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DESIGNING A TRAINING PROGRAM BASED ON SHWARTZ'S MODEL AND ITS EFFECT IN PIVOTAL THINKING FOR MATHEMATICS TEACHERS AND THEIR PUPILS' ACHIEVEMENT AND THEIR VISUAL THINKING

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ABSTRACT

This study aims to develop a training program for mathematics teachers according to the Schwartz model and to examine its effect on three main aspects: developing teachers' critical thinking, improving fifth-grade students' academic achievement, and enhancing their visual thinking. To achieve the study objectives, the researcher relied on a sample of 35 primary school mathematics teachers in Misan Governorate, divided into two groups: an experimental group of 18 teachers who received the training program designed according to the steps for developing training programs, which included 16 training sessions, and a control group of 17 teachers who did not receive the training. Additionally, 15 students were selected from each teacher, bringing the total number to 525 fifth-grade students. The study instruments included a critical thinking test for teachers (21 essay items), an achievement test (30 objective items), and a visual thinking test (25 multiple-choice items) for the students. The validity and reliability were verified, and difficulty, discrimination, and distractor efficiency were calculated. Various statistical methods were used, such as the t-test, Mann-Whitney test, and effect size.

The results showed statistically significant differences at the 0.05 level between the two groups, favoring the experimental group, across all variables (teachers' critical thinking, student achievement, and students' visual thinking).

The study concluded with a recommendation to train mathematics teachers in integrating thinking skills into their teaching according to Schwartz's model. It also suggested expanding similar studies to include teachers at other educational levels, as well as student teachers, to determine the program's impact on developing their cognitive abilities and learning skills.

KEYWORDS

Introduction

The Problem:

The teacher is the cornerstone of the educational process, as their level of competence directly affects students' growth and the development of their thinking (Al-Kubaisi, 2013: 19). Despite educational emphasis on the importance of teaching thinking and developing its skills, the educational reality does not provide sufficient opportunities for its practice. Instruction is predominantly based on memorization and rote learning, and thinking skills are rarely incorporated into the curriculum (Butrus, 2015).

Studies indicate the necessity of in-service training for mathematics teachers in teaching thinking skills, including specialized programs such as the Schwartz model, which aims to provide a learning environment that supports self-directed learning and visual thinking, positively impacting student achievement (Al-Hadidi, 2017: 2; Al-Jizani, 2016: 3). Based on the researchers field experience, a decline in primary school students' mathematics achievement was observed due to insufficient teacher training in integrating thinking skills into the curriculum.

Therefore, the study problem is defined by the following main question: What is the impact of developing a training program based on the Schwartz model on the critical thinking skills of mathematics teachers and their students' achievement and visual thinking?

Importance of the Study:

Training programs are the backbone of teacher development, as they contribute to raising teachers' academic and professional levels, improving their performance, and enabling them to create a classroom environment that stimulates students' thinking and creativity (Al-Surour, 2005: 23). Teaching thinking skills is considered one of the most important tasks of the teacher, especially in mathematics, which involves organizing ideas, solving problems, and developing various thinking skills (Al-Absi, 2009: 26).

John Dewey indicates that learners need an educational upbringing that enables them to think scientifically and rationally (Qatami & Omaima, 2005: 47), while Piaget believes that the primary goal of education is to prepare creative individuals capable of innovation (Alaqat & Fatima, 2015: 140). With the rapid development in various fields, thinking has become an essential necessity for facing the challenges of daily life, and its skills can be developed through appropriate training programs (Alwan, 2012: 90).

Studies indicate that integrating thinking skills into the curriculum improves students' achievement and visual thinking, especially when using Schwartz's model, which promotes active participation in forming a coherent cognitive structure (Saad & Tahseen, 2005: 30; Al-Sheikh, 2017: 3). Training in critical thinking also contributes to acquiring fundamental skills such as focus, organization, analysis, and evaluation, which supports mathematical achievement and contributes to developing students' mental abilities (Abu Jadu & Muhammad, 2015: 74-78; Al-Mashhadani, 2011: 38).

Theoretical Significance of the Study:

1. Addressing the scarcity of training programs that focus on integrating thinking skills into the curriculum.
2. Developing teacher competencies, which will positively impact student performance.
3. Offering suggestions for developing in-service teacher training programs.
4. Emphasizing the importance of critical thinking, achievement, and visual thinking in mathematics at the primary level.

5. Highlighting the importance of the primary stage as a foundation for subsequent educational stages.
Applied Significance of the Study:
1. Developing a training program based on Schwartz's model to train mathematics teachers in thinking skills.
2. Developing teachers' skills such as comparison, observation, summarization, and classification for use in teaching.
3. Improving students' achievement and visual thinking when the program was implemented with the study sample. 4. To leverage collaborative work and discussion among trainees to enhance their scientific backgrounds.
5. To provide the educational field with tests of critical thinking, visual thinking, and achievement for fifth-grade students.
6. To assist specialists in developing curricula and teacher training programs focused on thinking skills.
Third: Study Objectives:
• To develop a training program based on Schwartz's model for mathematics teachers.
• To determine the impact of the training program on:
1) The critical thinking skills of mathematics teachers.
2) The achievement of their fifth-grade students.
3) The visual thinking skills of their fifth-grade students.
Fourth: Study Hypotheses:
To achieve the study objectives, the researcher formulated the following null hypotheses:
1) There is no statistically significant difference at the significance level (0.05) between the mean scores of mathematics teachers who were trained according to the training program (experimental group) and mathematics teachers who were not trained according to the program (control group) in the overall score of the pivotal thinking test.
From this hypothesis, the following sub-null hypotheses were derived:
- There is no statistically significant difference at the significance level (0.05) between the mean scores of mathematics teachers who were trained according to the training program (experimental group) and mathematics teachers who were not trained according to the program (control group) in the skill of concentration. - There is no statistically significant difference at the 0.05 level between the mean scores of mathematics teachers who were trained according to the training program (experimental group) and mathematics teachers who were not trained according to the program (control group) in the skill of collecting information.
- There is no statistically significant difference at the 0.05 level between the mean scores of mathematics teachers who were trained according to the training program (experimental group) and mathematics teachers who were not trained according to the program (control group) in the skill of recall.
There is no statistically significant difference at the 0.05 level between the mean scores of mathematics teachers who participated in the training program (experimental group) and those who did not participate (control group) in the organization skill.
- There is no statistically significant difference at the 0.05 level between the mean scores of mathematics teachers who participated in the training program (experimental group) and those who did not participate (control group) in the analysis skill.

- There is no statistically significant difference at the 0.05 level between the mean scores of mathematics teachers who participated in the training program (experimental group) and those who did not participate (control group) in the generation skill. - There is no statistically significant difference at the 0.05 level between the mean scores of mathematics teachers who participated in the training program (experimental group) and mathematics teachers who did not participate in the program (control group) in the integration skill.
- There is no statistically significant difference at the 0.05 level between the mean scores of mathematics teachers who participated in the training program (experimental group) and mathematics teachers who did not participate in the program (control group) in the evaluation skill.

2) There is no statistically significant difference at the 0.05 level between the mean scores of mathematics teachers who participated in the training program (experimental group) on the pre- and post-tests of pivotal thinking.

3) There is no statistically significant difference at the 0.05 level between the mean scores of students whose mathematics teachers were trained according to the training program (experimental group) and students whose teachers were not trained according to the training program (control group) on the achievement test.

4) There is no statistically significant difference at the 0.05 level between the mean scores of students whose mathematics teachers were trained according to the training program (experimental group) and students whose teachers were not trained according to the training program (control group) on the visual reasoning test.

Fifth: Study Limitations:

The study is limited to: -

• Primary school mathematics teachers in the General Directorate of Education of Maysan Governorate.
• Fifth-grade students in primary schools affiliated with the General Directorate of Education of Misan Governorate.
• Chapters on mathematics (large numbers, addition and subtraction of large numbers, multiplication, division, and decimals) from the fifth-grade mathematics textbook for the 2024/2025 academic year.

Sixth: Defining Terms:

1) Training Program: It has been defined by:

• (Sayed and Abbas, 2012): A planned activity with specific objectives that have been precisely formulated based on the trainees' actual needs. The aim is to bring about changes in the trainees' knowledge, experience, skills, performance, work methods, and organizational behavior. Scientific methods are used in an environment that fosters professional and personal growth and encourages cooperative and individual learning for the trainees (Sayed and Abbas, 2012: 15). (Zayer et al., 2013): An integrated system of content that organizes knowledge, processes, skills, experiences, activities, and teaching strategies aimed at developing trainees' thinking skills and knowledge in order to improve their performance and ability to find appropriate solutions to assigned problems (Zayer et al., 2013: 21).

Operational Definition:

It is a set of skills, activities, and strategies planned to train mathematics teachers from the study sample (the experimental group) in thinking skills based on Schwartz's model. It helps them develop their scientific and practical experiences and enhances their critical thinking. This is achieved through

specific sessions and a defined timeframe, and is measured by the impact the training program has on the experimental group teachers as a result of testing the null hypotheses prepared by the studyer for the aforementioned purpose. 2) Schwartz's Model: This model has been defined by:

- (Al-Hajajja, 2014): A model for teaching thinking skills that emerged in the last decade of the 20th century, developed by Robert Schwartz. It emphasizes training individuals in analytical, critical, and creative thinking skills concurrently with training in metacognitive thinking skills, using verbal mind mapping strategies, graphic organizers, and thinking-based writing (Al-Hajajja, 2014: 10).
- (Al-Darawsha, 2014): A model that aims to teach thinking through integration, focusing on combining theoretical information received by the learner with thinking skills, using graphic organizers and verbal instructions. (Al-Darawsha, 2014: 8)

Operational Definition:

A model that seeks to integrate thinking skills (comparison and contrast, observation, summarization, classification, identifying the relationship between part and whole, classroom questioning, decision-making, problem-solving, critical thinking, creative thinking, and metacognitive thinking) with the mathematics curriculum content to make it more comprehensible. This is achieved by training mathematics teachers, which in turn improves their teaching of mathematics to fifth-grade students.

3) Focused Thinking: It has been defined by:

- (Al-Absi, 2009): Discrete or connected cognitive processes that represent fundamental building blocks in the structure of thinking. It consists of eight skills: (focus, information gathering, recall, organization, analysis, generation, integration, and evaluation) (Al-Absi, 2009: 219). Wilson (Abu Jadu & Muhammad, 2015) defines thinking as: specific mental processes that we intentionally use to process information in order to achieve diverse educational goals, ranging from remembering and describing things and taking notes to predicting events, classifying things, establishing evidence, solving problems, drawing conclusions, and making decisions (Abu Jadu & Muhammad, 2015: 77).

Operational Definition:

It is the trainee's ability to use the eight main core thinking skills and 21 sub-skills in the pre- and post-tests of core thinking, which are essay-type and designed for the purposes of this study. This ability is indicated by the trainee's total score resulting from their responses to the test items.

4) Achievement: It has been defined by:

Abu Zeina (2010): It is the learner's acquisition of knowledge, understanding, and mathematical skills as a result of exposure to specific educational experiences (Abu Zeina, 2010: 347). (Allam, 2010): It is defined as the achievement or proficiency in a specific skill or set of knowledge; that is, the acquired knowledge or developed skill in academic subjects, and it is represented by the scores on tests set by the teacher for his students (Allam, 2010: 55).

Operational Definition:

The sum of what fifth-grade elementary students learn in terms of mathematical information and skills after being taught the specified material (the first five chapters of the prescribed mathematics textbook). It is measured by the scores students obtain after answering the items on the objective test (four alternatives) for mathematics, which was prepared for the purpose of this study.

5) Visual Thinking: It was defined by:

(Ammar and Najwan, 2011): The mental ability that relies on the shapes, drawings, and images presented in the situation and the relationships involved therein. The individual must find meaning in the content presented to him in a verbal form (written or spoken) (Ammar and Najwan, 2011: 21).
(Moore, 2015): Visual perception is defined as mental representations of sensory experiences, perceptions, and imaginations, and the ability to interact with symbols representing elements of the internal or external environment using mental images.(Moore, 2015: 95)
Operational Definition:
The ability of fifth-grade students to think using their sense of sight, as demonstrated in their responses to visual thinking test items, by identifying and describing shapes, connecting information, interpreting ambiguity, and extracting meaning. This is measured by the total score they obtain on the test designed for this study.

Chapter Two:
Theoretical Framework and Previous Studies
• Training Program:
Training is a fundamental element in developing human behaviors and improving performance. It provides individuals with new knowledge and skills and influences their attitudes and behaviors. Their behavior within the educational institution fosters dedication and a sense of belonging to the work (Al-Lawzi, 2003: 289). In this context, in-service teacher training is viewed as a structured and planned process aimed at equipping them with the knowledge and experience that develops their abilities and meets their professional needs, leading to their job compatibility and the achievement of diverse objectives related to the training topic and the trainees' level (Sayed & Abbas, 2012: 16).

Training Principles:
The general principles of training can be summarized as follows:
1. To bring about a desirable behavioral change that is observable and measurable.
2. To provide trainees with practical skills that can be demonstrated through their performance.
3. To raise morale and improve their attitudes toward the profession.
4. To encourage self-learning and continuous participation in professional development courses.
5. To utilize incentives as a key factor in ensuring the success of the training process (Al-Duwaik, 1985: 40).

Benefits of In-Service Training
Studies have indicated a range of benefits for teachers participating in in-service training programs, including:
- Acquiring new experiences that qualify them to assume greater responsibilities.
- Enhancing self-confidence and boosting morale.
- Improving performance and increasing job satisfaction.
- Developing educational outcomes through skill refinement.
- Reinforcing professional conduct and instilling work ethics.
- Addressing changes in educational systems and keeping pace with scientific and technological advancements (Al-Sakarna, 2011: 30).

Basic Principles of Training

Modern training programs are based on several principles, including: reliance on a theoretical framework, setting clear objectives, meeting trainees' needs, aligning theory and practice, promoting self-directed learning, leveraging technology and modern study, individualizing training, and adopting a multimedia approach (Al-Khatib & Radah, 2013: 27-32).

The Importance of Training:

The importance of training lies in its role as a means of equipping individuals with new experiences that qualify them to assume greater responsibilities, assist them in decision-making and problem-solving, enhance job satisfaction, overcome anxiety and stress, and increase their self-confidence through the acquisition of new skills and experiences (Abu Shandi, 2011: 38).

Types of Training:

Pre-service Training: This precedes employment and aims to prepare and qualify teachers to perform their professional role (Al-Shaer, 1991: 14).

In-Service Training: This is considered more important, as it contributes to updating knowledge and skills to keep pace with educational and technological developments (Al-Mawla, 2011: 170). The studyer adopted this approach in developing her training program.

Theoretical Foundations of Training:

Training draws its foundations from several educational theories, including:

Cognitive Theory: Focusing on thinking processes, cognitive structure, and individual differences (Qatami & Naifeh, 1998: 37).

Behavioral Theory: Viewing learning as a change in observable behavior that can be monitored and reinforced (Qatami & Naifeh, 2000: 56).

Humanistic Theory: Focusing on the learner as an independent individual and fostering self-confidence and creativity (Muhyiddin & Abdul Rahman, 1997: 148).

Social Theory: Highlighting the role of modeling, observation, and interaction in learning (Karajah, 1997: 120).

Steps for Building a Training Program

The literature indicates that building a training program involves three main stages:

1. Planning Stage: This includes analyzing the trainees' needs and characteristics, the course content, activities and skills, and the training environment. It also includes designing the program by setting clear objectives, appropriate scientific content, and training strategies and media (Al-Zand, 2018: 409).
2. Implementation Stage: This includes preparing a daily implementation plan, organizing activities, defining content according to objectives, preparing training materials, monitoring trainee attendance, and submitting a final implementation report (Al-Zand, 2004: 493).
3. Evaluation Stage: This aims to assess the program's validity and effectiveness and includes:

Pre-evaluation: Before the program begins, to gather basic information.

Formative evaluation: During implementation to ensure that performance aligns with the objectives.

Summative evaluation: After the program's completion, to measure the results (Al-Zand & Hani, 2010: 332-333).

The Concept of Thinking:

Thinking is the highest form of mental activity in humans, distinguished from other creatures by its ability to solve problems, understand relationships, and organize experiences in new ways (Abu Jadu & Muhammad, 2015: 25). It is an integrated cognitive process influenced by perception, memory, and personal and social aspects, and it varies between conscious and subconscious thinking (Ghabari & Khalid, 2011: 22; Jaber, 2010: 24).

Characteristics of Thinking:

1. Purposeful and goal-oriented behavior.
2. Developmental behavior that changes with the individual's growth and experiences.
3. Relative and unattainable.
4. Shaped by the influence of environment, situation, and experience.
5. Manifests in diverse forms: verbal, symbolic, quantitative, logical, spatial, and formal (Al-Zand, 2016: 229).

Levels of Thinking:

Metacognitive: Planning, Monitoring, Evaluation

Cognitive: Processes (critical, creative, reasoning) and strategies (problem-solving, decision-making, concept formation).

Skills: Classification, reasoning, creative, critical, and metacognitive thinking (Abdul Aziz, 2009: 26).

Difficulty level: Basic (memorization, comprehension, application) and advanced (complex, critical, and creative thinking).

Assumptions of thinking: Any thinking has a clear objective and is based on assumptions and logical evidence.

Thinking represents an attempt to discover something or solve a problem.

It has applications and effects that must be evaluated (Saada, 2006: 58-59).

Theories of teaching thinking:

1. Behavioral theory: Learning results from the relationship between stimulus and response, and experience forms the basis of thinking (Abdul Hadi et al., 2003: 76-79).
2. Cognitive theory: Thinking results from processing sensory information and converting it into perception via memory (Abdul Aziz, 2009: 67).
3. Gestalt Theory: A holistic understanding of phenomena and the connection between the elements of a situation to reach a solution (Al-Zand, 2016: 237-238).
4. Humanistic Theory: Freedom and intrinsic motivation help develop thinking and creativity (Ghanem, 2009: 75-81).

Trends in Teaching Thinking Skills:

1. Direct instruction independent of the curriculum: Programs and courses dedicated to thinking skills.
2. Instruction within the curriculum: Teaching skills concurrently with the curriculum content.
3. Integrated instruction: Integrating independent programs with the curriculum content to develop thinking skills holistically (Abu Jadu & Muhammad, 2015: 47-48).

Importance of Thinking Skills:

For the learner: Enhanced understanding, self-confidence, independence, problem-solving, and readiness for practical life.

For the teacher: Effective planning, application of modern strategies, and promotion of interaction and classroom participation (Saada, 2006: 77-78).

Obstacles to Teaching Thinking Skills:

Traditional curricula and a lack of innovation, the teacher's passive role, students' reliance solely on textbooks, limited use of teaching aids, neglect of individual differences, and evaluating students with questions of a low cognitive level (Al-Ayasrah, 2011: 91; Ma'mar, 2006: 43).

Factors for the Success of Teaching Thinking Skills:

1. The Teacher's Role: Motivating, facilitating, and encouraging students.
2. The School and Classroom Environment: Providing a safe and interactive climate that supports discussion and participation.
3. The Suitability of Educational Activities: Selecting activities that challenge students' abilities and connect the content with thinking skills (Jarwan, 1999: 143-144; Abu Jadu and Muhammad, 2015: 40).

The Swartz Model:

The Swartz Model aims to integrate thinking skills into the curriculum to make learning more dynamic and stimulating for students' thinking, with a focus on analytical, creative, critical, and metacognitive thinking. The model aims to make thinking an accessible educational goal for all students, and encourages the adoption of mental Positive traits such as perseverance, initiative, and flexibility are fostered, while enhancing teachers' ability to guide students toward effective thinking (Qatami, 2013: 206).

Steps for Integrating Thinking Skills According to the Model:

1. Lesson Introduction: Preparing students for the lesson content and the thinking skill by defining the title, clarifying the objectives, and activating prior knowledge and experiences.
2. Skill Demonstration: Demonstrating how to perform the skill practically in front of the students using guiding questions.
3. Active Thinking: Engaging in individual or collaborative activities to integrate the skill with the content using graphic organizers to illustrate the relationships between pieces of information.
4. Thinking About Thinking: A reflective activity that helps students review and evaluate their thinking processes (metacognitive thinking).
5. Applying Thinking: Engaging in new activities to expand the application of the skill in similar or different situations (near and far transition).
6. Evaluating Thinking: Individual activities to assess the thinking skill using guiding questions and graphic organizers (Al-Qawasmeh & Muhammad, 2013: 265-267).

Thinking Skills Relied Upon in the Model:

1. Comparison and Contrast: Identifying similarities and differences to reach an understanding or make a decision (Nofal & Ferial, 2010: 51).
2. Observation: Acquiring information about objects and events using the five senses (Saada, 2006: 353).
3. Summarizing: Briefly re-presenting information to reinforce understanding and solidify ideas (Mustafa, 2002: 211).
4. Classification: Grouping elements according to common characteristics to promote order and understanding (Saada, 2006: 422).
5. Determining the Relationship Between Part and Whole: Analyzing the constituent parts of the whole to form accurate conclusions (Abu Jadu & Muhammad, 2011: 75).
6. Asking Classroom Questions: Formulating effective questions to support independent learning (Saada, 2006: 367).

7. Decision-Making: Choosing the optimal solution to a specific problem based on accurate information (Mustafa, 2002: 68).
8. Problem-solving: Overcoming obstacles to reach a goal through organized thinking processes (Nofal & Ferial, 2010: 109).
9. Critical thinking: Judging and studying matters carefully to reach sound conclusions. This includes deduction, induction, differentiation, and prediction (Al-Absi, 2009: 194-199; Saadeh, 2006: 179; Abdul Aziz, 2009: 161).
10. Creative thinking: The ability to produce new and innovative ideas. This includes fluency, flexibility, originality, and detail (Qatami, 2014: 763; Al-Ayasrah, 2013: 86-95).
11. Metacognitive thinking: Higher levels of thinking. This includes planning, monitoring, and self-evaluation of thinking (Obeid, 2011: 217-218).
Core Thinking Skills:
Core thinking skills represent the fundamental building blocks of thinking. Robert Marzano and colleagues, with support from the American Association for Curriculum and Instruction, identified 21 skills within eight main categories (Abu Jadu & Muhammad, 2015: 77-78).
1. Focusing Skill:
This skill directs the learner's attention to important information while ignoring unnecessary details. It emerges when encountering a problem or a lack of understanding. It includes:
Defining Problems: Clarifying questionable situations.
Setting Goals: Precisely defining learning outcomes to achieve effective learning (Marzano et al., 2004: 164-167).
2. Information Gathering Skill
This skill involves collecting data and information from various sources. It includes:
Observation Skill: Using the senses to acquire information (Saada, 2006: 353).
3. Question Formulation Skill: Formulating effective questions to generate new information (Atoum, 2012: 11).
4. Remembering Skills: Strategies for storing information in long-term memory:
Encoding: Converting information into mental symbols (Saeed, 2009: 294).
Recalling: Retrieving information when needed (Saeed, 2009: 294).
5. Organizing Skill: Arranging information to enhance understanding and effectiveness, including:

- Comparing
- Classifying
- Ordering

Representing information to transform it into diagrams or tables (Abu Jadu & Muhammad, 2015: 88-93).
This skill involves creating effective questions to generate new information. 5. Analysis Skill: Examining data and relationships, identifying key components, ideas, and errors. This includes: identifying features and components; identifying patterns and relationships; identifying main ideas; and identifying errors (Atoum, 2012: 12; Ibrahim, 2011: 212-213).
6. Generation Skill: Adding prior knowledge to new information. This includes: inferring; predicting; and elaborating (Al-Absi, 2009: 236-239).
7. Integrating Skills: Combining new learning with prior knowledge to build a deeper understanding. This includes: summarizing; and reconstructing to reorganize and expand upon information (Kizlik,

2009: 33). 8. Evaluation Skills: Making judgments about the validity or plausibility of information, including:
Establishing Criteria:
Verifying Information (Al-Afoun, 2012: 251).
The researcher adopted all these main and sub-skills in designing the items for the pivotal thinking test, tailored to the sample of mathematics teachers.
Academic Achievement: Academic achievement is a fundamental pillar of the educational process, as it measures the extent to which educational and pedagogical goals are achieved. It reflects the learner's competence and level of mental and cognitive performance (Al-Khaldi, 2008: 89). Achievement is also an indicator of the quality of educational institutions and their progress toward achieving their goals (Al-Zaher et al., 1999: 50). Achievement represents the learner's overall result at the end of the academic year, revealing strengths and weaknesses in various subjects. It is measured through regular assessments such as monthly, mid-year, and final exams (Nasrallah, 2010: 35; Al-Hassani, 2011: 329-331).
Aspects of Achievement:
Achievement can be developed through four main axes (Attia, 2008: 301):
1. The ability to recall and use facts: measuring information stored in memory.
2. Practical skills: applying knowledge, problem-solving, and scientific study.
3. Personal and social skills: communication, initiative, independence, and leadership abilities.
4. Motivation and self-confidence: the learner's self-esteem and belief in their abilities.
Factors Affecting Achievement:
1. Physical factors: health, nutrition, and physical constitution affect the ability to concentrate and achieve academic success (Al-Sarhan, 2004: 35).
2. Cognitive factors: intelligence is directly linked to achievement, and its measurement is essential when performance is weak.
3. Emotional Factors: Anxiety and emotional disturbances reduce the ability to comprehend and concentrate.
4. Social Factors: The family environment and social surroundings influence the level of academic achievement.
5. School Factors: The quality of the building, its facilities, curriculum, teaching methods, activities, educational resources, and the teacher all affect academic performance (Nasrallah, 2010: 5-12).
Achievement emerges as a fundamental tool for evaluating the effectiveness of educational experiences and determining the extent of the learner's success in acquiring knowledge and skills.
Visual Thinking: Visual thinking is a form of higher-level thinking that enables the learner to have a comprehensive view of the subject matter and understand the surrounding environment through the ability to visualize spatially and study shapes, similarities, and differences between them (Razouqi & Suha, 2013: 250). Arnheim believes that visual thinking is linked to imagination and creativity, and the learner relies on visual knowledge in processing information, with the importance of using drawings and images in thinking (Al-Haddad & Abdullah, 2000: 53-55).
Visual thinking develops in parallel with language and experience, distinguishing between visual and linguistic processing (Badawi, 2008: 128). It is also defined as the perception of relationships between images and visual stimuli for problem-solving (Attia, 2009: 28), and is characterized by recalling up

to 80% of visual information, compared to 30% for reading and 10% for listening (Ammar and Najwan, 2011: 18).

Components of Visual Thinking:

Visual thinking consists of three integrated components: seeing, imagining, and drawing. Each component supports the others to facilitate understanding, enhance imagination, and transform ideas into drawings that aid in comparison and evaluation (Obaid, 2004: 280; Afana, 2006: 41-42).

Advantages of Visual Thinking (Muhammad, 2004: 39)

• Improves the quality of learning and increases student engagement.
• Promotes commitment and classroom participation.
• Supports the exchange of ideas and different teaching methods. • Deepening thinking and building new systems.
• Developing problem-solving skills. Problems.
• Facilitating the recall of information for extended periods.

Visual Thinking Methods (Razouqi & Suha, 2013: 247)

1. Vision: Assimilating and processing visual information from the environment.
2. Imagination: Visualizing events and objects based on prior experiences.
3. Writing and Drawing: Organizing ideas visually and verbally to facilitate understanding and comparing solutions.

Methods for Developing Visual Thinking Skills (Ibrahim, 2008: 84)

- Practicing visual activities such as designing and reading visual networks and analyzing information.
- Using computer and artistic tools to visually represent information and discover new concepts.

Sub-Skills of Visual Thinking (Al-Afoun & Muntaha, 2012: 176-177)

1. Recognizing and describing shapes.
2. Analyzing shapes and identifying precise relationships.
3. Connecting information and distinguishing between relationships.
4. Perceiving and interpreting ambiguity and symbols.
5. Extracting scientific meanings and concepts from visual aids.

The researcher relied on these skills in constructing the items of the visual thinking test for fifth-grade students in mathematics.

Previous Studies:

• (Al-Hadidi, 2017): Designing a teaching strategy based on integrating thinking skills with content and its impact on developing core thinking skills and mathematical communication among fifth-grade science students.
• (Al-Sheikh, 2017): The effectiveness of a program based on Schwartz's model in developing critical thinking skills in science and life among fourth-grade female students in Gaza.
• (Al-Agha, 2017): The effect of using the formal organizer strategy in developing visual thinking and solving geometric problems among ninth-grade female students in Gaza.

Aspects of Benefiting from Previous Studies:

The researcher reviewed several previous studies to benefit from them in several areas, including:

1. Understanding the steps involved in developing training programs and integrating thinking skills into the curriculum.
2. Understanding the study methodology and experimental design used in previous studies.
3. Identifying the equivalence variables used in previous studies.

4. Understanding the sample size, type, and gender in previous studies.
5. Understanding the instruments used in the studies and how they were constructed.
6. Understanding the statistical methods used in previous studies.
7. Understanding the thinking skills used according to Schwartz's model and the critical thinking skills used in previous studies.
8. Reviewing the results obtained and using them in discussing the study findings.
9. How to define the study problem and formulate the questions and hypotheses that will be used to answer the study questions.

Chapter Three:
Study Procedures:
First: Developing the Training Program

The researcher developed the training program after reviewing relevant literature on educational training programs and examining several previous studies, including: Al-Sakaker (2010), Al-Atabi (2012), Al-Hajajja (2014), Al-Suwait (2014), Al-Sheikh (2015), and Al-Khafaji (2016). The development process was based on three main stages:

1- Planning Stage

This stage included:

1. Analyzing the characteristics of the trainees: All were graduates of colleges of education (Education, Open Education, and Basic Education), had no prior experience in training programs, and possessed (3-12) years of experience. The results of the pre-test, according to Schwartz's model, showed the equivalence of the two groups (experimental and control).
2. Analyzing training needs: These were identified through meetings with mathematics supervisors and teaching methodologists, as well as the results of the pre-test, which allowed for the identification of the actual needs of mathematics teachers.
3. Analysis of Training Content: A questionnaire was developed to identify thinking skills according to Schwartz's model. This questionnaire was reviewed by experts, and their feedback was taken into consideration.
4. Analysis of the Training Environment: The training was organized in cooperation with the Preparation and Training Division of the Misan Education Directorate, consisting of (32) training hours at Hajar Girls' Secondary School.

During the Design Phase:

1. The content was selected to align with the study objectives and the teachers' needs.
2. Specific objectives were formulated, most notably: equipping teachers with thinking skills according to Schwartz's model, integrating these skills into mathematics teaching, and encouraging their application.
3. Diverse training strategies were adopted (individual learning, mind mapping, discussion, brainstorming, cooperative learning, etc.).
4. Training resources were prepared (training venue, timing, materials, and cost).
5. The program's validity was verified by presenting it to experts with an 80% agreement rate, followed by a pilot test with a sample of (7) teachers to ensure the clarity and duration of the sessions.

2- Implementation Phase

The program was implemented over nine training days, during which the studyer personally led the sessions and monitored participants' performance through classroom activities, homework assignments, lesson plan preparation, and mind mapping.

3- Evaluation Phase

1. Pre-assessment: The pre-test of pivotal thinking and the Schwartz test were administered to determine the initial level.

2. Formative assessment: This relied on feedback through discussions, activities, and short quizzes following each session.

3. Summative assessment: This included the post-test of pivotal thinking, attendance at sessions, and completion of activities. All participants successfully completed the program and received certificates of participation and letters of appreciation from the Misan Education Directorate.

Second: Methodology:

Study Methodology:

The researcher adopted two complementary methodologies: the experimental method and the descriptive method (content analysis). The experimental method involves making a controlled change in conditions to measure its effect on a specific variable, while the descriptive method focuses on providing accurate descriptions of phenomena and their analysis. Regarding the experimental design, the True Experimental Design (TED) was used, as it is the most controlled and reliable design in terms of internal validity. It relies on the random assignment of groups (Creswell, 2012: 309).

Accordingly, the following were chosen:

• A two-group equivalent design (pre-test–post-test) to measure the core thinking variable among female teachers.

• A two-group equivalent design (post-test only) to measure the achievement and visual thinking variables among the students of female mathematics teachers.

Thirdly, the study population:

The study population consisted of the following:

a) The teachers' population:

This study population consisted of mathematics teachers in primary schools in Misan Governorate.

b) The students' population:

The students' population consisted of all fifth-grade students in the Maysan Education Directorate for the academic year (2024-2025).

Fourth: The Study Sample:

A- Teachers' Sample:

The sample was selected using simple random sampling from the study population, and included female teachers holding a bachelor's degree who teach the class Fifth grade students in the schools of the General Directorate of Education in Misan. The teachers were randomly divided into two groups:

Experimental group: (18) teachers who participated in the training program.

Control group: (17) teachers who did not participate in the program.

B- Student sample:

It consisted of fifth grade students taught by the teachers in the sample, and they were randomly selected (from those who did not fail) for the 2024-2025 academic year. (15) students were selected from each teacher, for a total of (525) students, distributed as follows:

(270) students from the teachers in the experimental group.

(255) students from the teachers in the control group.

V. Equivalence of study groups:

The researcher ensured the equivalence of the two study groups in a number of variables that she believed might affect the results of the experiment, for both the teachers and the students, as follows:

A. Teachers:

• Test according to Schwartz's model:

The pre-test, based on Schwartz's nine-item essay model, was administered to determine the study sample's prior knowledge of the model. The total score for the test was 40 points. The test was administered on September 10, 2024, to the study sample (mathematics teachers).

To confirm the significance of the difference, the Mann-Whitney U test for independent samples was used. The calculated U-value was 143.500 at a significance level of 0.750, which is greater than the established significance level of 0.05. This indicates the equivalence of the two groups (experimental and control) on this variable before the experiment.

• Years of Service:

Data on the years of service of the study sample teachers, whose service ranged from 3 to 12 years, were obtained from a pre-prepared information form. To confirm the significance of the difference, the studyer used the Kolmogorov-Smirnov test. The calculated value was 0.146 at a significance level of 1, which is greater than the established significance level of 0.05. This indicates that there is no statistically significant difference between the two groups, demonstrating the equivalence of the experimental and control groups in this variable before the experiment.

• Education:

The researcher ensured the equivalence of the two study groups in this variable, as all trainees held bachelor's degrees from colleges of education, basic education, and open education.

B. Student Equivalence:

The researcher ensured the equivalence of the students in the following variables:

1. Prior Knowledge in Mathematics

To ensure that the students in the study sample possessed prior mathematical knowledge related to the topics of the experiment, the researcher prepared a test consisting of 15 multiple-choice items (four alternatives each), covering concepts previously learned by the students in earlier stages. The test was administered from October 8, 2024, to October 24, 2024, and the responses were scored by awarding one point for each correct answer.

The results showed that the mean score of the experimental group was 8.43 with a standard deviation of 2.098, while the mean score of the control group was 8.13 with a standard deviation of 2.082. Using an independent samples t-test, the calculated t-value (1.645) at a significance level of 0.350 was greater than the established significance level of 0.05, indicating no statistically significant difference between the two groups. Therefore, it can be concluded that the two groups were equivalent in their prior knowledge of mathematics before the start of the experiment.

2- Prior Achievement in Mathematics

The researcher relied on the final grades obtained by the students in the mid-year exams for the academic year 2024–2025, as recorded in the school records, to measure prior achievement. After calculating the means, it was found that the experimental group students achieved a mean score of 68.88 with a standard deviation of 13.293, while the control group achieved a mean score of 67.80 with a standard deviation of 13.297.

Using the independent samples t-test, the calculated t-value was 0.935 at a significance level of 0.101, which is greater than the established significance level of 0.05. This indicates no statistically significant difference between the two groups, confirming their equivalence in prior mathematics achievement before the start of the experiment.

Sixth: Study Tools:

The study requires the development of three tests to measure the dependent variables: a pivotal thinking test for teachers, an academic achievement test, and a visual thinking test for students. Additionally, a pre-test of pivotal thinking was developed for the teachers to ensure equivalence between the two study groups (experimental and control). This necessitates a content analysis of the selected educational material to construct the academic achievement test and the visual thinking test, as outlined in the following steps:

- Pivotal Thinking Test (Pre- and Post-Tests):

The researcher developed two tests to measure the pivotal thinking skills of mathematics teachers before and after the training program, according to the following steps:

1. Objective:

To measure the level of pivotal thinking skills before and after the training program.

2. Skills Covered:

Based on the opinions of the reviewers, the test included all pivotal thinking skills, namely: focus, information gathering, recall, organization, analysis, generation, integration, and evaluation.

3. Item Construction:

The test consisted of (21) essay questions, one question for each skill, based on previous studies and the approved theoretical and procedural framework.

4. Instructions and Answer Key:

Clear instructions were provided to the teachers, and model answer keys were developed. The possibility of multiple correct answers for some items was considered, as indicated in the literature. Three points were allocated to each item, except for the observation skill (one point). The scores ranged from (0–61).

5. Statistical Analysis:

A pilot test was conducted with (100) teachers outside the main sample.

The results showed that the difficulty indices ranged from (0.21–0.49) for the pre-test and from (0.26–0.47) for the post-test, which are within acceptable limits.

The discrimination power ranged from (0.20–0.42) for the pre-test and from (0.21–0.38) for the post-test, indicating the validity of the items.

6. Psychometric Properties:

• Face Validity: The items were reviewed by expert judges and the necessary adjustments were made.

• Critical-Scale Validity: The items showed statistical significance when comparing the upper and lower groups.

• Construct Validity: The correlation coefficients between each item and the total score, as well as between the items and their main skills, demonstrated high internal consistency.

7. Reliability: The Cronbach's alpha coefficient was 0.83 for the pretest and 0.85 for the posttest, high coefficients confirming the test's homogeneity. A scoring reliability test was also conducted, yielding an agreement of 0.91–0.93 for rescoring and 0.87–0.90 for comparing the researchers score with another teacher's, which is an acceptable level.

8. Time Taken: The average time to complete the test was approximately two hours.

Thus, the Core Thinking Test The pre- and post-test is a tool ready for application to the basic sample of mathematics teachers in its final form.

- Analysis of the Fifth Grade Elementary Mathematics Textbook Content According to the Components of Mathematical Knowledge and Visual Thinking Skills

The researcher aimed to develop achievement and visual thinking tests for students by analyzing the content of the first seven chapters of the fifth-grade elementary mathematics textbook. The analysis relied on a dual instrument: one for the components of mathematical knowledge and the other for visual thinking skills.

1. Objective of the Analysis

To identify the components of mathematical knowledge (concepts, principles, skills, and problems) and visual skills (recognizing and describing shapes, analyzing shapes, connecting information, understanding and interpreting ambiguity, and extracting meaning) included in the textbook, in preparation for using them in constructing the tests.

2. Unit of Analysis

The researcher adopted the "paragraph or idea" as the basic unit of analysis, along with exercises, activities, and branching questions, taking into account illustrations and diagrams.

3. Analysis Controls and Procedures

The analysis was conducted on the seventh edition of the textbook.

All components of knowledge and visual skills were identified using a pre-prepared checklist. The targeted pages were read carefully, and the results were then compiled and categorized as frequencies and percentages.

4. Validity

The analysis tool, in its initial form, was presented to a panel of experts to confirm its face validity. After making the necessary modifications, it was approved with an agreement rate of 80%.

5. Reliability

To verify the tool's reliability, two types of reliability were used:

• Cross-interpersonal reliability: by comparing the researcher's results with the analysis from another school, which showed a high agreement rate.

• Time-based reliability: by repeating the analysis after two weeks, and the results showed a high degree of agreement with the initial analysis.

Calculating the reliability coefficient using Holsti's formula revealed that the tool possesses a high degree of reliability.

Thus, the analysis of the fifth-grade mathematics textbook content has become a precise scientific tool that can be relied upon in constructing achievement and visual reasoning tests for students.

- Student Achievement Test

The researcher developed an achievement test to measure the level of fifth-grade students in mathematics, covering the first seven chapters of the textbook (sets, lines and angles, large numbers, operations on numbers, natural numbers and their properties, geometric shapes, and common fractions).

The researcher began by defining the test's objective: to measure students' academic achievement in the targeted chapters. She then formulated behavioral objectives based on Bloom's Taxonomy at the first three levels (remembering, understanding, and applying). After content analysis, she derived 219 behavioral objectives, which were then reviewed by a panel of experts to ensure their accuracy and suitability.

Following this, a test map was created, linking the chapter content to the behavioral objectives. The test was constructed as an objective, multiple-choice question (four options), comprising 30 items distributed in accordance with the objectives and content. The questions were formulated to be age-appropriate and comprehensive, covering all relevant material, with clear instructions and an illustrative example of how to answer.

The test was administered to a pilot sample of 100 students to verify the clarity of the items and instructions and to estimate the appropriate time for answering. The average time was found to be 50 minutes, and most items were deemed understandable. A standardized scoring key was then developed, assigning one point for each correct answer and zero for incorrect or unanswered answers.

Statistical analysis of the items was conducted to confirm their suitability. All items were found to be within acceptable limits in terms of difficulty and discrimination. The answer choices also demonstrated good effectiveness, indicating the quality of the item design.

As for the psychometric properties of the test, face validity was established by presenting the items to experts and making necessary adjustments. Content validity was confirmed through the test map and analysis of the learning objectives and material. Regarding reliability, it was calculated using the Kuder-Richardson (KR-20) formula, yielding a coefficient of 0.87, a high level indicating good internal consistency.

Thus, the achievement test proved to be a valid, reliable, and objective instrument, ready for application to the primary sample of students.

- Visual Thinking Test

Since visual thinking is one of the dependent variables in this study, the researcher developed a specific test to measure it, based on relevant literature and previous studies.

The work began by defining the objective: to measure the visual thinking skills of fifth-grade students according to the skills identified through content analysis. These skills are: shape recognition, shape analysis, connecting relationships, interpreting ambiguity, and extracting meaning.

The test items were then formulated as multiple-choice questions (four options), totaling 25 items equally distributed across the five skills. Clear instructions were also prepared, accompanied by an illustrative example of how to answer the questions. The test was initially administered to a pilot sample of 100 students to ensure the clarity of the instructions and items and to determine the appropriate time frame. The time required to complete the test was found to be approximately 40 minutes, and the questions were well-understood.

A standard scoring key was developed, awarding one point for a correct answer and zero for an incorrect or unanswered answer, with a total score ranging from 0 to 25. Following the test

administration, its items were statistically analyzed. The results showed that the difficulty indices ranged from 0.30 to 0.56, which is considered acceptable, and the discrimination indices ranged from 0.28 to 0.51, confirming the test's validity. Furthermore, the answer choices were effective in distinguishing between the upper and lower groups.

Regarding validity and reliability, face validity was established by presenting the test to a panel of expert reviewers and making the necessary adjustments. Construct validity was also established by calculating the correlation coefficients between the scores of each item and the total score, which ranged from 0.424 to 0.886, indicating a high level of internal consistency. As for stability, it was calculated using the Kuder-Richardson equation (KR-20), and it was the test has a reliability coefficient of 0.80, indicating good consistency.

Therefore, the test is a valid and reliable tool for measuring visual thinking skills, characterized by validity and reliability, and ready for application to the main study sample.

Sixth: Procedures for Implementing the Experiment

Method The study experiment was conducted in chronological order beginning from obtaining official approvals ultimately at all level, directorate Preparation and Training division\ directorate of education in Misan and informing teachers about the training timing, location. The intervention programme consisted of 16 training sessions (2 per day) with a duration of 1 hour before a half-hour break. 35 teachers participated and were randomly allocated to the experimental (18 trained) or control condition (17 not trained)

The experiment was divided into two moments, initially the teachers fulfilled personal data forms and were given the Schwartz´s (1998) Thinking Model, an intelligence test and a pre-test of key thinking to equate both groups. Training Theoretical and practical workshops were combined in basic (e.g., critical, creative, metacognitive thinking styles) and advanced (i.e., analysis; comparison; summarization for decision-making under fluency and flexibility) analysis that spread through sets of sessions.

Upon completion of the programme, teachers undertook a post knowledge test on basic cognitive functions and scoring was conducted on responses from two groups. A sample of 15 students was then randomly taken from each teacher for an achievement test and a visual thinking task. Equivalence tests were performed on students who had prior knowledge, mid-term grades and IQ-test to ensure fairness among both groups.

Accordingly, the achievement test of these two groups' students were administered in semester 2 from 11/3 to 27/3/2025 and visualization test (from cityL1 to …41705). Time to execute the tests was registered, and testing procedures were controlled in order to ensure precision and standardization with respect to the study protocol.

Seventh: Statistical Methods

An investigator analyzed the data of the studies with statistical software (SPSS version 25), and some calculations were made manually. These methods of analysis were analytical instruments reliability estimates for mathematical knowledge components and visual reasoning skills by using Holsti's formula (Al-Hashemí & Mohsen, 2011: p.229), essay items,'s levels difficulty index discrimination index for objective one for pivotal reasoning test achievement test, visual reasoning test (Allam, 2010, the manner p.258159)

For intelligence and visual reasoning tests, validity of constructs were also checked by the Points-Physical correlation coefficient, whereas for Items internal consistency control of pivotal reasoning tests; Pearson's correlation coefficient. The deciphering of the two groups of independent samples and the pairing were verified by using Mann-Whitney U test or paired file. An independent samples t-test was performed to study group variations on the students' testing scores.

The data were also normally distributed according to the Kolmogorov-Smirnov test and reliability of the tool had been achieved by following using Cronbach's alpha for pivotal reasoning tests and Kuder-Richarson 20 for achievement and visual reasoning instrument. In addition, additionally the criterion of Cohen´s was used to estimates the current effect size of the training program on dependent variables. (Awda & Khalil, 1988: 231).

Chapter Four:

Presentation and Interpretation of Results:

First: Presentation of Results:

The study findings, in line with its objectives, demonstrated the impact of a training program based on Schwartz's model on developing critical thinking skills, achievement, and visual reasoning among mathematics teachers and their students.

1. Results of the Critical Thinking Test (Independent Groups)

• The average score of the teachers in the experimental group was 15.15, while the average score of the control group was 13.6.

• The U-value (U = 29) at a significance level of 0.001 showed statistically significant differences in favor of the experimental group.

• The effect size according to Cohen's d was 2.10, a very high effect size indicating the program's effectiveness in raising the level of critical thinking.

2. Results of the Critical Thinking Sub-Skills

• Focusing skill: Average score of 15.5 for the experimental group versus 13.15 for the control group, at a significance level of 0.000.

• Information gathering: Average score of 14.25 versus 11.5, a significant difference at 0.0001.

• Organization: Average (14.56) for the experimental group versus (12.05) for the control group, with a statistically significant difference at the 0.000 mark.

• Analysis: Average (13.50) versus (11.23), with a statistically significant difference at the 0.000 mark.

• Generation: Average (13.21) versus (11.02), with a statistically significant difference at the 0.012 mark.

• Integration: Average (13.23) versus (11.41), with a statistically significant difference at the 0.000 mark.

• Evaluation: Average (12.61) versus (11.51), with a statistically significant difference at the 0.000 mark.

• Recall: No statistically significant difference was found between the two groups, indicating that the program had less of an effect on this particular skill.

3. Pre- and Post-Test Results for the Experimental Group (Wilcoxon signed-rank test)

• The teachers' mean scores increased from 12.92 in the pre-test to 20.29 in the post-test.

• The results showed statistically significant differences at the 0.001 level, confirming a clear improvement after the program's implementation.

• The effect size was d = 2.08, indicating a very large effect.

4. Results of the Fifth-Grade Students' Achievement Test

• The experimental group achieved a mean score of 63.35, compared to 26.35 for the control group.

• The t-value was 11.122 at a significance level of 0.000, favoring the experimental group.

• This demonstrates that the program not only affected the teachers' performance but also directly impacted the students' achievement.

• The effect size was d = 2.89, indicating a very strong effect.

5. Visual Thinking Test Results

The experimental group's mean score was 25.91, compared to 23.10 for the control group.

The t-value (t = 5.002) at a significance level of 0.000 favored the experimental group.

The effect size (d = 1.92) was very high, confirming the program's role in improving visual thinking.

Second: Interpretation of Results

1. Program Effectiveness in Critical Thinking:

The significant differences between the two groups demonstrate that integrating thinking skills into lessons according to Schwartz's model helped teachers improve their performance in most skills, especially organization, analysis, and evaluation. The lack of differences in "recall" is attributed to the nature of this skill, which relies more on direct memorization than practice.

2. Impact on Academic Achievement: The experimental group's average score was nearly double that of the control group, indicating that the program enhanced teachers' teaching strategies, which directly impacted student learning.

3. Visual Thinking:

The students benefited from the integration of activities based on symbols, diagrams, and visual representations, which explains the superiority of the experimental group.

The large effect size (d = 2.89 in achievement, d = 2.10 in pivotal thinking, and d = 1.92 in visual thinking):

All of this confirms that the program did not have a fleeting effect, but rather left a substantial and practical impact on both teachers and students.

Third: Conclusions:

In light of the statistical results, the following can be concluded:

1. Effectiveness of the Training Program

The program based on Wurtz's model significantly improved the pivotal thinking skills of the teachers, with a total effect size of (d = 2.10), which is a very high effect size.

2. Sub-Skills of Pivotal Thinking

All the main skills showed statistically significant differences in favor of the experimental group, except for the memory skill. The strongest effect was observed in information gathering skills (d = 2.22), while the weakest effect was observed in recall (d = 0.91).

3. Students' Academic Achievement

The program positively impacted students' performance in mathematics. Their average score in the experimental group rose to 63.35 compared to 26.35 in the control group, with a t-value of 11.122 and a significance level of 0.000. The effect size (d = 2.89) reflects the strong impact on academic achievement.

4. Students' Visual Thinking Skills

The students in the experimental group achieved an average score of 25.91 compared to 23.10 in the control group, with a t-value of 5.002 and a significance level of 0.000. The effect size (d = 1.92) indicates that the program clearly enhanced visual thinking skills.

5. Pre- and Post-Test Results for the Experimental Group

The significant differences (from 12.92 to 20.29) and the large effect size (d = 2.08) confirm that the training was effective, even when comparing the results of the same group before and after the intervention.

Fourth: Recommendations:

Based on these results, the researcher recommends the following:

1. Integrate critical and visual thinking skills into the primary school mathematics curriculum, making them an integral part of the curriculum content.
2. Train mathematics teachers on Schwartz's model strategies through workshops and educational courses, enabling them to effectively integrate these skills into their daily lessons.
3. Publish a training manual outlining the steps for implementing Schwartz's model in education, supported by examples and practical activities.
4. Utilize diverse strategies, such as mind mapping, brainstorming, and problem-solving, to foster creative and visual thinking.
5. Develop educational curricula that prioritize the development of higher-order thinking skills rather than relying solely on rote learning or memorization.

Fifth: Recommendations:

To enrich future study, the researcher suggests:

1. Conduct similar studies at higher educational levels (middle and high school) to determine the effectiveness of Schwartz's model across different grade levels.
2. Investigate the impact of the training program on teachers' instructional performance and their attitudes toward the teaching profession, as well as its effect on developing students' skills.
3. Develop specialized training programs aimed at enhancing students' critical and visual thinking skills, while measuring their impact in subjects other than mathematics.
4. Review and revise the content of elementary school mathematics textbooks to include practical exercises for developing higher-order thinking skills.

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