



The Synthetic Strategy and its Role to developing the Mathematical Creative Thinking Skills

Hind Salem¹, Azaa Kindi², Maha Mohammad³, Zahraa Hamad⁴, Mohammad A. Tashtoush^{5*}
^{1,2,3,4,5} Sohar University, Oman

¹hind123@yahoo.com, ²AKindi@gmail.com, ³mmasadi@yahoo.com, ⁴zhamad@hotmail.com,

⁵mtashtoush@su.edu.om



*Corresponding Author

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ABSTRACT

This study aimed to investigate the role of the Synthetic Strategy on the development of mathematical creative thinking skills. The study sample consisted of (46) eighth-grade female students who were divided into two groups: an experimental group of (24) students taught linear equations using the Synthetic strategy, and a control group of (22) students taught using the traditional method. An experimental approach was employed, and a test for mathematical creative thinking was prepared. A pre-test and post-test were administered to both study groups, and their validity and reliability were confirmed. The Synthetic strategy was applied to teach solving linear equations. The results revealed a difference in the level of mathematical creative thinking in favor of the experimental group, and statistically significant differences were found between the mean scores of the two groups in mathematical creative thinking skills, which were attributed to the teaching strategy and in favor of the Synthetic strategy. Finally, the study recommended using the Synthetic strategy to teach linear equation and diversifying teaching strategies. It also suggested conducting further studies and research to explore the impact of different teaching strategies on the development of mathematical creative thinking skills

INTRODUCTION

Thinking is a phenomenon that grows and develops through different stages of life. It is one of the most diverse and interconnected subjects, involving complex cognitive processes of the human mind. What distinguishes humans from other creatures is their ability to think. Throughout their long and challenging journey from primitive ages to civilized eras, humans have been able to confront limitless problems (Fannakhosrow et al., 2022; Tashtoush et al., 2023 c). These problems become increasingly difficult and complex with the development and rapid changes of society. Thinking, in its general sense, encompasses all types of mental activity or cognitive behavior that involves the use of symbols to process things and events, rather than relying on sensory or material activity (Chupradit et al., 2023; Arafat, 2002).

Thinking is a mental activity characterized by multiple traits, including the ability to perceive the fundamental relationships in a given problem, the ability to select an alternative from a large number of available options, the ability to have insight and reorganize previous experiences, and the ability to reorganize available ideas to generate new ones. Some define it as an ability that is acquired and progressively developed through practice, requiring guidance and direction to reach higher levels (Tashtoush et al., 2023 a; Az-Zo'bi et al., 2022; Diab, 2000).

Thinking can be defined as a subconscious mental process with specific characteristics that individuals resort to in order to find solutions to encountered problems or make specific judgments. It involves processing information and previous experiences and connecting them. It is one of the most sophisticated mental activities (Al-Aila, 2012). Previous studies (Rasheed & Tashtoush, 2021 a; Arafat, 2002; Diab, 2000; Abri et al., 2023) indicate that there are multiple patterns of thinking, including: **Scientific Thinking:** It is an organized type of thinking that can be used in our daily lives, whether in work or other activities, or in our interactions with the surrounding world. It is based on a set of principles applied by individuals and derived from knowledge. It involves logic, problem-solving, and thinking about daily life events in an organized and cumulative manner. It is purposeful thinking that leads individuals to understand and interpret various phenomena and predict their occurrence. **Critical Thinking:** Some consider it comprehensive and reasonable thinking that relies on what individuals believe or perform. It includes abilities and capabilities and is considered a logical argument based on accuracy in observing facts related to specific topics in order to discuss and evaluate them and then draw logical conclusions. It relies on scientific objectivity and avoids subjective factors such as preconceived ideas and emotions. **Creative Thinking:** It is a behavioral aspect manifested in an individual's interaction with society. It is characterized by novelty, non-routine, or rigid thinking, and it involves producing serious and unique ideas or extraordinary innovations. It drives individuals to create what is new. We will explore this type in-depth later. **Superstitious Thinking:** It is unscientific thinking that does not rely on experience and logical evidence. Instead, it relies



on fictional stories and myths. Individuals resort to supernatural causes to explain and solve natural problems, attributing them to incorrect or mysterious reasons that they cannot identify or control. **Deductive Thinking:** It is based on inferring the validity of a specific judgment from other judgments. This method relies on logic in terms of applying general and valid rules to prove the validity of specific issues. Engineering theories, for example, are considered general and valid rules because their validity is proven by evidence. Each exercise is considered a specific case. **Logical Thinking:** This type of thinking involves sophisticated mental processes in which the individual is dynamic and active. It requires an organized cognitive store integrated into the individual's cognitive structure. It also requires continuous attention to achieve the goal. Logical thinking begins with sensory experiences, then develops into lower-level abstract experiences, and then into higher-level abstract experiences. Logical thinking occurs when an individual faces a problem for which there is no ready-made solution or experimental approach. It is practiced to attempt to understand the causes and reasons behind things, relying on theoretical evidence and descriptions. It is described as purposeful and directed thinking that requires significant mental effort. **Reflective Thinking:** This type of thinking is one of the highest mental processes. The teaching models provided to students help them develop their own methods of reflection when looking at the world and the ability to face any hypothetical situation or solve any problem they encounter. **Metacognitive Thinking:** This style of thinking is considered one of the highest levels of thinking, as it requires individuals to engage in continuous planning, monitoring, and evaluation of their thinking. It is a form of advanced self-thinking that involves self-monitoring and how one uses their thinking. In other words, it is thinking about thinking.

Some characteristics of thinking can be summarized as follows: Thinking is considered a purposeful behavior that does not occur in a vacuum or without a goal. It is an evolutionary behavior that becomes more complex and profound as individuals grow and accumulate experience. Effective thinking relies on the best available information and is guided by correct methods and strategies. Perfection in thinking is not possible in reality, but effective thinking can be achieved through training and practice. Thinking is formed by the interplay of surrounding elements such as time, situation or occasion, and subject. Thinking occurs in different forms and patterns (verbal, symbolic, quantitative, spatial, formal), each with its own specificity (Chupradit et al., 2022; Tashtoush et al., 2020 b).

As for the goals of thinking, they include: preparing and training students to plan, monitor, and evaluate the mental processes practiced in interactive and learning situations; empowering individuals to guide their lives with advanced thinking skills; actively listening and empathetically understanding students' ideas and developing their imaginative capacity; increasing individual's level of reflection and avoiding jumping to conclusions, as this leads to a noticeable development in the skill of conscious thinking and problem-solving ability (Jawarneh & Tashtoush, 2011).

The importance of thinking can be identified as follows: self-benefit to the individual (i.e., the importance of educating and equipping individuals with good thinking skills); general social benefit, where members of society acquire good thinking skills through which they can solve their own and social problems; mental health, which stems from sound thinking, as thinkers have the ability to adapt to events and changes; mastering good thinking and acquiring the ability to analyze, evaluate, and criticize make individuals knowledgeable and less influenced by others' ideas; thinking benefits the individual by helping them compete in this rapidly changing era full of events that require thinking; and the thinking individual benefits from good mental health, as a thinker with the ability to think critically enjoys good psychological well-being (Rasheed & Tashtoush, 2023; Jawarneh & Tashtoush, 2012).

Creativity is considered a type of thinking that is closely related to the ability to imagine. Individuals with a high level of creativity actively engage both physically and mentally in various activities in a successful manner. They can deviate from conventional or habitual methods when solving problems, and it requires using tools from talented individuals and developing new methods and ideas (Tashtoush, 2008; Tashtoush & Jawarneh, 2011; Rasheed & Tashtoush, 2021 a). There have been multiple definitions of the concept of creativity, reflecting the diverse interests, theoretical perspectives, and intellectual schools of thought of researchers and scholars. There is no universally agreed-upon definition for the concept of creativity, but here are some examples: Creativity is the "production of something new and original with specific characteristics, such as scientific value and social benefit. This requires the creative individual to depart from conventional thinking and traditional methods in order to achieve an uncommon output characterized by rarity and unfamiliarity. Since this production is linked to the social reality, it enjoys a degree of satisfaction and acceptance from a large group of individuals, ensuring the continuity of its impact over a period of time" (Awdeh, 2000). It can also be defined as the "mental readiness of an individual, prepared by their environment, to produce something new and unknown in response to the demands of social reality" (Hermes and Ibrahim, 1988).

Creative thinking is considered one of the key factors for success in daily life in general, and particularly in academic success. Therefore, fostering creativity has become one of the primary educational objectives pursued by advanced human societies, which view their creative individuals as the foundation of their wealth and the means of development in various educational, social, scientific, and technological fields (Tashtoush & Rasheed, 2023 d). As mathematics is the language of the mind and a means of its development and growth, and since teachers are one of the most important human inputs in the education system, responsible for facilitating the learning process by stimulating students' creative thinking, guiding and directing them to overcome academic failure, arousing their motivation to learn, and addressing their needs and aspirations. Teachers should involve students in decisions related to their educational activities and consider the diversity of their cognitive characteristics (Rasheed et al., 2021 b).

There have been various definitions of creative thinking among researchers and educational scientists. Some



examples include: Creative thinking is "the skills that can be measured through a test of creative thinking by extracting students' scores on each skill and on the test as a whole" (Al-Rashidi et al., 2015). It is "a cognitive mental process characterized by a high level of cognitive activity, in which an individual perceives the elements of a situation, discerns relationships between them, and seeks indicators that lead to the formation of new, diverse, and authentic structures" (Awdeh, 2000). Olson (1999) defines it as "a mental process in which ideas are generated and modified based on the individual's previous knowledge and experience. New solutions to problems cannot be formed without it." Dinca (1993) defines it as "a mental process aimed at gathering facts, perceiving materials, experiences, and information, and constructing new structures and configurations to shed light on the solution."

There are multiple perspectives on defining the skills of creative thinking, and their classifications vary due to the interplay between basic and higher-order thinking processes, as they are intertwined cognitive and knowledge-based skills. Some experts (Abu Mazid, 2012; Tashtoush et al., 2020 a; Wardat et al., 2023; Abri et al., 2023) classified them as follows: **Fluency**: It is the individual's ability to retrieve stored information whenever needed. It is the ability to generate multiple verbal and performance ideas for a problem or open-ended question. Fluency plays a significant role in a person's creative thinking, and its extent is determined by the quantity, measured by the number of responses and the speed of their generation. **Flexibility**: It refers to the change in an individual's mental state with a change in the situation. It is the ability to think in different ways and see the problem from multiple perspectives. **Originality**: It is a fundamental element of creative thinking and involves producing new ideas or a new approach. It can be described as the uniqueness in thinking, rarity, and the ability to go beyond direct and conventional ideas. This skill is highly associated with creative thinking, and it is the essence of originality to produce unconventional and unexpected ideas. These ideas result from the mind's ability to make distant and indirect connections between the knowledge existing in the cognitive system.

Synthetic Strategy

This strategy refers to the connection or combination of diverse elements that do not have an apparent relationship. It can be interpreted as a strategy of forming relationships. Educators have different opinions about its conceptual meaning. Some believe that it involves making creativity a conscious and intentional process by using metaphors, similes, and analogies. This can be achieved by linking the familiar with the unfamiliar or by generating new ideas from familiar concepts (Awdeh, 2000; Tashtoush et al., 2023 c). This strategy is based on three fundamental assumptions: that the creative abilities of individuals can be enhanced when they understand the psychological processes involved in creativity, that the emotional aspect of creativity is more important than the intellectual aspect, and that the irrational is more significant than the rational. Therefore, it is necessary to teach students the emotional and non-rational aspects of the creative process (Tashtoush et al., 2022 a).

This strategy is implemented by linking different elements that do not have an apparent relationship using metaphor and analogy within a systematic framework, with the aim of reaching creative solutions to problems. The ability to perceive the hidden similarity relationship, which most individuals lack, is actually the distinguishing characteristic of a true creative person. Furthermore, the search for harmony and the non-apparent resemblance between distant things, shapes, and experiences represents the essence of creativity in sciences, literature, and arts. Creative works lie in discovering the similarity relationship that no one has found before (Az-Zo'bi et al., 2022; Chupradit et al., 2023; Tashtoush et al., 2023 c). Synthetic Strategy utilizes two principles: "Seeing the strange as familiar and the familiar as strange." The first principle can be achieved through three basic mental processes: analysis, generalization, and representation. These processes usually take the form of searching for a model or a mental representation that includes this strange thing. The second principle is not merely about seeking strangeness and deviation but rather a conscious effort by the creative individual to gain a new perspective on the world, people, and ideas.

Mathematical Creative Thinking

The twentieth century witnessed a wide-ranging advancement of knowledge and sciences that extended its impact to all areas of life. Despite mathematics being an abstract science, the applications of its theories in practical fields encompass various aspects of current civilizational progress. Through mathematics, computer operations, communication devices, and satellite movements around the Earth can be explained. Moreover, discoveries in other sciences have resulted from the application of mathematical methods, such as the laws of relativity, gravitational force, and atomic structure. Therefore, mathematics can be considered a leader in the development of other sciences, as well as in various engineering, industrial, social, and educational fields (Tashtoush, 2012). Thus, the creativity of mathematicians contributes to providing solutions to some of the problems faced by society today. This creativity manifests itself in the discovery of new laws, the development of original theories, and the provision of numerous non-conventional and socially acceptable solutions to current world problems. Consequently, it becomes clear that the development of creative thinking has become a necessity in the technological age where mathematics plays a significant role. It is essential for us to understand the nature of creativity in mathematics (Fannakhosrow et al., 2022).

Creative thinking in mathematics is defined as the production of solutions to mathematical problems characterized by fluency, flexibility, authenticity, and suitability for addressing these problems. It also refers to the production of new solutions to problems in mathematics that are non-typical and unconventional. Additionally, it



involves producing various pieces of evidence for a single theory, multiple solutions to a single mathematical problem, and forming new mathematical relationships and ideas that go beyond the stagnation in mathematics (Tashtoush et al., 2023 b).

Problem Statement

The focus on developing creative thinking as a mental capacity has become an urgent necessity that falls within the scope of the curriculum. The role of universities is no longer limited to transferring information and knowledge, but also includes the responsibility of familiarizing students with creative thinking and developing their creative abilities. Similarly, the role of schools today is centered on preparing students to be capable of solving real-life problems through the development and enhancement of their creative abilities, potentials, and skills. Some researchers have noticed that when teaching mathematics, female students do not think about mathematical situations from multiple perspectives. Instead, they approach problems related to solving linear equations in the same way they have learned throughout their studies. There is a lack of diversity in the students' problem-solving methods, and they do not consider alternative approaches to problem-solving. It appears that the thinking methods they follow are merely a traditional translation of the teaching methods they have learned from their teachers over the years. This study adds an important dimension to the educational process as it sheds light on the skills of creative thinking and their development in mathematics. It involves generating and collecting ideas, recognizing suitable teaching strategies, formulating hypotheses, experimenting with them, and testing them. This study is only a prelude to numerous research and studies in the field of mathematics education, particularly in the topic of linear equations and their applications, aimed at developing creative thinking skills. Additionally, this study can identify general frameworks for some characteristics that can be incorporated into the mathematics curriculum in the future. Specifically, this study aims to answer the following questions:

1. Do the levels of creative thinking differ among female students in the experimental and control groups before and after implementing the Synthetic Strategy?
2. Are there statistically significant differences in the average performance of female students between the experimental and control groups in the test of mathematical creative thinking attributed to the Synthetic Strategy?

Study Objectives

The objectives of this study are to explore the levels of creative thinking among female students before and after implementing the proposed teaching strategy. It also aims to identify significant differences in the average performance of the experimental group and the control group in the mathematical creative thinking test attributed to the teaching strategy.

Study Significance

The study derives its importance from the significance of the topic it addresses, as the use of teaching strategies is considered an important subject that occupies the minds of educational experts in order to enhance the educational process, improve its quality, and its outcomes. This study is also considered a continuation of research and studies that aim to develop mathematical creative thinking skills among students. Educational institutions can benefit from it in the development of the educational process by utilizing modern teaching strategies and methods to enhance students' mathematical creative thinking skills.

Operational Definitions

Creative Thinking: A set of skills (fluency, flexibility, originality) that can be measured through the Test of Mathematical Creative Thinking.

Fluency: The ability of the student to generate the largest possible number of correct answers in response to a mathematical problem.

Flexibility: The ability of the student to generate different and appropriate answer patterns for the mathematical problem, characterized by diversity and non-routine.

Originality: The ability of the student to produce new and non-conventional ideas and responses that are distinct and have minimal repetition.

Development of Creative Thinking: Obtaining real opportunities that help the student to generate wonderful creative ideas by preparing them to become a scholar or thinker.

Synthetic Strategy: A set of teaching procedures based on a series of activities.



LITERATURE REVIEW

A study conducted by Awda (2000) aimed to assess the level of practice among mathematics teachers in the education directorates at Gaza in the secondary stage regarding strategies for developing creative thinking among secondary school students. The study considered the perspectives of students, teachers, high school principals, and mathematics supervisors. The researcher used a descriptive-analytical approach. To achieve the study's objectives, the researcher developed a scale of teaching practices for mathematics teachers that encourage creative thinking skills. The scale was administered to a stratified sample consisting of 1086 male and female students, (124) mathematics teachers, (63) principals, and (10) mathematics supervisors from the same directorates. The study revealed that the degree of mathematics teachers' practice in strategies for developing creative thinking and their skills was high among female teachers, especially in the scientific branch. The study recommended the development of a mathematics teacher's guide that includes creative activities, conducting training courses and programs for mathematics teachers.

On the other hand, Al-Rashidi (2005) aimed to examine the impact of the brainstorming strategy on teaching problem-solving, achievement, and creative thinking among ninth-grade female students in the Sultanate of Oman. The study used a quasi-experimental design with a sample of (71) students divided into two groups: control and experimental. The study revealed statistically significant differences in achievement, fluency, flexibility, and overall creative thinking abilities in favor of the experimental group, while no statistically significant differences were found in originality between the control and experimental groups. Similarly, the study conducted by Park and Kown (2006) aimed to examine the impact of a program for developing creative thinking in mathematics among seventh-grade students in Seoul. The researchers used an experimental design, and the study sample consisted of (398) students divided into two groups: experimental and control. The researchers used a test to measure creative thinking skills. The results of the study indicated that the students in the experimental group outperformed the control group in levels of creative thinking (fluency, flexibility, and originality).

A study conducted by Haddad (2009) aimed to measure the effectiveness of a proposed program in differential and integral calculus based on mathematical thinking methods and assess its effectiveness in developing creativity among student teachers (majoring in mathematics) at the College of Education, Sana'a University. The researcher used an experimental approach, and the study sample consisted of (74) students divided into two groups: an experimental group (37) student and a control group (37) student. The study utilized a questionnaire on mathematical thinking methods, lists for analyzing mathematical content based on cognitive levels, mathematical structural components, and thinking methods, as well as a test to measure mathematical creativity and a test to measure general creativity. The study found the proposed program to be effective in developing mathematical creativity and general creativity among the experimental group students.

A study conducted by Erdogan & Akkaya (2009) aimed to determine the impact of the Van Hiele model on the development of creative thinking among 6th grade students. The researchers used an experimental approach, and the study sample consisted of (55) students divided into two groups: experimental and control groups. The researchers used the Torrance Test of Creative Thinking. The study found that the experimental group, taught using the Van Hiele model, outperformed the control group, which was taught using traditional methods.

Abu Mazid (2012) conducted a study aiming to investigate the impact of using mathematical modeling on the development of creative thinking skills in mathematics among sixth-grade students in Gaza. The researcher used an experimental approach with a study sample of 83 students, divided into two groups: experimental (43) student and control (40) student. A test of creative thinking was prepared, and a pre-test and post-test were administered to both groups. The study showed statistically significant differences in the average scores of the two groups, favoring the experimental group in terms of creative thinking skills. The study recommended to use of mathematical modeling in math curricula and the necessity of preparing guidelines for teachers to teach math at the elementary level using mathematical modeling.

Al-Rashidi and others (2015) conducted a study aiming to explore the level of creative thinking among gifted secondary school students in Saudi Arabia in light of some variables. The study followed a descriptive correlational approach and employed a scale for creative thinking. The study revealed that gifted students had an average level of creative thinking across all thinking skills. It also showed that male first-year secondary school students had lower levels compared to other levels, while the performance level of females was higher than that of males.

A study by Fatah and others (2016) aimed to investigate the impact of using the Open-Ended Approach in teaching on the development of mathematical creative thinking and self-esteem in higher secondary stage students. The study sample consisted of eleventh-grade students from three schools, divided into two groups: an experimental group taught using the Open-Ended Approach and a control group taught using traditional methods. The study followed an experimental approach. The results showed that the development of mathematical creative thinking and self-esteem among students taught using the Open-Ended Approach was significantly better than those taught using traditional methods.

METHOD

Methodology

The current study followed an experimental methodology, which consisted of two groups: an experimental group and a control group. A pretest-posttest design was applied to both study groups.



Participants

The study population consisted of eighth-grade female students in all schools in Sohar region of the Sultanate of Oman. The study sample consisted of eighth-grade female students from one school in Sohar, divided into five classes, with a total of (107) female student. One class was randomly selected to represent the experimental group, comprising (24) students who were taught using the Synthetic Strategy. The other class, comprising (22) students, served as the control group and was taught using the traditional method.

Instruments

Mathematical Creative Thinking Test: The researchers developed a test to measure mathematical creative thinking skills based on previous studies (Dinca, 1993; Tashtoush, 2013; Tashtoush et al., 2023 a). The test consisted of four items representing various creative problem-solving tasks related to linear equations and their applications, considering the sequence of topics discussed during the dedicated teaching sessions. The test was administered through a set of multiple problems. To ensure the validity of the study instrument, it was presented to a group of mathematics teachers who provided their opinions and suggestions regarding the test. It was also reviewed by a specialized committee of faculty members from universities specializing in mathematics, mathematics curriculum, teaching methods, and assessment and evaluation. Based on their feedback, some items of the test were modified, and students' opinions regarding the time needed for the test were considered. To assess the reliability of the study instrument, the test was administered to a pilot sample of (20) students from both within and outside the study sample. Test-retest reliability was determined by calculating the Pearson correlation coefficient between the students' scores on the two administrations. The coefficient of reliability for the test as a whole was found to be (0.87), which is an acceptable and appropriate correlation coefficient for the purposes of the current study (Odeh, 2014).

Scoring Rubric: A scoring rubric was developed based on criteria (Tashtoush et al., 2020 b, Abri et al., 2023; Tashtoush et al., 2022 b) to correct and classify all the answers of the test items and distribute grades according to the classification of the response on the skills of mathematical creative thinking (fluency, flexibility, originality). The following criteria were used:

1. **Fluency:** This is measured by the student's ability to provide as many appropriate answers as possible. Each correct answer is awarded one point.
2. **Flexibility:** This is measured by the student's ability to exhibit diverse patterns of response. The more diverse the answers, the higher the flexibility score for the student. Each different pattern of response is awarded one point.
3. **Originality:** This is measured by the student's ability to provide uncommon or unusual answers that are not repeated by many students. The originality score is high if the answer is less frequent and low if it is more frequent. The grades are distributed as follows: **(a)**. If more than 20% of the students have the same answer, the student is awarded one point for this skill. **(b)**. If (10% - 20%) of the students have the same answer, the student is awarded two points for this skill. **(c)**. If less than 10% of the students have the same answer, the student is awarded three points for this skill.
4. **Total Score:** The sum of the scores for fluency, flexibility, and originality in the overall test.

To ensure the validity of the aforementioned scoring rubric, it was reviewed by an evaluation committee to provide feedback on the adopted criteria. To assess its reliability, a random sample of answer sheets (25 sheets) was selected and corrected twice, once by the 1st and the 2nd researchers. The agreement coefficient between the two corrections was calculated using the Holsti equation (Holsti, 1969), resulting in a coefficient of (0.83), which is an acceptable agreement ratio for the purposes of this study (Odeh, 2014).

Data Analysis

To answer the study questions, the mean scores and standard deviations of the study sample's responses on the skills of mathematical creative thinking were calculated. To determine whether there were statistically significant differences between the mean performance of the experimental group and the control group, a one-way analysis of variance (ANOVA) was used.

RESULT

Results to the First Question: "Do the levels of creative thinking differ among students in the experimental and control groups before and after implementing the proposed teaching strategy?"

To answer this question, the mean scores and standard deviations of the participants' scores on the Creative Thinking in Mathematics Test were calculated for the study variables pre-post applications implementing the proposed teaching strategy, as shown in Table (1).

Table (1): Mean and SD for the pre-post applications the strategy

Group	No	Pre-Test		Post-Test	
		Mean	SD	Mean	SD
Control Group	22	3.15	2.394	3.19	2.396
Experimental Group	24	4.42	2.966	5.16	3.115

The table (1) shows that the presence of differences in the means of the Creative Thinking in Mathematics Test based on the study variables pre-post applications implementing the proposed teaching strategy. It is evident that there are statistically significant differences in the scores of the Creative Thinking in Mathematics Test in favor of the experimental group, which was taught using the Synthetic strategy.

Results to the Second Question: "Are there statistically significant differences in the mean performance scores between the experimental group and the control group in the overall Creative Thinking in Mathematics Test attributed to the teaching strategy?"

To answer this question, a One-Way ANOVA test was conducted based on the study variables pre-post applications implementing the proposed teaching strategy. The results are presented in Table (2).

Table (2): Results of One-Way ANOVA for the MCT-Test

Source of Variance	SS	df	MS	F	Sig.
Between Groups	24.24	1	24.24	1.41	0.025
Within Groups	752.67	44	17.10		
Total	776.91	45			

Table (2) reveals the presence of statistically significant differences in the scores of the Creative Thinking in Mathematics Test attributed to the teaching strategy.

DISCUSSION

The results showed that the overall mean of students' grades in the test of mathematical creative thinking was moderate. This confirms the impact of using the proposed teaching strategy in developing mathematical creative thinking skills, which showed a difference in the levels of creative thinking between the average results of the experimental group students and the average results of the control group students in favor of the experimental group. This can be attributed to the fact that the proposed teaching strategy provided students with the opportunity to follow organized and logical steps that greatly contributed to the development of their creative thinking abilities. It also helped in the development of their cognitive structure, leading to better results. Perhaps this is because it helped familiarize students with the unfamiliarity or difficulty of problems through repeated problem-solving and diverse presentation styles, which contributed to improving their creative thinking development.

The results also showed a significant difference in the arithmetic means of the levels of mathematical creative thinking between the experimental group and the control group. This can be attributed to the fact that the students in the experimental group had a greater ability to mentally deal with problems, which contributed to improving their level of creative thinking. Additionally, the students possessed the ability to perceive hints and details quickly and accurately and used this ability to engage with new ideas, process information, transition from one idea to another, and demonstrate creativity in problem-solving.

The results also revealed statistically significant differences between the average performance of the experimental group students and the control group students in the test of mathematical creative thinking, attributed to the teaching strategy and in favor of the strategy of integrating concepts. This can be attributed to the fact that the teaching strategy enabled the experimental group students to solve unfamiliar and more complex problems with more confidence compared to the control group students.

The effectiveness of the proposed strategy lies in the diversity of problems and activities, their enrichment, and giving students sufficient time to think about the answers and clarify the requirements of each question. This led to a deep understanding reflected in an increased level of mathematical creative thinking among the experimental group students. Alternatively, it could be that their cognitive structure changed as a result of connecting their existing knowledge with new knowledge, leading to the generation of new ideas. Additionally, the use of the proposed teaching strategy allowed students to think about unconventional or non-traditional answers, different from the methods they learned in the classroom. Moreover, the students preferred the organized learning environment and exhibited a great desire and ability to learn.

CONCLUSION

1. Use the strategy of integrating concepts in teaching various mathematical topics, as it has proven to be effective in developing and improving students' ability to enhance mathematical creative thinking.



2. Diversify the methods, techniques, and strategies used in teaching mathematics and improve and develop assessments by focusing on higher-order cognitive processes.
3. Conduct further research and studies to explore the impact of different teaching strategies in developing mathematical creative thinking skills.

Conduct more research and studies on the development of other creative skills in mathematics teaching, such as organization, classification, comparison, concentration, visualization, mental transformations, analysis, composition, and evaluation of coding, and investigate their effectiveness in developing mathematical creative thinking.

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