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VISUAL THINKING SKILLS OF FIRST-GRADE INTERMEDIATE STUDENTS IN MATHEMATICS

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Abstract
This study aims to identify the visual thinking skills of first-year middle school students in mathematics. The researcher adopted a descriptive approach due to its suitability for the study's objectives. A research tool, a visual thinking skills test, was pre pared, the test consisted of 25 multiple-choice questions with four alternatives distributed across the four visual thinking skills, which are: (the skill of reading visual shapes, the skill of analyzing visual shapes, the skill of interpreting information on visual shapes, and the skill of inferring meaning from visual shapes). The validity and reliability of the tool were verified. Once it was ready for use, the visual thinking skills test was administered to the research sample (first-year middle school students) at Al-Shayma Girls' Secondary School and Abu Tarab Boys' Secondary School, both affiliated with the Maysan Governorate Education Department. After conducting the appropriate statistical analyses, the researcher concluded that first-year middle school students possess high-level visual thinking skills in mathematics. In light of the study's results, the researcher made a number of recommendations and suggestions.

Keywords: Visual Thinking skills, First-grade, Mathematics.

Chapter One: Introduction to the Research and Its Terminology

First: Research Problem

Visual thinking is one of the most important types of thinking, as it relies on what the eyes see and the subsequent analysis and processing that takes place within the human mind, resulting in the retention of this interaction in human memory (Amer and Al-Masri, 2016: 4). It has become necessary to learn thinking skills in our current time because students need thinking skills as important tools to help them live and cope in a rapidly changing world, therefore, the importance of studying mathematics is not limited to developing one type of

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thinking pattern, but includes all types of thinking, especially visual thinking, this highlights the importance of developing thinking skills, the goals of the educational process are no longer limited to memorizing and recalling information in tests, but it has become necessary to develop the mental skills of learners, such as the ability to extract meaning, observe, organize, and connect information as well as interpreting ambiguity and applying these skills in real-life situations. (Mohammed, 2021: 4). Educators emphasize that the mind is a thinking machine; whether you use it or not, its function is to think, and humans learn more through sight than through any other sense (Al-Atabi, 2008: 1). Visual thinking and its skills are considered strategic for understanding scientific information, as a picture is worth a thousand words, the importance of visual thinking is highlighted through the intensive presentation of drawings, symbols, and shapes that facilitate students' understanding, which is reflected in their improved performance in other areas (Willem and Ghazou, 2004: 41-98). Therefore, the researcher decided to examine this issue and delve deeper into its aspects to reveal the visual thinking skills of first-grade middle school students in mathematics, which may give students better results in achieving their desired goals. Based on the above, the research problem can be formulated in the following question:

To determine the extent to which first-year middle school students possess visual thinking skills in mathematics.

Second: Research Importance:

Learning thinking skills has become an urgent need, especially in an era characterized by speed and change. Students need to learn thinking skills as essential tools that help them live and interact in the present day, thinking makes them more confident, which in turn affects their level of achievement inside and outside school, contributes to the achievement of the student's life goals, improves their social communication with others, and enables them to complete the tasks required of them in society (Al-Obaidi and Al-Barzanji, 2017: 13). The senses that God has given humans are considered gateways to receiving knowledge about the world around them, and one of the most important of these senses is sight. The eye is like a camera for humans, capturing images of their surroundings, and the mind interacts with what it receives according to its nature (Amer and Al-Masri, 2016: 48). Thinking is one of God's blessings to humans,

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as the Holy Quran calls on humans to think, observe, and reflect on the universe. God says in His glorious book: "Will they not regard the camels, how they are created? And the heaven, how it is raised? And the hills, how they are set up? And the earth, how it is spread?" (Al-Ghashiyah: 17).

The educational reality indicates that learners focus on memorizing and retrieving knowledge, without focusing on understanding and comprehension. What is happening in the various educational stages is a lack of focus on thinking skills in general, and visual thinking skills in particular. (Ibrahim, 2006: 70) Textbooks are considered an important source of learning for students. They contain educational material that helps them achieve specific goals and are an essential reference for them. To be effective, textbooks must be written with a clear vision for developing and refining thinking skills (Al-Bari, 2013: 32). The mathematics curriculum is one of the most important scientific curricula concerned with developing students' thinking because it includes many geometric and mathematical laws and rules related to thinking, especially visual thinking (Abu Hilal, 2018: 60).

Based on the above, we can see the importance of visual thinking in learning and teaching mathematics to develop students' ability to think, understand, and organize. This is an extension of what many studies have presented on the importance of shapes and images in developing visual thinking, such as the study by (Jasim and Jasim, 2020) and the study by (Tafesh, 2011), and the study by (Al-Khazandar, 2007), these studies emphasized the importance of visual images alongside scientific content in general, and in middle school in particular, considering that middle school is a complementary grade to the other grades.

The importance of the study lies in the following points:

1- Keeping pace with international trends in mathematics education that support the development of visual thinking skills.

2- Utilizing visual thinking skills tests in the development of mathematics curricula.

3- The current study helps teachers understand the importance of images, illustrations, and conceptual maps in developing visual thinking skills.

4- Focusing on thinking skills in general in the curriculum, and visual thinking skills in mathematics textbooks in particular.

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Third: Research Aims: The current research aims to:

1- Identify the extent to which first-grade middle school students possess visual thinking skills.

2- Identify the visual thinking skills of first-grade middle school students according to gender.

Fourth: Research Questions: The research attempts to answer the following questions:

1- What is the level of first-grade middle school students' practice of visual thinking skills in mathematics?

2- Do the visual thinking skills of first-year middle school students differ according to gender?

Fifth: Research Limits: The research is limited to the following:

1- Time limit: The second semester of the 2022/2023 academic year.

2- Spatial limit: Al-Shayma Girls' Secondary School and Abu Tarab Boys' Secondary School.

3- Human limit: First-grade middle school students at Al-Shaima Girls' Middle School and Abu Tarab Boys' Secondary School, which are affiliated with the General Directorate of Education in Maysan Governorate.

4- Objective limit: Visual thinking skills (the ability to read visual shapes, analyze visual shapes, interpret information in visual form, and infer meaning from visual shapes).

Sixth: Terms Definition:

First: Skill: Defined by Abu Al-Haj (2016) as "the ability to perform a task in a manner determined by a measure developed for that purpose, based on understanding, speed, and accuracy" (Abu Al-Haj, 2016: 30).

Second: Thinking: Defined by (Al-Deeb, 2015) as "a combination of mental reasoning of ideas through sensory perceptions received by the mind and mental processing of these ideas to judge things." (Al-Deeb, 2015: 13)

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Third: Visual thinking: Defined by (Sattohi, 2011) as "thinking that arises through stimulating the mind with visual stimuli to perceive certain meanings or relationships in them through various mental processes." (Sattohi, 2011: 116)

Fourth: Visual thinking skills: Defined by (Al-Shobaki, 2010) as "a person's ability to deal with and visually distinguish between tangible materials so that they can perceive spatial relationships, interpret and analyze information, and interpret ambiguity." (Al-Shobaki, 2010: 35)

Fifth: Procedural definition of the first intermediate grade: The researcher defines it as the first of three stages of education after primary school. The duration of study in the intermediate stage is three years, according to the Education Law of the Iraqi Ministry of Education, and the age of learners in this stage is 13-15 years.

Chapter Two/Theoretical Aspects and Previous Studies

First Axis: Theoretical Aspects

This is the theoretical scientific background that researchers need to work with to prepare scientific research that will have an impact on knowledge construction (Al-Azawi, 2008: 45). It serves as the foundation upon which all research is built and represents the structure or framework of the idea or phenomenon to be researched. It defines the interactions and relationships related to the idea or phenomenon and relies on literature or books that have addressed the research topic. The researcher decided to divide the second chapter into two sections. The first axis is the theoretical background and includes visual thinking skills, while the second axis includes previous studies related to the research topic.

First: Visual Thinking Skills:

Visual forms are considered one of the most important tools in representing knowledge, not only because they are instructional and educational tools, but also because they are characteristics that link science to thinking. Visual thinking relies on the use of a set of visual forms, such as images, drawings, symbols, lines, and shapes, to explain and simplify complex information and present it in an easy-to-understand visual design. Visual thinking is based on reading and understanding, and extracting information correctly based on vision, and then

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matching it with images previously stored in the mind (Shafei et al., 2018: 57). (Jad Al-Haq, 2018) believes that visual thinking skills are "a system of mental processes that rely on the sense of sight, enabling students to read shapes, images, drawings, and models to distinguish between them and perceive the relationships that connect them to analyze and interpret them to derive meaning from the shape and translate it into written or spoken language." (Jad Al-Haq, 2018: 84). (Kose, 2019) stated that visual thinking skills consist of four skills: the skill of reading visual shapes, the skill of analyzing visual shapes, the skill of interpreting information on visual shapes, and the skill of inferring meanings from visual shapes, this is consistent with the study by (Jassim and Jassim, 2020), which divides visual thinking skills into four basic skills.

Second: Visual Thinking importance: The importance of visual thinking is highlighted in the following points:

1- It increases students' self-confidence.
2- It develops students' problem-solving skills.
3- It increases students' motivation towards academic subjects.
4- It develops different types of scientific processes such as observation, analysis, and conclusion. (Al-Masoudi and Sanabel, 2018: 254)

Third: Visual Thinking Tools:

A study (Abdulaziz, 2018: 30) showed that digital tools that support visual thinking organize information and capture ideas. Visual symbols can be likened to three tools:

A- Images: These are a visual symbol of ideas and represent the most accurate tools of communication.
B- Symbols: These are anything that signifies something and stands in for it, and are considered the most widely used and prevalent in communication.
C- Schematic drawings of shapes: These illustrate ideas and can be expressed with lines or simple shapes. They include drawings related to concepts, drawings related to images, and cartoons.

(Abu Zida, 2013: 61) added two new tools for visual thinking in addition to the tools mentioned above, which are:

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D- Geometric shapes: Straight and curved lines come together to form geometric shapes, which are subject to mental and visual processes, as the brain can understand and recognize their concepts.

E- Three-dimensional objects: These are the most clear and widespread visual tools, and are considered among the most important visual tools because everything that humans see is three-dimensional and indicates a specific concept or meaning. They consist of three variables: length, width, and height, and are called 3D.

Second Axis: Previous Studies

1- Study (Jassim and Jassim, 2020): The research aimed to determine the extent to which visual thinking skills are included in the fourth-grade mathematics textbook. The researcher used a descriptive analytical approach. To achieve the research objective, a list of key visual thinking skills and their sub-skills was prepared, after analyzing the content of the book, the stability of the analysis was verified through cross-time and cross-individual analysis, and a stability rate of more than 80% was obtained using the Holste equation, the research concluded that all key visual thinking skills were included in the books, with percentages of 44.04% for the skill of interpreting information in visual form in first place, followed by the skill of analyzing visual forms with a percentage of 31.35% in second place, then the skill of reading visual forms with a percentage of 12.71% in third place, and finally the skill of inferring meaning from visual forms with a percentage of 11.86% in fourth place, this indicates that the mathematics textbook includes visual thinking skills in varying proportions. The researcher made a number of recommendations and suggestions.

2- Study (Abdul-Razzaq and Fadhil, 2019): The aim of the research was to investigate visual thinking among students at Wasit University's Faculty of Education and to measure the level of visual thinking among students at Wasit University's Faculty of Education according to gender (male-female). The research sample was selected using simple random sampling and consisted of 40 male and female students. To achieve the research objectives, the researchers adopted (Al-Badiri, 2015) scale, which consists of 38 items. After applying the tool to the sample, the data was downloaded and statistically processed using the t-test for a single sample and the t-test for two independent samples, the results

indicate that the level of visual thinking among students at Wasit University College of Education is equivalent to the default average for the visual thinking scale with a non-significant difference. There is a statistically significant difference in the degree of visual thinking among students at Wasit University's College of Education according to the gender variable (male-female) in favor of males. Based on these research findings, a set of conclusions was reached, and the researchers made some recommendations and suggestions.

3- Study (Al-Mahraz, 2019): The research aimed to identify the visual thinking skills that should be included in the content of the eighth-grade engineering textbook. The researcher used a descriptive analytical approach and, to achieve the research objective, developed a content analysis tool. The results showed that visual thinking skills were available in varying proportions, depending on the nature of each topic in each unit and how it was presented in the textbook; the percentages for representing information in drawings, interpreting information in figures, analyzing figures, and inferring meaning were somewhat similar.

4- Study (Al-Shulawi, 2017): The study aimed to determine the extent of visual thinking skills in the sixth-grade science curriculum in Saudi Arabia. To achieve this goal, the researcher used a descriptive analytical approach. The study tool consisted of compiling a list of visual thinking skills and then converting it into a content analysis card, the study population consisted of the sixth-grade science curriculum, which consists of six study units containing 12 chapters, the sample consisted of all the images in the first and second semesters, which amounted to 218 images, the results showed deficiencies in most visual thinking skills, with three skills falling into the weak range, namely the skill of establishing relationships, the skill of analyzing shapes, and the skill of inferring meanings, while the skill of recognizing and describing shapes and the skill of interpreting ambiguity were in the average range.

Chapter Three/ Research Methodology and Procedures

First: Research Methodology: In order to achieve the research objectives, the researcher followed the descriptive methodology, as it is appropriate for the nature and objectives of the study. The descriptive methodology is defined as: "Research that relies on studying reality or phenomena as they exist in reality, and is concerned with describing it accurately through qualitative expression that

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describes the phenomenon and clarifies its characteristics, or quantitative expression that gives a numerical description that clarifies the extent and size of the phenomenon." (Abbas et al., 2014: 74)

Second: Research Procedures:

1- **Research Population**: This represents all individuals or persons who are the subject of the research problem. The population may be individuals or groups, depending on the research topic (Al-Jabri, 2011: 245). The current research population consists of first-year middle school students in all morning middle and high schools in the center of Maysan Governorate.

2- **Research Sample:** The research sample is defined as: a part of the research population that best represents the elements of the population, as the results of those elements can be generalized to the entire population, and inferences can be made about the research population (Al-Tamimi, 2018: 96). The research sample was selected purposively from the research population, the sample size was 80 first-year middle school students, 40 female students from Al-Shayma Girls' Secondary School, and 40 male students from Abu Tarab Boys' Secondary School, both of which are affiliated with the Maysan Governorate Education Directorate.

Table 1: Number of research sample members by gender

S.	Variable		Number
1	Gender	Male	40
		Female	40
Total			80

Third: Research Tool: The search tool is defined as how the researcher collects data from the sources specified in his research, so that he can solve the research problem and verify his hypotheses. (Al-Shayeb, 2009: 69) Since the research aims to identify the visual thinking skills of first-year middle school students in mathematics, the visual thinking skills test was the research tool, as explained below:

- Defining the objective of the visual thinking skills test: Defining the objective is one of the important steps in starting to construct the test. The test aims to measure the visual thinking skills of first-year middle school students in

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mathematics. Defining the purpose of the test requires defining the basic terms used in it, which are defined in the first chapter.

- Identifying visual thinking skills: The visual thinking skills to be measured have been identified based on:

A- What has been identified in some sources, including: a study (Jassim and Jassim, 2020), a study (Abdul-Razzaq and Fadel, 2019), and a study (Al-Mahraz, 2019) as (the skill of reading visual shapes, the skill of analyzing visual shapes, the skill of interpreting information on visual shapes, and the skill of inferring meaning from visual shapes), which represent visual thinking skills.

B- The opinions of some experts in mathematics and its teaching methods in stating their suitability for the age group of the research sample, which are (the ability to read visual shapes, the ability to analyze visual shapes, the ability to interpret information in visual shapes, and the ability to infer meaning from visual shapes).

- Formulation of the initial version of the visual thinking skills test: After identifying visual thinking skills, the researcher reviewed several local and Arab literature, research, and studies related to visual thinking, such as the study by (Jassim and Jassim, 2020), the study by (Abdul-Razzaq and Fadhel, 2019), and the study by (Al-Mahraz, 2019). Table 2 shows the test vocabulary items distributed across the four visual thinking skills.

Table 2: Vocabulary items for the four visual thinking skills tests

Item	Visual thinking skills	Test section
1	The skill of reading visual shapes	1, 2, 3, 4, 5, 6, 7, 8
2	Visual forms analysis skill	9, 10, 11, 12, 13
3	The skill of interpreting information in a visual form	14, 15, 16, 17, 18, 19
4	The skill of deducing meaning from the visual form	20, 21, 22, 23, 24, 25

- **Preparing Test Instructions**

A. Answering instructions: Instructions for answering the test were formulated and included student information, how to answer the questions, the number of questions, the time allowed for answering the test, and ensuring that no question was left unanswered.

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B. Marking instructions: Model answers were provided for all test questions, which were used to correct the test; one point was given for a correct answer and zero for an incorrect answer; questions left blank were treated as incorrect answers, and the total score for the questions ranged from 0 to 25.

C. Test validity: The test must be valid to measure the trait it is intended to measure. To verify the validity of the test, the researcher used the following types of validity:

First: Validity of assessors (apparent validity): This type of validity is achieved when specialists examine the test and conclude that the test items appear to measure what they are intended to measure, the test items were presented to several arbitrators in mathematics, teaching methods, measurement, and evaluation to verify the accuracy of their wording and consistency with the objectives for which they were designed, after taking into account all the opinions and observations expressed by the reviewers, the test was modified by rephrasing some of the items and correcting grammatical rules, deleting some questions that were not suitable for students, and modifying and replacing some images with ones more suitable for students, the test consists of 25 paragraphs distributed across four visual thinking skills, which are: (the skill of reading visual shapes, the skill of analyzing visual shapes, the skill of interpreting information in visual form, and the skill of inferring meaning from visual shapes). This verified the apparent validity test (assessors' validity).

Second: Construct Validity (Concept): There are several methods for verifying construct validity, including:

A- The relationship between the score of each paragraph and the total score for the domain to which it belongs: Pearson's correlation coefficient was used to find the correlation coefficients between the score of each paragraph and the score for the domain to which it belongs, the correlation coefficient values ranged between 0.491 and 0.821, when compared with the tabulated value of 0.361 at a significance level of 0.05 and a degree of freedom of 28, all were statistically significant, as shown in Table 3.

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Table 3: Correlation coefficient values between each paragraph and the total score for the corresponding domain in the visual thinking test

S.	Skill	Paragraph number	Correlation value	S.	Paragraph number	Skill	Correlation value
1	The skill of reading visual shapes	P 1	0.537	3	P 14	The skill of interpreting information in a visual form	0.582
		P 2	0.693		P 15		0.819
		P 3	0.667		P 16		0.718
		P 4	0.589		P 17		0.739
		P 5	0.599	4	P 18	The skill of deducing meaning from the visual form	0.491
		P 6	0.737		P 19		0.735
		P 7	0.567		P 20		0.821
		P 8	0.641		P 21		0.612
		P 9	0.678		P 22		0.554
2	Visual forms analysis skill	P 10	0.557		P 23		0.57
		P 11	0.73		P 24		0.632
		P 12	0.729		P 25		0.543
		P 13	0.598				

B- Relationship between each paragraph and the total test score: The correlation coefficient between the score of each paragraph and the total test score is statistically significant and is considered an indicator of the validity of the test construction, therefore, the researcher extracted the correlation coefficients of each paragraph with the total test score using Pearson's correlation coefficient.

The correlation coefficient values ranged between 0.546 and 0.876 when compared with the tabulated value (0.361) at a significance level of 0.05 and a degree of freedom of 28; all were statistically significant, as shown in Table 4.

Table 4: Correlation coefficient values between each paragraph and the total score for the visual thinking test

Paragraph number	Correlation values	Paragraph number	Correlation values
1	0.646	14	0.549
2	0.553	15	0.823
3	0.611	16	0.593
4	0.751	17	0.737
5	0.632	18	0.554
6	0.765	19	0.696
7	0.618	20	0.692
8	0.546	21	0.548
9	0.622	22	0.695
10	0.549	23	0.632
11	0.745	24	0.876
12	0.734	25	0.564
13	0.763		

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C- Relationship between each domain and the total test score: To verify the validity of the test construction, a correlation was found between the score for each domain of the test and the total test score, as the total score is a criterion for test validity, the correlation was calculated using Pearson's correlation coefficient, and the calculated correlation coefficients ranged between (0.759 – 0.872). When compared with the tabulated value (0.361) at a significance level of (0.05) and a degree of freedom of (28), all were statistically significant, which is an indicator of the internal consistency of the test items, as shown in Table 5.

Table 5: Correlation coefficient values between each domain and the total score for the visual thinking test

Item	Skills	Overall score of the test
1	The skill of reading visual shapes	0,872
2	Visual forms analysis skill	0.812
3	The skill of interpreting information in a visual form	0.765
4	The skill of deducing meaning from the visual form	0.759

- Exploratory application to test visual thinking skills: The exploratory sample was applied in two stages:

A- Application of the visual thinking test to the first exploratory sample: The test was applied to an exploratory sample consisting of 30 female students from the first intermediate grade who were selected by simple random sampling from the students of Al-Zawra Secondary School affiliated with the Maysan Education Directorate, in cooperation with the school administration, on 24/3/2023 for:

– To ensure the clarity of the paragraphs for which it was designed. It was found that all test paragraphs and answer instructions were clear.

– Calculating the time taken to administer the test. The average time taken by the first and last five students was calculated, and the average time was 50 minutes. The researcher deliberately chose the first exploratory sample and took care to administer the test herself.

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B- Second exploratory application: The purpose of this was to analyze the test items and then verify their psychometric properties, the researcher applied the visual thinking skills test on 25/3/2023 to a second random exploratory sample consisting of 100 female students, 50 from Al-Zawra Girls' Secondary School and 50 from Khaiber Intermediate School for Boys, in cooperation with the administrations of the two schools and the mathematics teachers. All students were notified a few days before the test date.

The answers of the exploratory sample were corrected, and then the scores were arranged in descending order, and the sample was divided into two groups: an upper group consisting of 27% of students and a lower group consisting of 27% of students.

Then, the following statistical analyses were performed on the two groups:

- Difficulty and discrimination coefficients for the items: To verify the difficulty of the visual thinking skills test items, the relevant equations were applied, it was found that the difficulty coefficients ranged between (0.398 – 0.587), and the ratio of difficulty and ease coefficients is considered acceptable if it ranges between (0.20 – 0.80). The discrimination coefficient of each test item was also calculated using specific discrimination equations and found to range between 0.317 and 0.585. A paragraph is considered good if its discrimination coefficient is 0.20 or higher. Therefore, the test paragraphs are considered good in terms of their discriminatory power, and thus they were retained without deletion or modification (Al-Zahir et al., 1999: 13). Table 6 shows the difficulty and discrimination coefficients for the visual thinking test items.

Table 6: Difficulty and discrimination coefficients for visual thinking test items

Paragraph number	Coefficient of difficulty	Discrimination coefficient
1	0.451	0.317
2	0.398	0.368
3	0.476	0.366
4	0.524	0.512
5	0.390	0.390
6	0.561	0.439
7	0.439	0.393
8	0.463	0.341
9	0.415	0.488
10	0.587	0.585

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11	0.512	0.488
12	0.549	0.512
13	0.549	0.512
14	0.488	0.585
15	0.488	0.488
16	0.476	0.366
17	0.500	0.317
18	0.476	0.561
19	0.463	0.537
20	0.452	0.512
21	0.451	0.366
22	0.503	0.561
23	0.451	0.512
24	0.476	0.463
25	0.439	0.439

- **False Alternative Effectiveness**: After applying the false alternative effectiveness equation to the test item alternatives, all results were negative, indicating that all alternatives were appropriate.
- **Test Stability:** Test stability was verified using the following method: Cronbach's alpha equation: The stability of the visual thinking skills test was calculated using Cronbach's alpha equation, and the stability coefficient was (0.87), which is a high value indicating that the test is highly stable and can be used to measure visual thinking, after confirming the validity and reliability of the visual thinking test, the test is ready for final application.
- **The Final Version of the Visual Thinking Test:** The final version of the test consists of 25 objective questions (multiple choice) with four alternatives, Appendix 2, which was prepared by the researcher to measure visual thinking skills, the test instructions were clarified, including some information about the students, the purpose of the test, the requirement to answer all questions, and the requirement to give only one answer per item.
- **Statistical Methods:** The results were analyzed and processed statistically using Microsoft Excel and the statistical program SPSS, which employed a set of statistical methods appropriate for the research.

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Chapter Four: Research Results and Interpretation

This chapter presents the researcher's findings, which aimed to identify the visual thinking skills of first-year middle school students in mathematics. The following is a presentation of the answers to the study questions:

Results related to the first question: What is the level of first-year middle school students' practice of visual thinking skills in mathematics?

To answer this question, the data were downloaded and statistically processed using a one-sample t-test, and the test's hypothetical mean (12.5) was compared with the sample mean (17.97), as shown in Table 8.

Table 8: One-sample t-test in the visual thinking test

Sample	Arithmetic mean	Hypothetical mean	Standard deviation	T value		Significance level (0.05)
				Calculated	Tabular	
80	17.97	12,5	2,62	18.62	1.66	Not significant

Table (8) shows that the calculated t-value was (18.62), which is greater than its tabulated value of (1.66). This indicates that first-year middle school students have a high level of visual thinking in mathematics.

Results related to the second question: Do visual thinking skills in mathematics differ among first-year middle school students according to gender?

To answer this question, the researcher used a t-test for two independent samples to compare the scores of the two groups. The results are shown in Table 9.

Table 9: T-test for two independent samples in the visual thinking test

Gender	Sample	Arithmetic mean	Standard deviation	T value		Significance level (0.05)
				Calculated	Tabular	
Males	40	18.57	2.50	2.08	1.66	
Female	40	17.37	2.64			

From Table (9), it is clear that the calculated T value was (2.08), which is greater than its tabular value of (1.66), this indicates that there are statistically significant differences in the level of visual thinking in mathematics among the students of the first average according to the gender variable, and in favor of males, as the arithmetic mean of their group was (18.57) with a standard

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deviation of (2.50), while the arithmetic mean for the female group was (17.37) with a standard deviation of (2.64).

Conclusions:

The most important conclusions reached by the research:

1- The level of visual thinking in mathematics among students of the first intermediate is high, this is because their study of the material was good, which helped in the development of their visual thinking.

2- The researcher believes that providing the optimal study environment motivates students to think visually in mathematics.

3- Male students have a higher level of visual thinking than female students.

Recommendations:

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

1. Increasing attention to the content of the mathematics curriculum to help mathematics teachers in developing visual thinking and other types of thinking among students.
2. Providing educational programs based on visual thinking to remove the obstacles faced by students during the different academic stages.
3. The use of educational activities by mathematics teachers that develop the visual thinking of students.
4. Paying attention to teaching methods and methods that develop visual thinking.
5. Include in the teacher's guide well-prepared lessons and models that develop students' visual thinking.

Proposals: To complement the results of the research, the researcher proposes to conduct the following studies:

1- The role of mathematics teachers in developing visual thinking among students in the primary stage.

2- Building a training program based on visual thinking for middle school students in different subjects.

3- Conducting studies dealing with visual thinking skills with other variables.

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