

# THE EFFECTIVENESS OF USING THE DUNN AND DUNN MODEL IN TEACHING THE UNIT OF REGULAR FRACTIONS FOR FIFTH-GRADE PRIMARY STUDENTS IN DEVELOPING ACHIEVEMENT AND MATHEMATICAL INTUITION SKILLS

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## Abstract:

*The current study aimed to reveal the effectiveness of using the Dunn and Dunn model in teaching the unit of regular fractions for fifth-grade primary students in developing achievement and mathematical intuition skills. The study sample was tested from fifth grade students in the first semester of Mosa ben Nosier school at Tabuk City, and they (30 students) were divided into two district groups; the first half (15 students) were allocated into the experimental group and the other half (15 students) made up the control group. After preparing and utilizing the instruments, the results of the research revealed the following: statistic between the mean scores of students of the experimental and control groups in the cognitive achievement test related to the unit of regular fractions in the first semester in favor of the average of the students of the experimental group, as it was found that there was a statistically significant difference at the level (0.01) between the average scores of students of the experimental group in the pre and post applications in the achievement test Cognitive, and in favor of the mean of post-application. The results also demonstrated that there were statistically significant differences between the control group and the experimental group in the mathematical intuition test as a whole, and in its components in the post-application for the benefit of the experimental group. Furthermore, the results indicated that to and statistically significant differences between the pre application and post application of the experimental group in the sport as a whole test intuition, and in its components in favor of the dimensional application, and in light of the results, this current study presents a number of recommendations as Encouraging math teachers to use the Dunn and Dunn model of learning styles to develop students' achievement and mathematical skills.*

## Introduction:

Our contemporary world is witnessing tremendous scientific and technological development. Scientific progress is one of the most important characteristics of this era, in which the rates of increasing knowledge have reached an unprecedented extent and the magnitude of scientific discoveries has greatly increased and thus, it validates the search for more appropriate methods to teach students how to think. Furthermore, it makes it one of the main tasks of education at all levels and for different stages; all pupils of all ages included, so that it works to raise the effectiveness of education and increase its feasibility while at the same time, keeping pace with the data of that ongoing revolution. This development imposed on teachers the need to reconsider their plans and methods of education so that they lead the formation of human and are able to meet the challenges of the times with the methods of the times.

Undoubtedly, mathematics is one of the main areas of knowledge in highlighting scientific development because it has a leading position among the various branches of science. In addition to this, it is composed of multiple and varied applications; so, it can be said that the fields of application of contemporary mathematics broaden their horizons and increase in what achieves them real leadership in the fields of natural and social sciences, Business administration and other fields of application. Therefore, mathematics curricula and their pedagogies must respond to the development data and abandon its traditional role. Students need more beneficial mathematics in their living paths, and their learning contributes to preparing them to face future challenges (Obaid, 1998, 3).

In spite of the efforts of those in charge of developing curricula at the Ministry of Education in the Kingdom of Saudi Arabia to develop mathematics curricula for their extreme importance, the weakness of students in their learning still hampers the authorities concerned with the educational process, especially the teacher whose traditional methods and individual efforts do not succeed in developing the ability to learn and master mathematics. This is

further-complicated by the growing complaints of society with its various spectra of the low level of their students in mathematics.

Therefore, it was necessary to adopt effective solutions that contribute to increasing the achievement of students at all educational levels, and this is confirmed and supported by Mina (2004, 49), as it indicates that one of the most important trends and future changes in the teaching and evaluation of mathematics in the Arab world is to make room for experimenting with some new trends in this field, with the influence of some methods and methods used in some directions.

(Najdi, 2015, 155) also states that when we look to the future in the twenty-first century, we need to review the goals, systems and methods of all curricula, including those that deal with the study of the environment. This is so that we have a clear approach to our children's education. Planning is characterized by a holistic view of the future, and this will not be achieved if we continue in the styles and methods of teaching currently prevailing, as it is not sufficient to throw facts and scientific information. That's because this will not build real environmental education; therefore, the conferences and studies that were concerned with studying the environment, focused on the styles and methods that achieve student positivity, which in turn focuses on direct experience and learning by doing.

Among the most important strategies and methods of modern teaching is the Dunn and Dunn model, including: active and contemplative learners, activists who tend to learn to do active work, and meditators who prefer to think about something first and quietly, activists build their learning on the saying: "Let's try that and see how it works." "As for the contemplative, one of their aphorisms said is:" Let us think about this thing first. "The active learner also prefers to work in groups, while the contemplative learner prefers individual work. As for the second classification of learners, it is the sensual and intuitive learners, where the sensual learner tends to favor the facts, and prefers to solve problems by building constructive plans and methods, and tends to pay attention to the details, it is practical and cautious, he does not like the courses that do not provide connections with the real world, and the intuitive learner, tends to discover possibilities and relationships, loves to innovate, and tends to focus on mere abstracts and mathematical expressions. As for the third classification, it is the visual and verbal learners. The visual learner is better-remembers through watching, while the verbal learner relies on verbal explanations verbally. Likewise, there are serial and inclusive learners. While the first type tends to understand linear steps from one step to another in a sequence, the inclusive people learn better through large jumps, and at a time when the serialists tend to follow methods with logical steps to reach a solution, we find that the totalists can solve complex problems faster, but they find it difficult to do the job (Abu Al-Nadi & Hala, 2010)

The Dunn and Dunn model has been developed by (Retaden and Kenneth Dunn) where this model provides a therapeutic and diagnostic educational framework, which basically depends on each learner learning better in his own way, so his preferred methods must be diagnosed; for this information to be used in designing procedural and situational educational styles that fit his preference. This model is based on two assumptions, the first: that it is possible to identify the individual learner's preferences in learning environments, the second: that it is possible to use various educational procedures, and modify educational environments, to fit the learner's preferences. This model is built on the basis that the individual has a set of biological characteristics, and evolutionary characteristics that are unique to others, and these characteristics affect how an individual learns new information and skills, and that the quality of learning will be better if the learning environment is designed to match the centers of strength in the learning of the individual. As for the main objective of the model, it is to improve the effectiveness of learning by diagnosing and adapting the learner's learning style to appropriate educational opportunities (Jaber & Qar'an, 2004).

In addition, if this model is applied correctly,, it aims to improve academic performance at all levels of learners, especially those with low achievement, as it addresses the diverse senses of the learner, whatever his mental level encourages this learner to participate and improve learning.

One of the foundations of the model is that the learning method is a set of personal, biological and developmental features that make the learning environment effective for some learners, and ineffective for others. This is due to the fact that there are significant differences between the learning preferences of different individuals, and those preferences are unique, and the extent of the impact can be measured through their suitability, and the stronger the preferences, the more important it is to take appropriate educational strategies, and one of the foundations on which it is based also, is that the suitability of learning styles preferences results in an increase in achievement, and a change in the direction towards learning, and learners can learn how to benefit from strengths in their learning styles, especially when learning a new skill, and the less successful an individual is, the greater the need to adapt his or her preferred learning method (Ibrahim, 2011)

The researcher believes that it is possible to take advantage of the principles and foundations upon which the model is based. That's to say, if the teacher organizes the educational environment with its various elements, from methods, means and activities, to fit with different types of learning among learners, then they can all acquire knowledge, despite the individual differences between them in mental abilities.

As for the elements of the Dunn and Dunn model of learning patterns, they can be presented in several areas: environmental patterns and they include sound, light, heat, and design. Then emotional patterns, these include structural planning, motivation, perseverance and responsibility. On the other hand social patterns, and include individual education, learning with friends and learning with adults. As for the physiological patterns, these include sight, hearing, touch, movement, food and drink. The psychological patterns include the analytical and holistic style and the combination of the two (Ibrahim, 2011).

When employing the Dunn and Dunn model, the elements of the educational learning process must be reconsidered, in a manner consistent with the elements and principles of the model. The teacher must understand the elements of different learning styles among learners, and then organize the class in a manner that supports these patterns, and maintains various educational learning resources. This encourages mastering the art of managing large or small groups and individual learning. As for the student, his main role is to develop an understanding of his preferred learning style, and then to use this understanding in order to choose his learning activities. It's part of his responsibility to monitor his development, to know the appointments required of him, and in order to suit the learning patterns, It should classroom contains I have a mixture of furniture and tools that differ from the traditional class, so there should be seats suitable for small groups and individual ones, and with regard to educational materials and procedures, the teacher must choose, develop and collect various educational resources (Jaber & Qar'an, 2004), therefore it is necessary to take into account several procedures and activities. Instructional learning using observing patterns of learning according to the Dunn and Dunn model, as follows (Felder& Soloman, 2003):

To observe the visual / verbal pattern of the learner, the teacher can use color coding, writing sentences, cards, representing information with drawings and diagrams, and recording of information. In order to observe the kinesthetic sense, it is necessary to use methods that help make learning tangible such as creating models, visiting museums and workplaces. As for the verbal auditory pattern, it is necessary to employ phonograms in addition to recording and discussing lectures. As for the holistic pattern, the teacher should focus on the learner's vision of the overall picture before focusing on the details, and he should link the topic to other topics. Likewise, he should draw a map that explains the relationship between the information. And taking into account the analytical pattern, the teacher should follow sequential steps and make summaries of what he offers or explains.

As for the contemplative pattern, it gives the teacher enough time for students to think, give feedback from time to time, and use the short notes as an expression of the learner's understanding. In order for the teacher to take into account the collective style in his activities and experiences, he must focus on group activities, work with learners, put the learner within a team, and respect the opinions of learners despite their differences. a. What is a learner with an individual style, so he learns better when he works alone, and is happy if he is assigned to do individual tasks. Taking into account the intuitive pattern requires the teacher not to be satisfied with activities that focus on the learner's memorization and regurgitation of the information, but rather replace it with activities that encourage the learner to link information, stop at the semantics of the material presented, and give space for imagination and thinking before beginning to answer a question (Jaber & Qar'an, 2004).

Among the studies that used the Dunn and Dunn model, the study of Shalaka (2018) pointed out the importance of using the Dunn and Dunn model to increase achievement and inferential thinking.

### **Feeling the problem:**

The reality of mathematics teaching witnesses the lack of a learning environment using effective teaching strategies, as teachers rely in most practices, on direct presentation through presentation, and the explanation that characterizes the teacher's control over classroom activity. This often leads to the lack of motivation in students, and their anxiety about studying, hence the low level of their achievement. This is what the researcher observed through his field experiences and studies. Research has emphasized the necessity of taking into account the patterns of learners and individual differences between them; Currently, the world is living through an era of great scientific and technical revolution, and the educational process, in spite of the use of educational techniques, is no longer limited to the transfer of knowledge from the teacher to the student, but the teacher has become the demands of the search for

modern educational strategies centered around the student so that these strategies based on the direct positive interaction between the student and teaching techniques under the guidance of the teacher.

And to make sure - as well - of the research problem, a preliminary test was applied that included a set of mathematical skills for the fifth elementary grade students at Mosa ben Nosier school at Tabuk City, as the maximum degree is 10 degrees, and the results of the statistical analysis as shown in the following table:

**Table (1) results of the exam**

Sample number	The smallest degree	The greatest degree	The average	mistake percentage
36	1.5	10	4.8472	0.38618
12	1.5	9.5	4.8750	0.74398
24	1	10	4.2292	0.49634

As shown in Table 1, the students' average scores ranged between (4.2-4.8), and this does not agree with modern educational trends represented in reaching the level of educational products to the point of mastery.

From all this, the researcher generated a sense of the current study problem, which was represented by the low level of performance of the fifth elementary grade students. Hence the need to use a new method, which is the Dunn and Dunn model.

In light of the results of the exploratory study and the recommendations of previous studies and research, the main problem can be formulated for research in the following question:

**What is the effectiveness of using the Dunn and Dunn model in teaching the unit of regular fractions for fifth-grade primary students in developing achievement and the skill of mathematical intuition?**

#### **Research hypotheses:**

The current research attempts to test the validity of the following hypotheses:

1. There is no statistically significant difference at the significance level (0.01) between the mean scores of the experimental group students that were studied according to the Dunn and Dunn model of learning patterns and the control group students who studied in the traditional way on the cognitive achievement of the unit of regular fractures determined for the fifth primary grade pupils.
2. There is no statistically significant difference at the level of significance (0.01) between the mean scores of the pre and post measurements of the experimental group students that were studied according to the Dunn and Dunn model of learning patterns on the cognitive achievement of the unit of regular fractures determined for the fifth primary grade pupils.
3. There is no statistically significant difference at the significance level (0.01) between the mean scores of the experimental group students who studied according to the Dunn and Dunn model of learning patterns and the control group students who studied in the traditional way on the mathematical intuition of the fifth primary elementary students.
4. There is no statistically significant difference at the significance level (0.01) between the mean scores of the pre and post measurements of the experimental group students who studied according to the Dunn and Dunn model of learning patterns on the mathematical intuition of the fifth elementary grade students.

#### **Research aims:**

The current research aims to reveal the effectiveness of the use of the Dunn and Dunn model of learning patterns to develop mathematical thinking and achievement for fifth grade primary school students.

#### **Research importance:**

The current research can contribute to benefiting many groups concerned with the educational process as follows:

**Teachers: This is through:**

- The use of the Dunn and Dunn model of learning styles in teaching units, courses and other materials, which includes insufficient achievement and the skill of mathematical intuition among students in the elementary and other stages.
  - Developing teachers 'performance by studying modern and methodical teaching methods in dealing with problems related to students, the most important of which is the development of achievement and intuition in mathematics.
  - May increase the motivation of teachers and their desire to develop their teaching performance through teaching strategies that contribute to achieving many of the desired educational outcomes.
- **Primary fifth pupils:** By developing their achievement level and mathematical intuition.

**Curriculum Preparers and Education Experts: By:**

- Training male and female teachers to prepare tests to diagnose students' under-achievement and mathematical intuition, and how to modify them.
- Directing the attention of the training and education personnel towards training male and female teachers on how to design a Dunn and Dunn model for learning patterns to develop levels of thinking and achievement in mathematics among learners at different stages.

**Research experimental design:**

In light of the nature of the current research, a pilot design known as: (pre-test / post-test for Control Group Design) control group is used.

**Table (2) Research experimental design**

Tribal regular fractures	The research sample	Experimental treatment	Fractions posttest
Cognitive achievement test in the unit of regular fractions	<b>Experimental</b>	Dunn and Dunn Model	Cognitive achievement test in the unit of regular fractions
Mathematical intuition test	<b>Control</b>	traditional way	Mathematical intuition test

**Statistical methods used in the current research:**

- (K<sup>2</sup> equation).
- Paired - Samples t-Test.
- Independent-Samples t-Test.
- ( $\eta^2$ )
- Arithmetic Averages
- Standard Deviation

**Research method:**

The curriculum includes:

- The quasi-experimental curriculum: This approach will be followed in order to know the effect of the independent variable, which is a Dun model on the dependent variable, which is the development of academic achievement and mathematical intuition for a regular fractions unit in mathematics.

**Procedural definitions:**

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## Learning Styles

Dunn et al. (1995: 353-361) define learning patterns as more than just remembering individual and new difficult information through the way of listening, seeing, reading, writing, explaining, speaking, or active experience, but rather a combination of variables (Biological, experimental, and experiential) and each contributes to the individual's own learning. It works as an integrated unit.

The result of the relatively stable cognitive, emotional, and skill indicators and behaviors in the interaction of the fifth elementary grade student with the educational environment surrounding him, with a view to absorbing and then adapting to it.

The Dunn and Dunn Model: a set of indicators and criteria that the teacher must observe when teaching learners, and is measured by the degree that the researcher obtains as a result of the teacher's response to a set of questionnaire clauses that he formulated in light of the indicators of learning patterns (Dunn and Dunn). These patterns are; verbal-visual, non-verbal, motor sensory, verbal auditory, holistic, analytical, contemplative, group, individual and intuitive.

### Academic Achievement:

It is defined procedurally in the current research as the expected level of performance in mathematical skills, and it is measured by the degree that the student gets in the cognitive achievement test in the unit of "regular fractions" prescribed for the average fifth grade students.

Mathematical intuition skills:

Kabbad (2009, 261) defined mathematical intuition as follows: 'it is a mental cognitive activity in which observation, experimentation, treatment, and incubation of the available information about the problem are done spontaneously and continuously, until a sudden solution to the problem is reached'.

Procedurally, it defines a type of mathematical reasoning, which is the mental activity of the student in which the mathematical question is contemplated and analyzed with a view to perceiving relationships and linking them with previous experiences to arrive at an estimated formula for the solution, followed by verification of the validity of the result reached by providing evidence and proofs of the correctness of the solution, Teacher teaching practices should encourage the development of mathematical intuition skills. Mathematical intuition skills are defined as follows;

- Meditation skills: where the individual contemplates the important sport in front of him and identifies and analyzes its elements, and draws the necessary plans to understand it until it reaches the results.
- Relational thinking skills: Identifying the existing relationships between the components of the problematic situation, and linking them with previous experiences to find new relationships that help to reach the appropriate solution.

Critical thinking skills: They are based on careful evaluation of the premises and the conclusions, so that they are marked by impartiality.

## Theoretical framework and previous studies:

### Dunn Learning Styles Model

"Dunn" has carried out a careful review of the educational heritage in relation to how individuals learn, and this review revealed that there are many studies that emphasize the individual differences between students in the way each of them begins to focus on information, processing, absorbing and retaining it, as well as new and challenging skills.

In 1972, "Dunn" found (12) variables, then in 1977, "Dunn" announced the existence of (18) variables. After that, I in 1990, "Dunn" (21) identified another variable, until it reached (24) variables in the year 2001.

### All variables fall under five triggers:

- **Environmental stimuli, which include:** sound versus quiet, lighting versus low light, cold vs. warm, formal session versus informal session.



- **Emotional stimuli**, which include: motivation, perseverance, responsibility, adult motivation, self-motivation, teacher motivation, no motivation and structure versus tests.
- **Social stimuli, including:** individual learning, learning with friends, learning with adults, and learning in multiple ways.
- **Physiological stimuli**, which include: cognitive abilities (visual, auditory, tactile, kinetic), food, movement, and time.
- **Psychological stimuli include:** analytic / holistic / or combining the two, and preferences for using the hemispheres of the brain (Dunn & Honigsfeld, 2001,6).

The "Dunn" model has a set of foundations based on it:

- Learning style is a set of personal, biological and developmental traits that makes a specific environment, methods and learning resources effective for some learners and ineffective for others.
- There is a significant difference between the learning preferences of different individuals and those preferences are unique. The effect of suitability of these preferences can be measured.
- The stronger the preferences, the more important they are in adopting standard educational strategies.
- The appropriateness of individual learning styles preferences through educational and instructional interventions results in an increase in academic achievement, and a change in individual attitudes towards learning.
- Students can learn to take advantage of strengths in their learning methods, especially when learning a new or difficult subject.
- The less successful an individual is, the greater the need to adapt his or her preferred learning style (Khairy, 2008, 105).

Previous studies have been conducted on learning patterns, including the study of Abdel-Gawad (2016) that aimed to identify the level of teachers in the lower basic stage of the criteria of the (Dunn and Dunn) model of learning patterns, and the differences in this level due to gender changes, years of service, and classroom. It also aimed to know the level of tendencies of teachers of the lower basic stage towards the teaching profession, the differences in it attributable to the six variables, and years of service, and the study sought to reveal the relationship between the level of teachers of the lower basic stage teachers of the criteria of the model (Dunn and Dunn) of learning patterns, and their tendencies towards a profession teaching. To achieve the goals of the study, the researcher built two tools; the first - a resolution of the criteria, the second - a measure of inclination towards the teaching profession, and the two tools of the study were applied to a random sample of (144) teachers. The study reached several results including; - the relative weight of the level of consideration of stage teachers, the minimum baseline for the (Dunn and Dunn) model criteria for learning patterns along the axis of the questionnaire as a whole (77.3%). There are no statistically significant differences in the level of observance by teachers of the lower basic stage of the criteria of the (Dunn and Dunn) model attributable to the variables (gender, years of service, and grade taught by the teacher). The relative percentage of the level of tendencies of teachers of the towards the teaching profession (73.0%). There are no statistically significant differences in the level of inclination of teachers of the lower basic stage towards the teaching profession due to the two variables (gender, years of service). - There is a positive relationship between the level of teachers in the basic stage taking into account the criteria of the (Dunn and Dunn) model, and their professional inclinations towards the teaching profession.

The study of Shalaka (2018) aimed to find out the effectiveness of the Dunn and Dunn model in achieving geography and developing inferential thinking among literary fifth graders. The researcher used experimental design with partial control as well as post-tests. Intentionally, among the schools affiliated to the General Directorate for the Education and the research sample consisted of (60) students, distributed over two study divisions, and the results of the study showed the superiority of the experimental group students who studied the subject of natural geography, according to the model of Dunn and Dunn over the students of the group. The officer who studied the same material in the usual way in the achievement test and test deductive thinking, and in the light of the findings of the research researcher came up with a number of conclusions and recommendations and proposals.

A study (Al-Mohtasib, 2013) that aimed to reveal the relationship between the level of scientific thinking of students in the upper basic stage, and their preferred learning styles, as the researcher chose a cluster sample consisting of (1213) male and female students, from government schools, affiliated to the second Amman Directorate in the capital of Jordan, the researcher used two tools: the test of scientific thinking and the FARC scale, and the results showed that the level of scientific thinking is low, and that it progressed with the progress in the educational

level of female students compared to students, and the results of the study also showed that there is a variation in the learning patterns of students, with There are differences in thinking depending on For the audio / practical learning style.

As for the study (Ghoneim & Buddy, 2012), it aimed to identify the educational patterns prevailing among students of the Faculty of Education at King Faisal University, and their relationship to some variables, through the auditory, visual, motor, tactile, social and independence patterns. The sample of the study consisted of students of the College of Education, who were (812) male and female, and the researchers used a questionnaire to collect data. The study results indicated that the fourth level students prefer visual interaction, and social studies students participate in them, and that third and fourth level students prefer an active learning style, and that students of Islamic studies and the Arabic language prefer an auditory learning style.

also (Ibrahim, 2011) conducted a study, aimed at identifying the effectiveness of a program based on the model (Dunn) of learning patterns, in developing reading skills and the direction towards them, among students with learning difficulties in the first preparatory grade of Al-Azhar, and the researcher chose a sample of those with learning difficulties amounting to (50). A student, who built a list of preferred learning styles, and the results of the study indicated that there are significant differences between the average levels of students in the control and experimental groups, in the reading comprehension test in favor of the experimental group, and the presence of significant differences between the two groups in the scale of the trend towards reading, which was in favor of the experimental group as well.

#### **The concept of academic achievement:**

Academic achievement is defined as the degree of acquisition attained by an individual, or the level of success achieved or attained in a subject or educational field (Abu Allam, 2011, 305).

Achievement is directly related to students' academic performance to clarify the extent to which students' educational goals have been achieved, and are measured by achievement tests, which are tools for measuring an individual's achievement of particular knowledge or a skill gained as a result of education or training (Al-Turairy, 2012, 280-281).

The achievement tests measure the extent to which students understand some of the knowledge, concepts and skills related to the subject matter, as academic achievement indicates the current state of individual performance or learning or what he has already gained in an educational program (Abu Allam, 2011, 305-306).

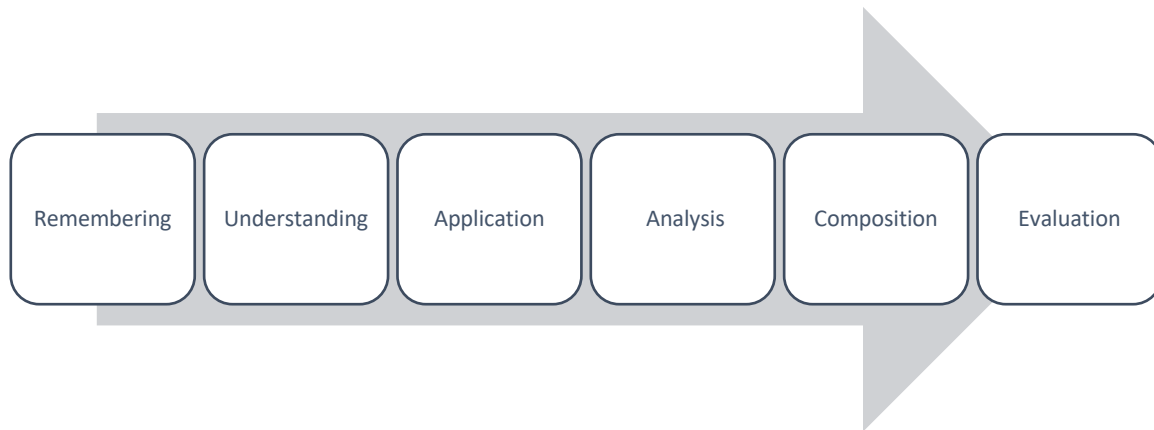
It is clear from the above that the academic achievement is one of the most important goals of the educational process with all its elements and it is also one of the criteria for evaluating it, which made his study the focus of great interest from researchers and educational students. The achievement test is one of the regular fracture tools that provide information about the extent of the individual's acquisition of cognitive experiences at their various levels.

#### **Types of academic achievement:**

It is reported (Saadeh and Ibrahim, 1991) that there are three types of academic achievement according to what he reported:

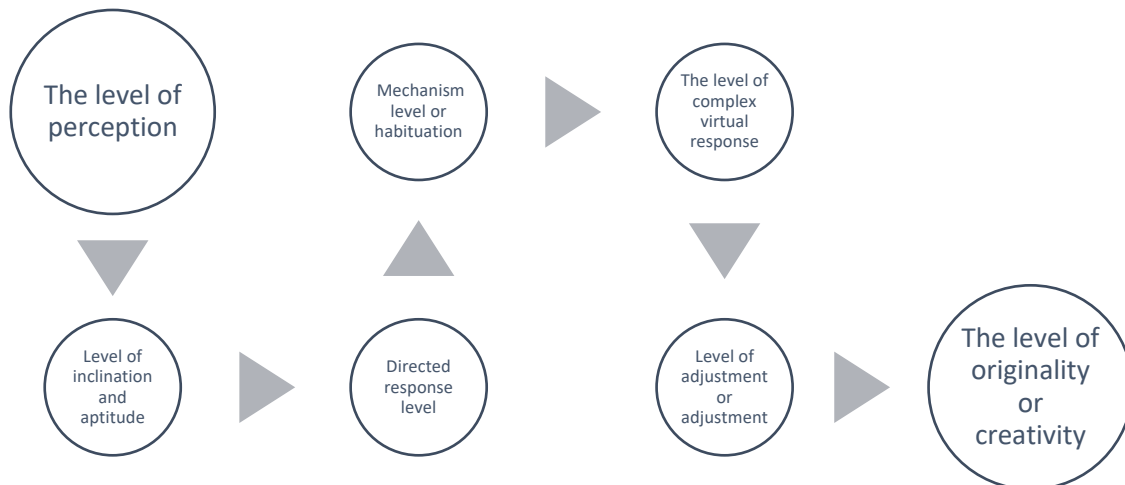
First: Cognitive academic achievement; it is the achievement that includes the mental processes of the learner at all levels; from merely retrieving the information he has read or heard, to understanding and applying what it means, to analyzing their interrelated relationships, and then judging its content in terms of accuracy, objectivity and modernity. Bloom divided the field of knowledge into six different levels, which can be represented in the following figure:





**Figure No. (1) levels of cognitive achievement**

Second: Skill Academic Achievement; it is the academic achievement representing the kinetic skills of the limbs of the human body, such as the movement of hands or feet or the whole body, and it is necessary to have the criterion or criterion by which the skill performance is measured by time or by percentage of accuracy in performance. Simpson classified the field of motor skill to levels as shown in the following figure:



**Figure No. (2) Skill levels of academic achievement**

Third: Emotional Achievement; achievement that deals with emotional issues that evoke feelings, and deals with the trends, feelings, , and values in the heart that affect its aspects of behavior and its various activities. He divided the emotional realm into five levels:

**Figure No. (3) Levels of emotional academic achievement**

Academic achievement tests are also considered one of the most important tools for measuring academic achievement, an( Zaitoun, 1994) stresses that academic achievement tests have many benefits in the field of learning evaluation, including:

- Helping students to better-understand themselves, as a result of the feedback that reveals their strengths and weaknesses.
- Assisting in determining the different levels of the male or female student in the aspects that the test measures, and for which they are designed.
- Increasing students' motivation, and urge them to do more diligence.
- Helping in predicting students 'achievement in other subjects.
- Helping to judge the effectiveness of the teaching strategy used in teaching educational content.

- Detecting students with learning difficulties, with the aim of preparing appropriate treatment plans for them.

### **Academic achievement problems:**

The issue of underachievement is one of the most important problems that hinder the educational process, and prevents it from fulfilling its mission fully, and everyone who practiced teaching can acknowledge the existence of this problem in almost every semester, where there is a group of students who are unable to keep up with the rest of their colleagues in achieving expectations. The curriculum is determined and assimilated, and this group often turns into a source of riots and inconvenience, which may cause disruption in the classroom process or a disruption of schooling in general within the school (Haredi, 2003, 87).

When talking about the problem of poor achievement and weak educational level, as Hammoudi (2009, 43) points out, one of the characteristics of the educational system outcomes in Arab countries, there is low achievement at its comprehensive level, and therefore the problem of underachievement is one of the problems that the educational system suffers in the Arab countries as mentioned in the statistical report of UNICEF. This is in addition to wasting human energies and material capabilities, and he indicated that after the students returned to the classroom, they did not achieve a good academic level, and (Dhiyab, 2006, 42) indicates that the problem of low academic achievement is a global problem that is not nearly without a society from societies.

Among the studies that adopted development of achievement in mathematics are the study of sentences (Camel, 2018), which aimed to identify the effectiveness of a proposed teaching strategy based on some mind habits in developing achievement in mathematics and mathematical intuition skills among fifth-grade primary students, and Sufyan's study (2018) which targeted building a program based on the principles of logic and metacognitive strategies and verifying its effectiveness in improving the achievement of students at the first university level in the Department of Mathematics at the College of Education at the University in the "Mathematical Logic and Groups" units and developing mathematical proof skills and thinking skills beyond knowledge. The transition of the effect of learning metacognitive thinking skills to other educational courses.

In addition, the Habashneh study (2018), which aimed to measure the effectiveness of a program based on some metacognitive and multimedia strategies in improving achievement and developing critical thinking skills in mathematics and reducing math anxiety among ninth grade students in Jordan.

Also, the Hashem Study (2017), which aimed to identify the effectiveness of a simulation-based e-learning environment in developing visual spatial visualization and achievement in engineering for first preparatory first graders, which concluded that there is a positive correlation between spatial visualization and academic achievement.

### **Mathematical intuition skills:**

With reference to the literature and studies, mathematical intuition skills can be identified in;

1. Induction: It is intended to reach a general result from some observations, observations or special examples.
2. Deduction or conclusion: It is intended to obtain a special result based on a general principle, or is the application of the general rule to a special case of the rule to which it applies.
3. Measurement: It consists of matching a new situation with a previous position that was previously correct, or an issue compared to the validity of another similar case.
4. Circular: It is a written formulation or a phrase written in the general image, by noting some special cases.
5. Expressing symbols: It is intended to use symbols to express mathematical ideas or verbal data.
6. Formal logic: It is the study of logic of expressions according to their form, whereby expressions, denials and logical connectivity tools represent symbols, and the application of final results to all expressions that have the same form.
7. Mathematical proof: means the evidence or argument to show that the validity of a phrase stems from the validity of previous expressions for it or is a series of statements to indicate the validity of a result by reasoning and logic and presenting evidence based on a previous theory or postulate.
8. Perception of relationships (relational thinking): means the ability to extract new relationships or information that have not been previously studied but could be predicted from the relationships and information given.

9. Reflexive thinking: It is intended for the student to reflect on the situation in front of him, analyze it to its elements and draw the necessary plans for understanding it until it reaches the results required by this position, then establish these results in light of the plans that have been developed for it.

10. Critical thinking: It is a process based on accuracy in observing the facts that relate to the topics of discussion, evaluating these topics and the ability to draw conclusions from them in sound logical ways, taking into account the objectivity of the whole process and distance from subjectivity.

From the above, we find that mathematical intuition skills that must be available to students in the mathematics course are skills (induction, deduction, measurement, generalization, symbol expression, formal or graphic logic, mathematical proof, relational thinking, contemplative thinking, critical thinking).

#### **How to develop mathematical intuition skills:**

(Ibrahim, 2009, 24-28) believes that in order for the teacher's practices and performance to be effective in teaching mathematical intuition skills with a view to developing them, he must have mentoring skills along with some of the steps that the teacher must follow to develop mathematical intuition for students. Among these are:

- Preparing learners to build a classroom: Learners must be prepared for class interaction at individual and group levels, and confirm that the ultimate goal of education is to acquire the ability to think.

- Explicit response to learners' questions and requirements: When the teacher is keen to respond to learners' questions and requirements, within the limits of what they study and on the basis of appropriate social judgments, this helps to develop mathematical intuition among students.

- The teacher as a model: When the teacher possesses the elements of cognitive behavior that are evident in everyday life practices and in teaching tools, it is a cognitive model, so learners try to guide him inside and outside the classroom.

Provide an opportunity for discussion and expression.

- Giving sufficient time for reflection: The question should be as procedures that challenge the intelligence of learners and require thinking about them seriously, so it is important that the teacher gives sufficient time to think about educational tasks or activities, and that he works to provide an educational environment that helps to think.

- The teacher provides appropriate opportunities for students to describe the steps they have taken, which express the paths of their mathematical thinking, and in this way the teacher can track these paths, and correct them whenever the educational situation requires that.

- Linking the words and expressions in the teaching position with the thinking skills and operations, and that the teacher's linguistic outcome should be appropriate, and that the teacher's underlying motives be raised, and that the teacher expresses the appropriate polite personality.

- Attention to the evaluation methods that the teacher applies to the thinking processes that the learner performs, and sometimes slightly challenge them, to reach the first levels of the higher thinking processes (epistemological thinking).

#### **Study procedures:**

Preparation of instruments:

Instruments included the following:

An achievement test in mathematics in the first and second sections.

A mathematical intuition skills test.

Study population and sample:

The current study population consisted of fifth primary pupils, and in light of the experimental design, the study sample of fifth grade pupils in the first semester of Mosa ben Nosier school consisted of (30) students who were divided into (15) students of the experimental group and (15) students of the control group.

Preparation of instruments:

First: Achievement Test:

The achievement test was prepared in the mathematics course for fifth grade primary students in the light of learning patterns according to the following stages:

1. Planning and preparation: by setting the test goal .
2. Formulation of test vocabulary: The test vocabulary of the test type was formulated from multiple sources, taking into account the conditions for formulating this type of question. So that each question has four optional alternatives (A, B, C, D)
3. Adjusting the test: By calculating by presenting it to a group of arbitrators, to amend, add, and delete, calculate the stability of the test by applying it to a prospective sample of fifth grade primary students. The stability of the test was calculated using the Kuder-Richardson formula (20) (KR). 20 This treatment is used to calculate the stability of tests and measures if the singular degrees are binary (1, zero) (Allam, 2000, and 165) and the stability ratio came (0.677), and this makes us feel confident that the test has a high degree of stability.
4. Preparing the final step of the test: After making all the required adjustments, the test became valid for application, and it was tried in its final form and put its instructions.

Second: Mathematical intuition test:

The mathematical intuition test was prepared according to the following stages:

Test settings: The test was set by formulating its instructions and determining how to correct it. The time for answering the test was determined to be 35 minutes and by calculating its consistency in order to identify the extent of clarity and accuracy of the instructions and the extent of its suitability for the level of the fifth elementary grade students, and the appropriate vocabulary to measure students' ability to think about mathematics.

The validity of the internal consistency: The internal consistency of the mathematical intuition test was confirmed by calculating the correlation coefficient between the scores of each of the test questions compared to the overall score. It was found that the coefficient of consistency of all test questions and the overall degree of thinking are all statistically significant correlational factors at the level of 0.01 which indicates the validity of the test of thinking.

Stability of the test: The stability of the test was calculated by applying it to the exploratory sample. Using the Cronbach alpha coefficient, the stability of the creative thinking test reached (0.89), which indicates that the test is of high stability.

Teaching aids: Many teaching aids were used in the teaching of mathematics, these included activity boards and cards, notes containing instructions for carrying out tasks and activities, transparency, LCD, OHP, Cartesian drawing board.

Calendar: A test achievement and a test in mathematical intuition were applied, after students answered the activities of the lesson. The evaluation questions were comprehensive for learning aspects including final open problems and they have more than one way to solve and have come to include life situations.

Third: The components of the mathematics lesson according to the Dunn and Dunn model:

Each lesson consists of the lessons of the Dunn and Dunn model of learning styles, which are four stages: preparation or introduction, concept building, general discussion, and summarization and bridging. The role was divided between the teacher and the student as shown in the following table:

Dunn and Dunn Model Learning Styles Program by Teaching Mathematics:

Lesson components:

**Table (3) teaching steps through the Dunn and Dunn model**

M	Stage	The role of the teacher	The role of the student
1	Lesson preparation) introduction)	<ul style="list-style-type: none"> <li>• Define learners' styles according to their educational preferences.</li> <li>• The teacher reviews the concept of</li> </ul>	Participate in discussions by answering

		<p>the relationship variable (asking specific questions).</p> <ul style="list-style-type: none"> <li>Clarification is required from working papers and the smart board can be used.</li> <li>The teacher must observe the time specified for this.</li> </ul>	the questions raised.
2	Division of groups (the stage of building and forming mathematical concepts )	<ul style="list-style-type: none"> <li>The teacher stimulates discussion as students work to facilitate the process of building and shaping concepts.</li> <li>Navigating between groups and following their results without direct teacher involvement in guiding the results.</li> <li>Record the results of the goal and display it on the blackboard.</li> </ul>	<ul style="list-style-type: none"> <li>Students work in groups to try to solve math problems.</li> <li>Students confirm the solution through discussion method.</li> </ul>
3	Discussion about the results	<ul style="list-style-type: none"> <li>View results for all groups.</li> <li>Discussing the results of each group. The teacher must allow the groups to discuss their results through self-evaluation.</li> </ul>	Participate in screens and each group tries to explain its results.
4	Clearance and bridging	Summarizing past activities and results and linking steps together.	Participate in summarizing those results and linking information.

### Ensure equivalence of research groups:

The researcher conducted an analysis of the difference between the average scores of students in the experimental and control groups before applying the experimental treatment material to make sure the two groups are equal, so that the researcher reassures that any learned behaviors, information and facts are due to the application of the Dunn and Dunn model, or in other words, controlling foreign variables, and the results of the analysis of variance As in the following table:

Table (4)

Results of the analysis of variance of the experimental and control groups on the mathematical intuition test

Source of contrast	Sum of squares	Degrees of freedom	Average squares	F	Significance level
Between groups	266 .3	1	266 .3	70.03	Not significant
Within groups	7.1271586	82	8.70643		

Since the tabular  $p$  is greater than the computed  $p$ , there are no statistically significant differences between the control group and the experimental group in the pre-application of mathematical reasoning, and this means that the two groups are equivalent before applying the experimental treatment material.

The researcher also conducted the contrast between the average scores of students in the experimental and control groups, but here on the achievement test prepared in advance, the results of the analysis showed the variance as in the following table:

Table (5)

The analysis of variance shows the scores for the experimental group and the control group on the cognitive achievement test

Source of contrast	Sum of squares	Degrees of freedom	Average squares	F.	Significance level
Between groups	40.02	1	0.025	70.000001	Not significant
Within groups	2.24888	82	81382.6		

Whereas the scores of the value of the tabular value are greater than the calculated  $p$ , therefore, they are not indicative; thus, we are assured that the two groups are completely equal, whether on the mathematical intuition test or the cognitive achievement test.

### Presentation, discussion and interpretation of research results:

To answer the research and hypothesis validation questions, the following are displayed:

1. **Results related to the first hypothesis and its text**, "There is no statistically significant difference at the level of significance (0.01) between the mean scores of students of the experimental group that was studied according to the Dunn and Dunn model of learning patterns and the control group students who studied in the traditional way on the cognitive achievement of the unit of regular fractions determined on primary fifth grade pupils.

To choose the validity of this hypothesis, standard mean and standard deviations and (T) values for students 'experimental and control groups' scores in the cognitive achievement test related to the unit of regular fractions were calculated afterwards, and the effect strength and use of the omega square were calculated, and the following table shows that:

Table (6)

Means, standard deviation, and "T" values and the effect size of the results of applying the dimensional cognitive achievement test to each of the experimental and control groups

M	Group statement	Number n	Average m	Standard deviation p	Degrees of freedom	Value of t	Significance level T	The magnitude of the effect is the square of omega	The amount of impact force



								$\eta^2$ (	
1	Experimental	15	19	369.31	28	3.34	0.01	0.16	Large
2	Control	15	3	52.72					

It was clear from the results of the previous table that there is a statistically significant difference between the mean scores of students of the experimental and controlling groups in the cognitive achievement test related to the unit of regular fractions in the first semester in favor of the average of the experimental group students. Thus the zero hypothesis is rejected, and the alternative hypothesis stipulates that: there's a statistically significant difference at the significance level (0.01) between the mean scores of the experimental group students that were studied according to the Dunn and Dunn model of learning patterns and the control group students who studied in the traditional way on the cognitive achievement of the unit of regular fractures determined for the fifth grade students primary school for the experimental group. "

It also turned out - from the previous table that the strength of the influence of teaching according to the Dunn and Dunn model of learning patterns on developing the cognitive achievement of students of the experimental group is "significant".

**2- Results related to the second hypothesis;** its text: "There is no statistically significant difference at the level of significance (0.01) between the mean scores of the pre and post measurements of the experimental group students that were studied according to the Dunn and Dunn model of learning patterns on the cognitive achievement of the unit of regular fractures determined for the students of the class fifth grade.

To choose the validity of this hypothesis, standard mean and standard deviations and (T) values for the associated samples (experimental group before and after) were calculated in the cognitive achievement test afterwards, and the effect strength and use of the omega square were calculated, and the following table shows that:

Table (7)

Average and standard deviation, "T" values and the effect size of the results of applying the cognitive achievement test before and after the experimental group

M	Group statement	Number n	Average m	Standard deviation p	Degrees of freedom	Value of t	Significance level T	The magnitude of the effect is the square of omega $\eta^2$ (	The amount of impact force
1	Tribal	15	2.3	17.24	14	23.16	0.01	87.0	Large
2	after	15	19	328.21					

It was clear from the results of Table (9) that there is a statistically significant difference at the level (0.01) between the mean scores of students of the experimental group in the pre and post applications in the cognitive achievement test, and in favor of the average after application, and thus the null hypothesis was rejected and the alternative hypothesis stipulated that "there is a difference" D. Statistically significant at the level of significance

(0.01) between the mean scores of the pre and post measurements of the experimental group students that were studied according to the Dunn and Dunn model of learning patterns on the cognitive achievement of the unit of regular fractions determined for the fifth elementary grade students in favor of post-application.

It has also been shown - through the previous table, that the power of influence to use the Dunn and Dunn model of learning patterns in teaching topics of " regular fractions " in developing cognitive achievement for students of the experimental group is great.

**3- The results related to the third hypothesis, and its text:** "There is no statistically significant difference at the level of significance (0.01) between the average grades of the experimental group students that were studied according to the Dunn and Dunn model of learning patterns and the control group students who studied in the traditional way on the mathematical intuition of fifth graders. Primary"

To verify the validity of this hypothesis, the value of (T) was calculated for two unrelated groups (experimental and control) on the mathematical intuition test, as shown in the following table:

Table (8)

Differences between the mean scores of students of the experimental and post-control groups on the mathematical intuition test as a whole and its components

The magnitude of the effect is the square of omega $\omega^2$ (	Value of t	Degree of freedom	standard deviation	Average $\bar{m}$ (	Number $n$ (	the group	The components of mathematical intuition
0.89	9.632	28	34.88	102.32	15	Experimental	<b>Meditative</b>
			11.305	35.21	15	Control	
0.72	6.054	28	13.432	48.34	15	Experimental	<b>Relational</b>
			3.845	24.30	15	Control	
0.92	15.145	28	28.325	151.37	15	Experimental	<b>Critic</b>
			12.623	66.32	15	Control	
0.86	13.977	28	60.324	300.58	15	Experimental	<b>Total marks</b>
			27.003	130.21	15	Control	

It was clear from the previous table that the calculated value of (T) for the total mathematical intuition test (13.977) and for the contemplative (9.632), the relational (6.054), the critic (15.145) at degrees of freedom (28) at the significance level (0.01), and this indicates the presence of differences Statistically significant between the control group and the experimental group in the mathematical intuition test as a whole, and in its components in the dimensional application in favor of the experimental group, and this means rejecting the null hypothesis and accepting the alternative hypothesis which states that "there is a statistically significant difference at the level of significance (0.01) between the mean scores students of the experimental group that studied according to the Dunn

and Dunn model of learning patterns and students of the control group that studied by the traditional method of mathematical intuition in primary five pupils in favor of the experimental group.

**4- Results related to the fourth hypothesis; its text:** “There is no statistically significant difference at the level of significance (0.01) between the mean scores of the pre- and post-measurements of the experimental group students who studied according to the Dunn and Dunn model of learning patterns on mathematical intuition among fifth-grade primary students.”

To verify the validity of the previous hypothesis, the value of (T) was calculated for two associated groups (experimental before and after) on the mathematical intuition test as a whole, and its three components, as in the following table:

Table (9)

Differences between the average scores of students of the experimental group, pre and post in the test of intuitive math as a whole and its components

The magnitude of the effect is the square of omega $\omega^2$ (	Value of t	Degree of freedom	standard deviation	Average $\bar{m}$ (	Number $n$ (	Application	Ingredients Mathematical intuition
0.79	10.54	14	9.123	32.65	15th	Tribal	<b>Meditative</b>
			34.88	102.32	15th	after	
0.75	8.14	14	6.534	25.43	15th	Tribal	<b>Relational</b>
			13.423	48.34	15th	after	
0.72	7.94	14	27.34	91.43	15th	Tribal	<b>Critic</b>
			28.325	151.37	15th	after	
0.87	11.93	14	43.46	150.32	15th	Tribal	<b>Total marks</b>
			60.324	300.58	15th	after	

It is clear from Table (10) that the calculated value of (T) for the test of mathematical intuition is entirely (11.93), in contemplative (10.54), relational (8.14) and in critic (7.94), which is higher than the value of the (T) table at degrees of freedom (14) when Level (0.01), and this indicates that there are statistically significant differences between the pre-application and the post-application of the experimental group in the mathematical intuition test as a whole, and in its components in favor of the post-application, and this means rejecting the zero hypothesis and accepting the alternative hypothesis which states that "there is a statistically significant difference at the level of Significance (0.01) between the mean scores of the pre and post measurements for the students of the experimental

group that studied according to the Dunn and Dunn model of learning patterns Li intuition sports in the fifth grade students for the experimental group ".

Thus, the results of this study are consistent with the results of each of the studies (Ibrahim, 2011) and (Shalaka, 2018) on the effectiveness of using the Dunn and Dunn model to increase students' skills.

In addition, the researcher attributes the superiority of the Dunn and Dunn model of learning styles over the methods used in academic achievement and mathematical intuition to the following reasons:

- Dunn and Dunn's learning styles model is based on the skill of modifying misconceptions. This results in increased achievement and the development of mathematical intuition among students.

- Dunn and Dunn's learning styles model is based on the focus of the teaching process on the learner.

Increase student achievement and mathematical intuition by controlling thinking about mathematical operations.

- The experimental group excelled in achievement to take into account the individual differences between students.

### **Research Recommendations:**

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

1. Encouraging teachers to use non-traditional teaching methods in developing achievement and mathematical intuition skills.

2. Conducting workshops that include math teachers in each school with the aim of discussing the latest methods and strategies that contribute to developing mathematical intuition skills.

3. Encourage math teachers to use the Dunn and Dunn model of learning styles to develop students' achievement and mathematical skills.

4. Exam questions include creative aspects, higher-order thinking skills, and a review of current assessment methods and current examination forms.

5. Developing programs for preparing and training the mathematics teacher, continuing their training, maintaining professional and academic growth.

### **Suggested Research:**

In light of the results of the current study, the researcher suggests conducting the following researches and studies.

1. The effectiveness of using Dunn and Dunn for learning styles in developing higher-order thinking skills in mathematics for middle school students.

2. The effect of using the Dunn and Dunn model of learning styles on developing mathematical problem-solving skills for high school students.

3. The effectiveness of the Dunn and Dunn model of learning patterns in developing mathematical concepts among students of the first cycle of basic education.

4. The effectiveness of the Dunn and Dunn model of learning patterns in developing scientific thinking skills in math subject for secondary school students.

### **References:**

- Abdel-Gawad, Iyad (2016). "The level of teachers of the lower basic stage in the standards of the Dunn and Dunn model for learning styles and its relationship with their tendencies towards the teaching profession." *An-Najah University Journal for Research - Humanities: An-Najah National University*, Vol. 30, No. 1: 51-86.

- Abu Allam, Salah Mahmoud (2011). Measurement and evaluation of academic achievement, third edition, Safat, Kuwait: Dar Al-Qalam Press.
- Abu Al-Nadi, & Hala, Jamal. (2010). Most preferred learning styles among the students of Isra Private University (reality and ambition). *Journal of Social and Educational Studies*, Egypt, 16(1), 61-112.
- Al-Mohtasib, Sumya. (2013). Scientific thanking and its relationship with learning styles among the students of upper primary stage. *The educational Journal*, 106(2), 283-324.
- Al-Turairy, Abdul Rahman bin Suleiman (2012). The concern of the test for university students and its relationship to some variables, second edition, *Journal of the Faculty of Arts*, Alexandria University, Egypt.
- Camel, Amr Mohamed El-Sayed Ahmed (2018). A strategic effectiveness based on some mind habits in mathematics for primary school pupils in developing achievement and mathematical intuition, Master Thesis, College of Education, Mansoura University.
- Dhiyab, Youssef (2006). *The Psychology of Scholastic Delay: A Curative Analytical View*, Curriculum House.
- Dunn, R. G., Griggs, S. A., Olson, J., Gorman, B., and Beasley, M. (1995): A meta-Analytic validation of The Dunn and Dunn model of learning-styles preferences. *Journal of Educational Research*, 88, 353-361 .
- Dunn, R. Thies, A. & Honigfeld, A. (2001): Synthesis of the Dunn & Dunn learning style model Research: analysis from a neuropsychological perspective. School of education and Utopia parkways, Jamaica, NY.
- Felder R. & Soloman, B. (2003). Learning Styles and Strategies. [www.ncsu.edu/felder-public/ILSdir/styles.htm](http://www.ncsu.edu/felder-public/ILSdir/styles.htm).
- Ghoneim, Mohammed & Buddy, Zaki. (2012). Differences in learning styles and their relationship with some variables. *Reading and knowledge Journal*, Egypt, 125. 164-232
- Habashneh, Adnan Khalaf Safhan (2018). The effectiveness of a program based on some metacognitive and multimedia strategies in developing achievement and critical thinking skills and reducing math anxiety among ninth grade students in Jordan, Faculty of Education, Mansoura University.
- Hammoudi, Ahmed (2009). Non-school social variables associated with both academic achievement and social exclusion: a critical psychology study, *Journal of Humanities*, p. 41.
- Haredi, Adel Mohamed (2003). Individual differences in emotional intelligence in the light of vital / social variables. *Journal of Arab Studies in Psychology - Egypt*, Vol. 2, No. 2: 57-108.
- Hashem, Mahmoud Saad Abdel-Moneim (2017). Developing a simulation-based e-learning environment to develop visual spatial perception and achievement in engineering for prep students, Master Thesis, College of Education, Damietta University.
- Ibrahim, Ahmad. (2011). The effectiveness of a program based on Dunn's model of learning styles in the development of reading skills and the attitudes towards reading among Azhari first secondary graders with learning difficulties. *Journal of the Faculty of Education*, Tanta University, (43), Egypt, pp 2-84.
- Ibrahim, Magdi Aziz (2009) *Lexicon of Teaching and Learning Terminology*, World of Books, Cairo.
- Jaber, Liana & Qar'an, Maha. (2004). *Learning styles (theory and practice)*. Qattan Foundation, Qattan Centre for Educational Research and Development, Ramallah - Palestine.
- Kabbad, Abdullah (2009). *Methods of teaching mathematics in general education schools*, Riyadh, Al-Rushd Library.
- Khairy Al-Maghazi Ajaj (2008): *Methods of Thinking and Learning, A Comparative Study*, 2nd edition, Cairo, The Anglo-Egyptian First Edition.

- Mina, Fayez Murad (2004). "Developing mathematics education in a knowledge society." In the Fourth Scientific Conference - Mathematics for General Education in the Knowledge Society - Egypt, Qaliubiya: The Egyptian Society for Mathematics Education: 46-53.
- Najdi, Ahmed Abdel-Rahman (2015) The approach in the postmodern era, 3rd floor, Al-Aqsa House for Printing, Cairo.
- Obaid, William (1998). Community mathematics to face future challenges (a proposed framework for developing mathematics curricula at the beginning of the twenty-first century). Mathematics Educations Journal, The Egyptian Mathematical Education Association, Volume 1.
- Saadeh, Jawdat and Ibrahim, Abdullah (1991). The Effective School Curriculum, Amman: Dar Ammar.
- Shalaka, Mortada Hamid (2018). "The effect of the Dun and Dunn model on the achievement of geography and the development of inferential thinking among literary fifth graders." Journal of Educational and Psychological Research: University of Baghdad - Center for Educational and Psychological Research No. 56: 363-391.
- Sufyan, Yahya Muhammad Ali (2018). The effectiveness of a program based on the principles of logic and metacognitive strategies in the achievement of students of the Faculty of Education and the development of their skills in proof and thinking and the transmission of the impact of learning, PhD thesis, Faculty of Education, Mansoura University.
- Zaitoun, Ayish (1994). "Methods of teaching science". Oman: Dar Al-Shorouk for publication and distribution.