Al-Safa for Publishing and Distribution, Amman, Jordan.
9. Al-Rabat, Baheera Shafiq Ibrahim (2015b). Modern Trends in Curriculum and Teaching Methods. 1st ed., Dar Al-Fikr Al-Arabi, Egypt.
10. Zair, Saad Ali & Sama Turki Dakhil (2016). Linguistic Skills Between Theory and Practice. Dar Al-Manhajiyyah for Publishing and Distribution, Amman.
11. Al-Sulaiman, Hani (2003). The Creative Personality. Dar Al-Maseera for Printing, Publishing and Distribution, Amman.
12. Al-Dhahir, Zakaria Mohammed et al. (1999). Principles of Measurement and Evaluation in Education. 1st ed., Dar Al-Thaqafa for Publishing and Distribution, Amman, Jordan.
13. Atta Allah, Haitham Youssef (2021). Flexible Thinking and Its Relationship with Negotiation among Iraqi Police Officers. Unpublished Master's Thesis, University of Baghdad, College of Arts, Department of Psychology.
14. Ghawi, Naseer & Al-Maayouf, Rafid Bahr (2011). The Effect of the Laboratory Model in Correcting Common Mathematical Misconceptions among First Intermediate Grade Students, Journal of Educational and Psychological Research, 8(29), pp. 311–341.
15. Qatami, Naifa (2009). Child Thinking and Intelligence. Dar Al-Maseera for Publishing, Distribution, and Printing, Amman, Jordan.
16. Al-Kadhimi, Hiyam Mahdi Jawad & Al-Aqabi, Ali Khazal Jabr (2023). The Effect of a Proposed Strategy Based on Realistic Mathematics Theory on Achievement and Mathematical Connectivity among Third Intermediate Grade Female Students, Journal of Educational and Psychological Research, 20(77), pp. 391–415.
17. Al-Kubaisi, Abdul Wahid Hameed (2010). Systemic Thinking: Its Employment in Learning and Teaching Derived from the Holy Quran. 1st ed., De Bono Publishing and Distribution, Amman, Jordan.
18. 2016 .(The Effectiveness of the Jigsaw Strategy on Achievement and Developing Flexible Thinking among Intermediate Stage Students in Mathematics, University of Sharjah Journal for Humanities and Social Sciences, University of Anbar, Iraq.
19. Majeed, Abdul Hussein Razuqi & Yassin, Hamid Ayal (2012). Measurement and Evaluation for University Students. Al-Yamamah Library for Printing and Publishing, Baghdad, Iraq.
20. Al-Muflih, Abdullah (2008). Flexible Thinking Skills Course, The 16th Training Program, Ibn Baz Charity Project at Saud Al-Babtain Center for Heritage and Culture.
21. Naam, Fawzia (2016). Constructing a Test to Measure Flexible Thinking in Solving Mathematical Problems. Unpublished Master's Thesis, Faculty of Humanities and Social Sciences, Kasdi Merbah University, Algeria.

Foreign Resources: .22

23. Abdulalsalam, W. H., Ibrahim, Z. H., & Majeed, B.H. (2025). "Utilizing Machine Learning Techniques to Predict University Students' Digital Competence", International Journal of Engineering
24. Akpinar (2007) The Effec of DUAL Situated Learning Model on Students' Understanding of Photosynthesis and Respiration Concepts Journal of Baltic Science Education,6(3),16- 26
25. Glover, John A., Ronning, RoyceR., & Reynolds, Cecil R.(2013): Handbook of creativity USA New York: SpringeScience Business & Media.
26. Hassan, A. K. (2018). "Effect of the Fink model of active learning in lateral thinking and the achievement of mathematics students in mathematics", ALUSTATH JOURNAL FOR HUMAN AND SOCIAL SCIENCES, 224(3), pp. 63–88. doi:10.36473/ujhss.v224i3.
27. Jawad, L. F. (2022). Mathematical connection skills and their relationship with productive thinking among secondary school students. Periodicals of Engineering and Natural Sciences, 10(1), 421-430
28. Li , T.(2020).Use of Magic performance as a Schema Disruption Method to Facilitate Flexible Thiniking Skills and Creativity , The University of Georgia, Science Dirrect,journal homepage: www.elsivier.com/locate/tsc
29. Majeed, B.H., Hassan, A.K., Hammadi, S.S. (2023). "The Effect of Cognitive Modeling in Mathematics Achievement and Creative Intelligence for High School Students", International Journal
30. Majid, B. H. (2018) "Mathematical-procedural Knowledge ant its relation to logical-mathematical intelligence among students at the third stage in mathematics department", Journal Of Educational and Psychological Researches, 15 (58), pp. pp. 478-498
31. Passing.D.Eden.s.(2000):Improving the flexible thinking in Deaf and Hard heaving children with virtual Rea technology .ber llan university Israe.
32. She H., Lee Ch. Q.(2008).SCCR digital Learning System for Scientific Conceptual Change and Scientific Reasoning. Computer & Education Journal,. (51). 724-742. Retricved from: http://www.Sciencedirect.com
33. She, H (2004). Fostering Radical Conceptual Change through Dual- Situated Learning Model Journal of Research in science
34. Suhail, A.H., Faris, E.J., (2024). "The effectiveness of a proposed strategy in light of anchored instruetion learning on achievement among middle school students", Edelweiss Applied Science and Technology< 4(80), pp. 1252–1260
    a. Teaching, 2(41), 142-164

35. Tracy, F.; Betterini, W, Bronstein, S & Cohen, K. (2011): Flexible Thinking
36. Umbach,R,Raine,A,Ruben,C,&Portnoy,j.(2017).Neighborhood Disadvantage and Neuropsychological Function as part Mediaators of Race – Antisocial Relationship : A serial Medication Model. Journal of Quantitativ criminology.10.1007/s10940-017-9343-z
37. Yousif, M. R., Ameen, L. A., Jassim, B. M., & Majeed, B. H. (2024). "The Impact of Two Proposed Strategies Based on Active Learning on Students' Achievement at the Computer and Their Social Intelligence", International Journal of Engineering Pedagogy (iJEP), 14(1), pp. 39–49. doi: 10.3991/ijep.v14i1.47085
38. Zietsman, A.I. and Hewson P.W. "Effect of instruction using microcomputer simulation and conceptual change strategies on science learning' Journal in science Teaching, 1986 , 23(1) ,27-39