العدد 6 لسنة 2022 المجلة العراقية للبحوث الانسانية والاجتماعية والعلمية
No. 6 – Aug. 2022 Iraqi Journal of Humanitarian, Social and Scientific Research
Print- ISSN 2710-0952 E-ISSN 2790-1254

The effect of a strategy based on analogical thinking on developing divergent thinking among second-grade intermediate students

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Abstract

The aim of the current research is identify impact of a strategy based on analogical thinking on development divergent thinking of the second intermediate female grade students . In order to reach the goal, the researchers formulated two null hypotheses, and to verify the hypotheses of the research, an intentional sample of the second-grade students in the middle school in Al-Resala for girls in Mosul city for the academic year (2021-2022) was selected, numbering 101 students, divided into two divisions, one representing the experimental group and the other The control group is represented by (50, 51) female students respectively, and the two research groups were rewarded in the following variables (chronological age in months, the academic achievement of the parents, the general average, intelligence quotient, pre- divergent thinking test). The experimental group was taught according to an existing strategy on analogical thinking and the control group according to the usual method

The researchers prepared the necessary supplies for the research, namely defining the scientific material, and formulating the behavioral objectives of the material specified in the chapters (seventh, eighth, ninth, tenth) of the science book for the second intermediate class, and the teaching plans for teaching the experimental and control groups were prepared according to the strategy of the list of analogical thinking and the method Ordinary . With regard to tools, the researchers prepared a test for divergent thinking, and in its final form it consisted of (6) skills (associative fluency, intellectual fluency, form fluency, verbal fluency, automatic flexibility, adaptive flexibility of meanings), and the discriminatory strength and stability were calculated for him as his stability reached (0.81).The experiment was applied starting from the first semester of the academic year (2021-2022), as the pre-test for divergent thinking was conducted for the students of the research sample on (11/14/2021) and the experiment began on (15/11/2021) and continued for an entire semester with two lessons per week, to be a total The total lessons are (16) for each group. After completing the experiment, the tool (the dimensional divergent thinking test on 18/1/ 2022) was applied. When data was collected, analyzed and processed statistically by using the T-test for two independent and interrelated samples, the results showed the following:

1- There is a statistically significant difference at the level of significance (0.05) between the average degrees of divergent thinking (before - after) for the experimental group that was studied with a strategy based on analogical thinking.
2- There is a statistically significant difference at the level of significance (0.05) between the average scores of the experimental group that studied with a strategy based on analogical thinking and the control group that studied in the usual way in the divergent thinking test.
In light of the results of the research, the researchers came out with a number of conclusions, including the effectiveness of the analogical thinking strategy in developing divergent thinking among first-grade students in favor of the experimental group compared to the usual method. In teaching, including the strategy of analogical thinking, as well as the interest of book-writing committees to include biology books with intellectual and skill activities in a way that stimulates the energies of students and enhances their thinking skills in general and divergent thinking in particular. To complement the current research, the researchers put forward proposals for future research.
Keywords :strategy based on analogy thinking ,development, divergent thinking

أثر استراتيجية قائمة على التفكير التناظري في تنمية التفكير التباعدي لدى طالبات الصف الثاني المتوسط في مادة الأحياء

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الملخص

هدف البحث الحالي إلى معرفة أثر استراتيجية قائمة على التفكير التناظري في تنمية التفكير التباعدي لدى طالبات الصف الثاني المتوسط ، وللوصول إلى الهدف صاغ الباحثون فرضيتين صفريتين ، وللتحقق من فرضيات البحث تم اختيار عينة قصدية من طالبات الصف الثاني المتوسط في متوسطة الرسالة للبنات في مدينة الموصل للعام الدراسي (2021-2022) والبالغ عددها (101) طالبة ، توزعت على شعبتين احدهما تمثل المجموعة التجريبية والأخرى تمثل المجموعة الضابطة وبواقع (50، 51) طالبة على التوالي ، وكوفئت مجموعتي البحث في المتغيرات الأتية (العمر الزمني بالأشهر ، والتحصيل الدراسي للأبوبين ، والمعدل العام واختبار صالح زكي (للذكاء) ، واختبار التفكير التباعدي القبلي) وقد تم تدريس المجموعة التجريبية وفقاً لاستراتيجية قائمة على التفكير التناظري والمجموعة الضابطة وفقاً للطريقة الاعتيادية . قام الباحثون بتهيئة المستلزمات الضرورية للبحث والمتمثلة بتحديد المادة العلمية ، وصياغة الأغراض السلوكية للمادة المحددة بالفصول (السابع ، الثامن ، التاسع ، العاشر) من كتاب العلوم لصف الثاني المتوسط ، كما تم إعداد الخطط التدريسية الخاصة بتدريس المجموعتين التجريبية والضابطة وذلك وفقاً لاستراتيجية قائمة التفكير التناظري والطريقة الاعتيادية. وفيما يتعلق بأدوات ، فقد أعد الباحثون اختبارا للتفكير التباعدي و تكون بصيغته النهائية من (6) مهارات (الطلاقة الارتباطية ، الطلاقة الفكرية ، طلاقة الأشكال ، الطلاقة اللفظية، المرونة التلقائية ، المرونة التكيفية للمعاني) ، وتم حساب القوة التمييزية والثبات له إذ بلغ ثباته (0.81) . طبقت التجربة بدءً من الفصل الأول للعام الدراسي (2021-2022) إذ تم إجراء الاختبار القبلي للتفكير التباعدي لطالبات عينة البحث بتاريخ (2021/11/14) وبدأت التجربة بتاريخ (2021/11/15) واستمرت فصلاً دراسياً كاملاً بواقع حصتين بالأسبوع ليكون

مجموع الحصص الدراسية الكلية (16) حصة لكل مجموعة ، وبعد الانتهاء من التجربة تم تطبيق الاداة (اختبار التفكير التباعدي البعدي بتاريخ (18/ 1/ 2022) وعند جمع البيانات وتحليلها ومعالجتها احصائياً باستعمال الاختبار التائي لعينتين مستقلتين ومترابطتين اظهرت النتائج ما يلي :

1- يوجد فرق ذو دلالة إحصائية عند مستوى دلالة (0.05) بين متوسطي درجات التفكير التباعدي (القبلي- البعدي) للمجموعة التجريبية التي درست باستراتيجية قائمة على التفكير التناظري

2- يوجد فرق ذو دلالة إحصائية عند مستوى دلالة (0.05) بين متوسط تنمية درجات المجموعة التجريبية التي درست باستراتيجية قائمة على التفكير التناظري والمجموعة الضابطة التي درست بالطريقة الاعتيادية في اختبار التفكير التباعدي .

وفي ضوء نتائج البحث خرج الباحثون بعدد من الاستنتاجات منها فاعلية استراتيجية التفكير التناظري في تنمية التفكير التباعدي لدى طالبات الصف الاول المتوسط لصالح المجموعة التجريبية مقارنة بالطريقة الاعتيادية ، كما أوصى الباحثون بعدد من التوصيات منها اقامه دورات تدريبية لمدرسين ومدرسات مادة الأحياء للمرحلة المتوسطة على استخدام الاستراتيجيات الحديثة في تدريس ومنها استراتيجية التفكير التناظري ، وكذلك اهتمام لجان تأليف الكتب بتضمين كتب الاحياء انشطة فكرية ومهارية بما يحفز طاقات الطالبات ويعزز لديهن مهارات التفكير بشكل عام والتفكير التباعدي بشكل خاص واستكمالاً للبحث الحالي وضع الباحثون مقترحات لبحوث مستقبلية

الكلمات المفتاحية : استراتيجية قائمة على التفكير التناظري ، التنمية ، التفكير التباعدي

First: the research problem

Our current era has witnessed great and rapid progress in the scientific and technological field and the emergence of many research and studies in the field of education. This led to the development of philosophical educational thought, as it is no longer acceptable to adhere to traditional teaching methods because they cannot meet the needs of the learner with the existence of a systematic book that contains a huge amount of Rather, the real challenge for education today is to prepare the student who is able to face the future and interact positively with its changes and developments, and this is reflected in the way science is presented to students and what it contains of concepts, facts and theories...etc.

(Ali, 2006: 4)

Through the researcher's modest experience, he conducted an interview with some of the teachers of biology to find out their opinions and ask them about the problems they face in teaching biology for the second intermediate grade. It is in the textbook for the sake of female students reaching success only, and that many teachers do not have the desire to change their teaching methods.

We suffer from the reality of teaching in our schools, which still prefers memorization and neglects the use and development of thinking. Therefore, there has become an urgent and great need to learn the methods of thinking, including analogical thinking skills to be used in our daily lives in order to be in line with the importance, objectives and nature of the biology subject and with the reality of renewable life and the requirements of the times.

The researchers was also briefed on a number of modern educational methods and models and learning strategies in his desire to develop and learn thinking among the students, and among these strategies is the analogical thinking strategy because it depends on the interaction between the school and the

students in the classroom and the diversity in the activities of comparison, application, conclusion and discussion practiced by the students in the classroom as indicated It was referred to previous studies such as the study (Al-Hashimi 2016), the study (Al-Rahim 2017), and the study (Al-Asadi 2018). The researchers decided to choose a modern strategy to develop the reality of teaching and to try to develop divergent thinking among second-grade middle school students.

fore, the problem of the current research was determined by the following question:

Q/ What is the impact of a strategy based on analogical thinking in developing divergent thinking among female students of the second intermediate grade?

Second :the importance of research

Education has an important and fundamental role in the scientific and technical development that our world is experiencing in this era. It seeks to raise a productive individual equipped with knowledge, skills and individual capabilities that motivate him to actively participate in serving the community in which he lives, and thus is the main engine for all progress and development witnessed by the community, and for education to strive to achieve Its objectives must be a scientific education that works to provide the student with information and functional concepts and to develop his basic skills, scientific trends and ways of thinking, which makes him able to understand the environment around him and to face the problems he is exposed to and try to solve them according to a sound scientific approach and in multiple ways and methods.

(Al-Abayji, 2002: 111)

Accordingly, education has become the main focus when understanding its nature in the field of scientific education, and the contents of scientific education in terms of strategies, contents, textbooks, teacher preparation and evaluation of the educational process. Science and the use of the teaching method that makes the student the focus of the educational process

(Ambo Saidi and Suleiman, 2011: 17)

On this basis and as a result of the great progress in research in the field of psychological and educational sciences, modern methods, methods and strategies have been developed to overcome difficulties and achieve the desired educational goals of the learning process. It is based on theories of learning, including constructivism, in which the process of acquiring knowledge is an active and continuous process, and the student is the focus of the educational process.

One of the most important of these strategies emanating from the constructivist theory is the analogical thinking strategy, which represents an effective tool in facilitating the process of building knowledge that the student performs on the basis of the concepts he learns and available in his knowledge environment.

(Zaytoun Kamal, 2002: 255)

The importance of using thinking strategies in education may be due to the importance of constructivist philosophy. In this philosophy or theory, the learner builds knowledge by himself, and modifying the learner's misunderstanding is one of the basic principles of this philosophy. The analogical thinking strategy has been developed on the basis of theoretical considerations and empirical results conducted on analogical thinking and analytical studies conducted on the use of analogies.

(Duit 1991:627)

Symmetryappears to be very important in children's thinking, as (Halford and Goswami) have emphasized. Children often use symmetries from well-known domains as a way to fill in gaps in their knowledge of other domains. For example, Inagaki & Hatano asked (Inagaki & Hatano 1987), for example. Five-year-olds hypothetical questions such as (What would happen if the rabbit was given more water continuously), and most of the children answered using human symmetry, and they said (If I keep drinking water, I will get sick and I think the rabbit will be too), and the children's response is clear and easily when it is The symmetries are more human-like than the dissimilar ones (Wali, 2015: 34-37)

This encouraged the researchers to choose the analogical thinking strategy, as it is suitable for the age and modern stage, and it can be applied using analogies.

It has become a duty to teach thinking and the ability to use logical analysis of problems, as it teaches and develops the student's acquisition of information, using his experiences and information to the strongest and farthest extent when interacting with himself. (Al-Douri, 2009: 95)

Divergent thinking, as one of the types of thinking, aims to find new, different or unknown solutions by the learner to certain problems, and it includes a new consistency of ideas.(Mohammed, 222:2004)

One of the features of this type of thinking is the production of old ideas in new relationships. It is flexible thinking that takes multiple directions, not one direction, and goes beyond obvious, obvious things to searching for possible remote and indirect results, possibilities and many solutions to a single problem. It is represented in situations that allow several correct answers.

(Al-Ajili, 2009. 77)

Many studies and research have been conducted on divergent thinking aimed at developing students' thinking and in different study subjects (Al-Jabali, 2012) in history,(Al-Obaidi, 2020) in chemistry, and (Al-Jubouri, 2019) in geography

The researchers thought that he should be interested in divergent thinking in this research and try to develop it among second-grade students in the middle school in biology.

From the above, the importance of the current research can be determined by several points:

1- The concordance of the analogical thinking strategy with the modern educational trends that seek to test the modern active learning strategy in learning
2- Providing educational institutions with thinking tests in general and the divergent thinking test in particular
3- The current research helps middle school biology teachers in giving them the steps of the Analogous Thinking strategy and encouraging them to use it
4- This research contributes to developing the students' divergent thinking skills and helping them to interpret the matters of their daily lives, due to the connection of divergent thinking in daily life and the problems it contains, making decisions and planning for the future.

Third: The aim of the research

The current research aims to identify:
The effect of a strategy based on analogical thinking on the development of divergent thinking among second-grade students in middle school in biology.

Fourth: the research hypotheses

1. There is no statistically significant difference at the level of significance (0.05) between the average degrees of divergent thinking (before - after) for the experimental group that was studied with the analogical thinking strategy.
2. There is no statistically significant difference at the significance level (0.05) between the average scores of the experimental group that studied with the Analog Thinking List strategy and the control group that studied in the usual way in the divergent thinking test

Fifth: Limitation of the Research

The current research is determined by the following:
1. Human limits: second-grade middle school students in middle and secondary day schools for girls in the city of Mosul for the academic year (2021-2022).
2. Time limits: the first semester of the academic year (2021-2022) AD.
3. Cognitive limits: the scientific subject to be taught to the students of the second intermediate grade, which is:
• Chapter Seven (Kingdom of Protests and Kingdom of Fungi)
• Chapter Eight (Kingdom of Plants)
• Chapter Nine (Kingdom of Animals)
• Chapter Ten (Environmental System)

Sixth: Definition of Basic terms

Effect

It is defined by:
1- Shehata and Zeinab (2003)
The result of a desirable or undesirable change that occurs in the learner as a result of the learning process. (Shehata and Zainab, 2003: 22)
2- Ibrahim (2009)

"The ability of the individual under study to achieve a positive result, but if this result is not achieved, the individual may be one of the direct causes of negative repercussions." (Ibrahim, 2009:30)

The researchers defines the procedural effect as: the change in divergent thinking among the second-grade students of the middle class of the experimental group after being taught by (the Analog Thinking List Strategy) and it is measured by the scores obtained by the students in the divergent thinking test, tribal and dimensional, which was prepared by the researchers.

Analogy thinking strategy

It is defined by

1- Qatami (2016)

Making comparisons and finding similarities between two mutually exclusive things to help students make relationships between concepts(Qatami, 2016: 735)

2- Razouki and Muhammad (2018)

A mental process that helps students to reach knowledge by generating ideas, analyzing them and simulating them, and then knowing the relationship between two fields, one of which is called the basic field, and the other the strange field, and by using the means of observation that expresses the solid relationship between the two fields. (Razuqi and Muhammad, 2018: 53)

The researchers defines them procedurally: as sequential steps used by the researchers (the teacher) in teaching biology subjects for the second intermediate grade, the purpose of which is to find similarities and differences between two concepts, one of the subject of the lesson and the other presented by the students of the experimental group according to organized and sequential steps that help the students to give ideas, brainstorm and discuss their ideas collectively.

development

It is defined by

1- Ahmed (2009)

"The positive change that is achieved as a result of the worker's use, which was previously identified and planned, and this change can be measured by achievement tests, observation tools, or other evaluation methods."

(Ahmed, 2009: 157)

2- Zayer & Wasma (2015)

The amount of cognitive growth and development of learners due to their exposure to effective educational variables (Zayer& Wasma, 2015:157)

The researchers defines procedural development: the change in the level of divergent thinking among the students of the experimental group who studied according to the strategy of the list of analogical thinking, which is statistically inferred by the difference between the two tests (pre- and post-test).

Thinking

It is defined by

1- Kuhn (2006):

"The organized thinking that students use when explaining the reasons behind things and trying to know the results of actions, but it is more than just identifying the causes or results, and it means obtaining evidence that supports, proves or denies the point of view."
(Kuhn2006:173)
2- Jarwan (2013)
It is a series of mental activities that the brain performs when exposed to a stimulus that is received by one of the five senses (sight, smell, taste, touch, hearing, and thinking in its broad sense, a process of searching for meaning in situations or experiences.

Divergent thinking

It is defined by
1- Guilford(1959)
Mental abilities represented in the person's production of information and multiple and varied responses characterized by fluency, flexibility and originality in ideas as a result of exposure to stimuli presented to him.
(Meeker 1969:2)
2- Razuqi and Istabraq (2019)
The ability of the learner to produce as many original and unfamiliar ideas as possible about the problem he is exposed to. (Razooki and it takes, 2019: 27)
And the researchers adopts the theoretical definition of Guilford (1959) for divergent thinking
The researchers defines divergent thinking procedurally as: the ability of the second intermediate grade student to produce the largest number of unfamiliar ideas and the flexibility of ideas and their adaptation to meanings that appear in the student's answer to the divergent thinking test prepared by the researchers for this purpose.

Theoretical framework

Constructivism Theory

The origin of constructivism is one of the intellectual doctrines, as it formed the revolution of application and research within human studies, especially social, and the way to deal with knowledge and how to acquire it. Learner knowledge in a real social atmosphere helps to acquire concepts through his self-activity and its integration with cognitive structures
(Atiya, 2015: 88)
Archen Walsh defined it as the method by which the student acquires, processes, develops and uses cognitive processes in similar life-like cognitive situations.
(Bichard, 1997:12)

Analog thinking strategy

Analogous thinking strategy is an old educational strategy, but recently educators have based it on the ideas of the theory that confirms that the student's role is active in building his knowledge through his previous experience. And man concludes a similarity or symmetry in his inventions to what is observed in

his surroundings in which he lives, as in the invention of the airplane in a way that corresponds to the shape of a living bird. Analogous thinking in teaching depends on random excitement and the generation of new ideas by discovering relationships between previous knowledge and new experience that do not have a visible relationship between them and previous experience, but rather discover by thinking by searching for a relationship between the suspect (the content of the lesson) and the suspect (known from the learner).

(Qatami, 726:2016) (Atiya, 211:2009)

Of course, the analogical thinking strategy seeks to develop students' mental processes, and that the student (the learner) seeks to employ something familiar and known in which a kind of difficulty and abstraction (similarity), which makes the learning process popular with students because analogies connect the learners to their lives or the environment. surrounding them and help the teacher to teach the topics of the nature of science.

(Al-Masoudi 18:2014)

Assumptions of Analogous Thinking Strategy

1. Analogous thinking results in creative ideas and discoveries
2. The student's thinking is differential thinking to form initial connections with the information presented to him
3. The learner is the center of the learning process and his role is positive and active

(Qatami, 729:2016)

4. Analogous thinking is generative thinking and the synonym of analogy is productive thinking for living analogies.
5. Analog thinking is an aggregate thinking of what exists and arriving at new things
6. For every known analogy, there is a similarity to it in the learner's thoughts and the possibility of generating new analogies between concepts.
7. Analogous thinking strategy is used in teaching various educational subjects such as science, mathematics, literature and others.

(Al-Asadi, 18:2018) (Al-Rahim, 48:2017)

Advantages of Analogous Thinking Strategy

1- To provide a visual perception of what is present
2- It works to explain scientific phenomena in a way that suits the minds of the educated.
3- It works to develop the ability to solve problems and treat difficulties according to scientific controls
4- This strategy belongs to the strategies of creative learning and learning critical thinking
5- It helps to develop learners' visual spatial intelligence

6- It works to develop the mental processes of the learners because they seek to employ something known and familiar to something that has a kind of difficulty and innovation.
(AL-Lulu, 2006: 14) (Al Hashemi, 2016: 62)

One of the creative thinking strategies is brainstorming, which is a set of educational moves planned by the teacher that stimulates learners' thinking. Brainstorming also allows to generate a large number of ideas automatically, and in an atmosphere of freedom and safety that stimulates learners to think analytically, critically and creatively. (Al-Sir et al., 142:2021)

Brainstorming has played a major role in analogical thinking plans, as the researchers used it as an important step for collecting and organizing ideas and as a springboard for imagination that helps generate students' ideas, as they are the main element in the educational process.

Analog thinking strategy steps

1. Introducing the new concept we want to teach
2. Identify a familiar and meaningful concept that has the same characteristics as the new concept and review it with students
3. Brainstorm the similarities of the old and new concept
4. Another brainstorming for the differences between the old and new concept
5. Discuss topics that show similarities between the two concepts
6. We ask the students to write the similarities between the old and new concepts, then draw a summary of the topic and complete the explanation of the elements of the topic

(Qatami, 725: 2016)

The teacher's role in the analogical thinking strategy

1. Defining precisely the steps involved in analogical thinking
2. Using symmetry in an interactive way that matches the educational content and knowledge of students

(Qatami, 735.2016)

3. Stimulate imagination and encourage students to think analogously about different topics
4. Encouraging students to build their own symmetry, taking into account the limitations of using this symmetry and providing feedback

(The Merciful, 2017:49)

5. Discussing students' answers and listening to their opinions, and emphasizing that there are no wrong answers
6. Use a graphic representation of the lesson topic to help students think and remember
7. It encourages cooperative learning among students

(Al-Asadi, 20:2018)

The student's role in the analogical thinking strategy

1. The student is more aware of his own operations. Which increases his ability to think about how, when, what and why

2. The student plays a key role in linking his previous experiences with the new one by making comparisons and drawing conclusions
3. Using symmetry to solve the problems encountered
(Left, 19:2014)
4. He participates with his peers in thinking and works with the principle of group learning
5. Student self-reinforcement under the guidance of the teacher during the exercise of thinking
6. The student is curious about knowledge

(Al-Asadi, 20:2018)

Divergent thinking:

It is a type of thinking and it is sometimes called the starting thinking, and it is the thinking that is characterized by focusing on the diversity of outcomes and their quality. Divergent thinking, as Guilford sees it, includes the production of new information, and the generation of new information from given information.

(Qatami, 2003, p. 22)

Spearman, who is the first to distinguish between divergent thinking and convergent thinking by means of measurement, believes that divergent thinking (free or absolute) is measured using its own tests that require the learner (examined) independence in thinking and uniqueness in the test of creative answers with originality and excellence, while convergent thinking is Narrow and limited thinking, measured using traditional general intelligence tests, which require the learner (examined) to determine specific and correct answers to specific paragraphs or direct questions. (Razooki and Istabraq, 2019: 21)

Principles of Divergent Thinking:

1- The principle of postponing judgment: It is a basic principle in divergent thinking. This principle recommends postponing judgment and evaluation until the completion of generating a large number of alternatives.

2- The principle of striving for the largest number of ideas: This principle emphasizes the quest to generate the largest number of ideas and alternatives, which increases the possibility of the existence of original and distinct ideas.

(Khalil, 2007: 22)

3- The starting principle: writing down all the ideas that come to mind, whether they are useful, useless or illogical, that is, encouraging learners to put forward unfamiliar ideas. (Jarwan, 2002: 285)

4- The principle of adding to the ideas of others: that is, add something to the ideas of others, and this principle encourages interest in the ideas proposed by others in the problem-solving process, and thus may be able to reach original ideas, by merging ideas and deducing various ideas. (Ahmed et al. 2011: 50-56)

Divergent thinking skills (abilities)

First: fluency

Fluency is one of the most prominent components of divergent thinking, and it represents providing the largest number of appropriate responses to a problem

in a specific period of time (Al-Khalidi, 2008: 60), and it can be quantitatively determined by the number of responses provided by the learner, and it can be measured by calculating the amount of ideas that were given. Learner about a specific topic in a specific period of time

(Al-Ayasra, 2011::116)

Fluency is classified into four types:

1- Relational Fluency: This skill represents the divergent production between meanings such as the relationship of similarity and contrast or the part or the whole, that is, the learner's ability to recall the largest possible number of words that are related to a particular word or fulfill specific conditions in terms of meaning.

(Razooki and Istabraq, 2019. 52)

2- Intellectual fluency: Idea fluency refers to the learner's ability to produce the largest possible number of ideas in a specific period of time, regardless of the type or level of these ideas or aspects of seriousness in them. Examples include putting forward many ideas for a problem or writing the largest number of titles On the topic of a story or article.

(Abdulaziz, 2007: 86)

3- Fluency in shapes: Shapes fluency represents the learner's ability to quickly draw a number of shapes and details or add modifications to visual stimuli such as drawn shapes, that is, provide some additions to certain shapes to form real drawings.

(AL-Zayyat 2009: 55)

4- Verbal fluency: It represents the learner's ability to reach the largest possible number of sentences or words with different meanings, such as writing the largest number of words that begin with a certain letter or writing a number of phrases consisting of words each beginning with the letter B.

(Al-Jazan, 2002: 32)

Second: flexibility

Flexibility refers to the skill that is used to produce various patterns of thinking, and this skill develops the learner's ability to transfer these patterns and change the direction of thinking and move from normal thinking processes to response and reaction and perceive things in a variety of different ways (Al-Ayasra, 2011: 346).

Flexibility is divided into two types:

1- Automatic flexibility:

It means the ability of the quick learner to produce the largest possible number of ideas related to a particular problem or situation.

(H.E., 2006: 291)

2- Adaptive flexibility:

Adaptive fluency represents the learner's ability to change the mental direction in which he looks at solving a problem, for the purpose of arriving at new and diverse solutions. (SalaHdin 2006: 95)

Relative studies :

The first axis: studies related to the strategy of analogical thinking

1. Al-Hashimi's study (2016): The effect of teaching by guided imagery using the analogical thinking strategy on the achievement of the subject of environmental science, pollution and reflective thinking among students of the College of Basic Education

❖ The aim of the study: To identify the effect of teaching by guided imagination with the analogical thinking strategy on the achievement of the subject of environmental science, pollution and reflective thinking among the students of the College of Basic Education.

❖ Place of study: Iraq

❖ The study sample: 60 male and female students from the third stage / College of Basic Education were divided into three groups (two experimental groups, one group and a control group).

❖ Design: Three-group micro-adjustment design

❖ Study tool: achievement test and reflective thinking test

❖ The statistical methods used: Pearson correlation coefficient, difficulty equations, discrimination coefficient, effectiveness of wrong alternatives, t-test for two independent samples, Cooper's equation, Tukey's equation, Alpha-Krumbach equation

2. Al-Rahim Study (2017): The effect of the analogical thinking strategy on the achievement of second-grade female students in middle school in biology and the development of their environmental awareness

❖ The aim of the study: to identify the impact of the analogical thinking strategy on the achievement of second-grade female students in middle school in biology and the development of their environmental awareness.

❖ Place of study: Iraq

❖ The study sample: 54 female students from the second intermediate grade, divided into two groups (experimental and control).

❖ Design: The design of the two groups (experimental and control) with partial control

❖ Study tool: achievement test and environmental survey scale

❖ Statistical tools used: the statistical package (SPSS).

❖ Results of the study: The researchers concluded that the adoption of the analogical thinking strategy has an impact on raising the level of achievement of the experimental group students.

The second axis: studies related to the divergent thinking test

1. Al-Naqa and Abu Odeh (2016): The effect of using the problem-solving strategy in developing divergent thinking skills in science for the ninth grade female students.

❖ Objective of the study: To identify the effect of using problem-solving strategy in developing divergent thinking skills in science for the ninth grade students.
❖ Place of study: Palestine
❖ The sample of the study: 20 female students of the ninth grade
❖ Design: One-case group design (before - after)
❖ Study Tool: Divergent Thinking Test
❖ Statistical tools used: SPSS statistical package
❖ Results of the study: The experimental group that studied with the problem-solving strategy in the divergent thinking test outperformed the control group that studied in the usual way.

2. Abbas study (2018): The effectiveness of the Stepanz model in divergent thinking among fifth-grade students in biology in the subject of biology
❖ Objective of the study: To identify the effectiveness of the Stepanz model in divergent thinking among female students of the fifth biological sciences in the subject of biology Place of study: Iraq
❖ The sample of the study: 74 female students of the fifth scientific grade, divided into two groups (experimental and control).
❖ Design: The design of the two groups (experimental and control) with partial control
❖ Study Tool: Divergent Thinking Test
❖ Statistical methods used: t-test for two independent samples, t-test for two correlated samples, chi-square, Pearson correlation coefficient, Alpha Cronbach equation, Baycerreal coefficient
❖ Results of the study: The researchers concluded that there is a statistically significant difference in the divergent thinking test in favor of the experimental group students

Research Methodology and Procedures

First: Experimental design

The researchers adopted the experimental design known as equivalent groups design with two tests (Best Khan 2006:177), and took the first group as an experimental group and studied using a strategy based on analogical thinking, while the second group is the control group and was taught using the usual method . As shown in Figure (1).

group	parity	independent variable	dependent variable	post test
Experimental	1-Chronological age 2- Intelligence 3-Previous collection	strategy based on analogical thinking	Divergent Thinking	Divergent Thinking Test
control		the usual way		

Figure No. (1)

Second: Defining the research community Population of the research

The research community is meant as a group of individuals who have data on the phenomenon on which we are allowed to conduct the study

(Abu Saleh 2009:252)

The research community consisted of all female students of the second intermediate grade of middle and secondary day schools in the city of Mosul for the academic year (2021/2022).

Third: Selecting a sample of the research

Part of the original community chosen by the researchers in different ways, and it includes a number of individuals from the original community (Al-Duailej: 2010: 91) so that the results of that sample can be generalized to the entire community and make inferences about the features of the community (Abbas et al., 2012: 218), as the researchers was intentionally intentionally on the message medium for girls, the two research groups were randomly selected from a total of six divisions, as Division (B) was chosen to represent the experimental group studying biology according to a strategy based on analogical thinking, and their number was (55) female students, and Division (D) to represent the control group that was studying the same subject in the usual way, and their number was (57) students. Five failed students from Division (B) and six students from Division (D) were statistically excluded because they had previous experience from last year.

Table No. (2) Number of research sample members

	Division	the group	Teaching method	Number of students	the excluded	Final number of students	total summation
1	B	experimental	strategy based on analogical thinking	55	5	50	101
2	D	control	the usual way	57	6	51	

research results

First: the results related to the first null hypothesis, which states the following:

There is no statistically significant difference at the level of significance (0.05) between the average degrees of divergent thinking (before - after) for the experimental group that was studied with a strategy based on analogical thinking.

The scores of development of divergent thinking for the experimental group were calculated by the degree of difference between the two tests (pre- and post-test) for each student of the experimental group.

For the purpose of verifying this hypothesis, the researchers extracted the arithmetic mean and standard deviation of the divergent thinking test scores for the experimental group. Then a t-test was applied to two correlated samples, and the results were included in Table (3).

Table (3)

The t-test results for the mean and standard deviation

For the experimental group in the divergent thinking test (before - after)

divergent thinking	**the number**	**Average arithmetic**	**standard deviation**	**T value**		**Statistical significance at the 0.05 . significance level**
before	50	29.3600	2.97445	**calculated**	**tabular**	**Statistically significant**
after		37.8800	4.93897	14.164	2.011 (0.05) (49)	

By noting the table (4) above, we find that the calculated (t) value amounted to (9.972), which is greater than the tabular (t) value of (1.987) at the significance level (0.05) and the degree of freedom (99), and this indicates the existence of a significant difference Statistically in developing the divergent thinking test between the students of the experimental and control group and in favor of the experimental group, and thus rejects the fourth null hypothesis and accepts the alternative hypothesis and states that "there is a statistically significant difference at the level of significance (0.05) between the mean scores of the divergent thinking test for the students of the experimental group who I studied according to the analogical thinking strategy, and the students of the control group who studied according to the usual method" in favor of the experimental group

Effect size:

To clarify the effect size equation for the independent variable (a strategy based on analogue thinking) in the dependent variable (divergent thinking), as the effect size equation d) was adopted according to (Cohen 1988) coefficient for the independent variable in the dependent variable as in Table (5)

Table (5) The value of the effect size (d) and the effect of a strategy based on analogical thinking in the divergent thinking test

the group	Average arithmetic	standard deviation	The difference between the two averages	Weighted standard deviation	Cohen	indication (05,0)
experimental	8.5200	4.25340	7.6769	3.85115	1.9	big
	0.8431	3.44890				

It is clear from the table (5) above that we note that the value (d) represents the size of the effect, which amounted to (1.9), which is an appropriate value to explain the size of the effect by a large amount for a strategy variable based on symmetrical thinking in the divergent thinking test according to the gradient set by (Cohen, 1988). Which indicated that the size of the effect is large, as indicated by Howell, 2010) and according to the table (Table (6)).

Evaluate the effect size and evaluate its size

Evaluate the size of the effect	Values (deffect size
young	0.2and less
Average	0.5
big	0.8and above

(Howell, 2010 :230)

The researchers attributes this result to the following reasons:

1- The researchers' use of simple and uncomplicated analogies that are close to the learning environment contributed greatly to the development of divergent thinking among them.

2- The effectiveness of the Analog Thinking List strategy by employing educational methods used to stimulate thinking among students through the stages of brainstorming, which is one of the steps of the Analog Thinking strategy, which helped the students to release ideas.

The result of the current research agreed with the study (Al-Naqla and Abu Odeh, 2016), and study (Abbas, 2018).

Conclusions, recommendations and suggestions

Conclusions

❖ The effectiveness of the Analogous Thinking List strategy in developing divergent thinking among second-grade intermediate students.

❖ Teaching using the analogical thinking list strategy is compatible with the objectives of teaching biology in terms of the content and organization of learning, and giving the student a key role in the educational process, and this is what modern education calls for.

❖ A strategy based on analogical thinking is a modern strategy in line with the development of biology in the world.

Recommendations:

❖ The importance of using modern models and strategies, especially the Analog Thinking List strategy, in teaching biology and developing divergent thinking.

❖ Urging the curriculum developers to develop different exciting thinking activities for students to help develop divergent thinking skills.

Suggestions:

❖ The effect of a strategy based on asymmetrical thinking on the achievement of second-grade female students in the middle school in biology and the development of their pivotal thinking

❖ The effect of the analogical thinking strategy on understanding and retaining scientific concepts for fourth-grade students of science

References

1. Ibrahim, Bassam Abdullah Taha (2009): **Learning based on life problems and the development of thinking**, 1st Edition, Dar Al Masirah for Printing and Publishing, Amman, Jordan

2. Abu Saleh, Muhammad Sobhi (2009): **Statistical Methods**, Arabic Edition, Al-Yazuri Scientific Publishing and Distribution House, Amman, Jordan.

3. Ahmed, Abu Saud Muhammad, and Samir Muhammad Yusuf Izz al-Din, Muhammad Abd al-Raouf Saber al-Attar (2011): **Thinking of the Six Hats in Science**, 1st Edition, Debono for printing, publishing and distribution, Jordan

4. Al-Asadi, Ahmed Mahdi Abdel-Saheb (2018): The effect of the analogical thinking strategy on the achievement and inferential thinking of first-grade students in mathematics in mathematics (**unpublished master's thesis**) University of Baghdad, College of Education / Ibn Al-Haytham, Department of Educational and Psychological Sciences, Iraq.

5. Ambo Saidi, Abdullah Bin Khamis and Suleiman Al Balushi (2011): **Methods of Teaching Science, Educational Concepts and Applications**, 2nd Edition, Dar Al Masirah for Printing, Publishing and Distribution, Amman, Jordan

6. Al-Jabali, Imad Abdel Wahed (2013): The effect of teaching with a strategy (PLAN) on divergent thinking among fifth-grade literary students in European history (**unpublished master's thesis**), College of Education, University of Al-Qadisiyah, Iraq

7. Al-Jubouri, Mahmoud Khalil Hamad (2019): The effect of a training program based on the scamper strategy in developing divergent thinking among second-grade students in the subject of geography and their attitudes towards it,

(**unpublished doctoral thesis**), College of Education for Human Sciences, Tikrit University, Iraq
8. Jarwan Fathi Abdel Rahman (2002**): Creativity, its concept, standards, theories, measurement, training, stages of the creative process**, 1st edition, Dar Al-Fikr for printing, publishing and distribution, Amman, Jordan.
9. Al-Hizan, Abdullah bin Ibrahim (2002**): Overviews on Creative Thinking**, 1st Edition, King Fahd National Library, Saudi Arabia.
10. The trick, Muhammad Mahmoud, (2012): **Design theory and practice**, Fifth Edition, Dar Al Masirah for Publishing, Distribution and Printing, Amman - Jordan.
11. Al-Khaza'leh, Muhammad Suleiman and others (2011**): Effective Teaching Methods**, 1st Edition, Da Safaa for Publishing and Distribution, Amman, Jordan
12. Khalil, Kamal Muhammad (2007): **Divergent Thinking Skills, an empirical study**, 1st Edition, Dar Al-Manhaj for Publishing and Distribution, Amman, Jordan.
13. Dahlan, Omar Ali (2014): **The teacher increased in teaching and learning**, 3rd edition, Dar Al-Shorouk, Amman, Jordan
14. Al-Duailej, Ibrahim bin Abdulaziz (2010**): Methods and Methods of Scientific Research**, Dar Safaa for Publishing and Distribution
15. Al-Douri, Ali Hussein (2009): The **Principles of Education in the Modern Curriculum**, 1st Edition, Ithra Publishing, Jordan
16. Al-Rahim, Abdul-Razzaq Jawad Ibrahim (2016): The effect of the analogical thinking strategy on the achievement of second-grade intermediate students in biology and the development of their environmental awareness, (**unpublished master's thesis**), College of Basic Education, University of Babylon, Iraq
17. Razouki, Raad Mahdi, Nabil Rafiq Muhammad (2008): **Thinking and its patterns** (Part V), I 1, Dar Al-Kutub Al-Ilmiyya, Amman, Jordan
18. Razouki, Raad Mahdi and Istabraq Majid Ali Latif (2019): **Series of Thinking and its Patterns**, 1st Edition, Dar Al-Kutub Al-Ilmiyya, Beirut, Lebanon
19. Zayer, Saad Ali, Sama Turki Dakhl (2015): **Modern trends in tampering with the Arabic language**, 1st edition, House of Methodology for Publishing and Distribution, Amman, Jordan.
20. Al-Zayyat, Fatima Mahmoud (2009): **Creative Psychology**, Dar Al-Masira for Publishing, Distribution and Printing, Amman, Jordan.
21. Zytoun, Kamal (2004) "**Teaching Science to Understanding is a Constructive Concept**", 1st Edition, Alam Al-Kutub, Cairo, Egypt
22. Al-Sir, Khaled Khamis, Omar Ali, Iyad Ibrahim (2021) **Contemporary Strategies in Teaching and their Scientific** Applications,drkhaledkhelserr@hotmail.com Al-Aqsa University, Gaza, Palestine

23. Saadeh, Judah Akhmed et al. (2006): **Active learning between theory and practice**, 1st edition, Dar Al-Shorouk for Printing and Publishing, Amman, Jordan.
24. Shehata, Hassan, Zainab Al-Najjar (2011): **A Dictionary of Educational and Psychological Terms**, 2nd Edition, Dar Al Masreya Al-Lebanon, Cairo, Egypt
25. Salah El-Din, Arafa Mahmoud (2006): **Thinking Without Borders**, 1st Edition, World of Books for Publishing, Distribution and Printing, Cairo, Egypt
26. Abbas,hopefull senseYen (2018): " activeye model sixyaBget off(Stepan) on divergent thinking among fifth-grade biological science students in biology" (**unpublished master's thesis**), College of Education, University of Al-Qadisiyah, Iraq
27. Abbas, Muhammad Khalil and others, (2012), **Introduction to Research Methods in Education and Psychology**, 4th edition, Dar Al Masirah for Publishing, Distribution and Printing, Amman.–Jordan.
28. Al-Abayji, Amal Fattah (2002). A balancing study of the scientific trends of middle school students, **Journal of Teachers College**, Al-Mustansiriya University, No. 35, Baghdad.
29. Abdel Aziz, Saeed (2007): **Teaching thinking and its skills - exercises and practical applications**, 1st edition, Dar Al-Thaqafa for Publishing and Distribution, Amman, Jordan.
30. Al-Obaidi, Elaf Saad Ahmed, (2020): The effect of the jar-filling strategy on the achievement of chemistry and divergent thinking among first-grade intermediate students, (**unpublished message)**, College of Education for Pure Sciences / Department of Chemistry, Ibn Al-Haytham, University of Baghdad, Iraq
31. Al-Ajili, Sabah Hassan (2009): **Principles of Educational Measurement and Evaluation,** College of Education for Publication, Babylon, Iraq
32. Attia, Hussein Ali (2009): **Comprehensive quality and newness in teaching**, Dar Safaa, Amman, Jordan
33. Attia, Mohsen Ali (2015): **Constructivism and its applications. Modern Teaching Strategies**, House of Methodology for Printing and Publishing, Amman, Jordan.
34. Ali, Wafaa Mahmoud Younis, (2006): "The effect of using the brainstorming method and lichen composition in developing creative thinking, environmental awareness, and acquiring biological concepts of environment and pollution among third-grade students/Department of Biology/College of Education" (**unpublished doctoral thesis**), College of Education, University of Mosul. Iraq
35. Al-Ayasra, Walid Rafiq (2011): **Strategies for Teaching Thinking and its Skills**, Osama House for Publishing and Distribution, Amman, Jordan.
36. Qatami, Nayfeh (1994): **Teaching thinking for the basic stage**, i 1, Dar Al-Fikr, Amman, Jordan

37. Qatami, Youssef (2016): **Knowledge and Teaching Strategies**, 2nd Edition, Dar Al Masirah for Publishing, Distribution and Printing, Amman, Jordan
38. Qatami, Youssef and others (2003): **Basics of Teaching Design**, 2nd Edition, Dar Al-Fikr for Printing, Publishing and Distribution, Amman, Jordan.
39. Lulu, Fathia Subhi Salem (2006): **Modern Strategies in Teaching**, 1st Edition, Al-Talib Library for Printing and Publishing, Gaza, Palestine
40. Muhammad, Muhammad Jassim (2004): **Educational Psychology and its Applications**, 1st Edition, House of Culture for Printing, Jordan
41. Al-Masoudi, Ali Safi Fadel (2014): The effect of using the analogical thinking strategy in the literary achievement of fourth-grade students in Western language (**unpublished master's thesis**), College of Basic Education, University of Babylon, Iraq
42. El Naga, Salah Ahmed Abdel Hadi and Abu Odeh Mohamed Fouad (2016): "The effect of problem-solving strategy in developing divergent thinking in science for ninth-grade students", **International Journal of Research in Education and Psychology**, University of Bahrain–Scientific Publishing Center, Volume 4, Issue 2
43. Al-Hashemi, Ali Rabie (2016): The effect of teaching with directed imagination and the analogical thinking strategy on the achievement of environmental science, pollution and reflective thinking among students of the College of Basic Education, (**unpublished doctoral thesis**) College of Education / Ibn Al-Haytham, University of Baghdad
44. Wali, Muhammad Jassim and others (2015): **Acquiring knowledge and teaching deductive thinking, applied and training programs**, 1st floor, Debono Center for Teaching Thinking, Dubai, United Arab Emirates
45. Al-Yasari, Hadeel (2014): "The Effect of Analogous Thinking Strategy on the Expressive Performance of Fifth-Grade Literary Female Students", (**unpublished letter)**, Ibn Al-Haytham College of Education, Baghdad, Iraq

Second: foreign sources

46. Best, WB & JV Khan (2006): **Research in Eduction** (10 Edition) Persian Eduction lnc.
47. Bichard, MH (1997): **Constructiveism and Relativism**, ashopper guide, science education. Vol (8) No (1)
48. Duit, Susanm (1991) : T**he prediction of Risk_Tak ng and self-Efficacy in Children**, Dissertation Abstracts Internia (1986) Voh
49. Howell.((2010.DC(2010): statistical methods for psychology "ed Wadsworth , cengage leaming.Canada
50. Kuhn, D., & Frankin, S. (2006) The Second: what develops (and who decade). In W.Damon,RMLearner (series Eds), **Psychology** : Vol. 2 Cognition, perception and language, pp. (136-138), Hobokin, NJ: John Wiley & sons.
51. Meeker, M (1969) **The structure of intellect**, merril publishing.