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Mathematical Intelligence and Its Relationship with Thinking Patterns and Mathematics Achievement of Intermediate Third Year Students

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This research aims to identify the level of mathematical intelligence and thinking patterns among intermediate third year students in Baghdad, and the relationship between the research variables. The researchers have used the descriptive analytical method and prepared two tests, one to measure the level of mathematical intelligence consists of (23) items, and the second in mathematics achievement consists of (30) items multiple options. After applying the tests on a sample of 209 students and calculating the data statistically, the level of mathematical intelligence and thinking patterns among the students was shown to be low. Differences exist in the mathematical intelligence and thinking patterns for females. A relationship exists between mathematical intelligence and each of the thinking patterns and achievement.

Key words: *Mathematical Intelligence, Thinking Patterns, Academic Achievement, Mathematics, Intermediate Stage.*

Introduction

The subject of mental abilities and intelligence is one of the most prominent topics that preoccupies many researchers. Intelligence has been defined as "the ability to solve problems and creativity in products of value through a specific set of abilities, talents and intellectual skills that Gardner called "intelligence" and not looking at human intelligence from a unilateral perspective. Gardner (1983) assumed the existence of seven kinds of intelligence, i.e. linguistic,

mathematical logic, musical, spatial, physical/kinetic, social, and personal intelligence, and then added eighth intelligence which is natural intelligence. Gardner, (1983 p.34)

Verbal / Linguistic Intelligence is "the ability of an individual to deal with words, meanings, and words and to use them effectively, verbally and in writing, as shown in the ability to use language in persuasion."

Logical / Mathematical Intelligence is "the ability to use numbers and logical relationships in virtual construction [since ... then ... cause and effect], in addition to classification, reasoning, generalization, and testing hypotheses and calculative processes".

Visual / Spatial Intelligence is a "careful observation of the outside world, including visual perception, the representation of ideas, and conscious perception of purpose" (Salah al-Din Arafa, 2005 p235).

While Social Intelligence is defined as "the ability of the individual to recognize and distinguish between the situations and feelings of others and their motives and purposes, including sensitivity to facial expression, sound and gestures, and the ability to distinguish and respond appropriately to them" (Jaber Abdul Hamid Jaber, 2003p11).

Mohamed Abdel Hadi Hussein (2008) identified a set of features for each of these intelligences summarized by the two researchers: (memory strength, the ability to ask questions to others and in different formats, possessing a large vocabulary, and the ability to deal with the numbers which generates great pleasure in reading and writing and dealing with words and solving the words and numbers puzzles, the ability to acquire new languages easily, the tendency toward activities based on certain rules, the desire to know the ways in which different things work, the collection and classification of different objects according to certain characteristics, the tendency to analyse when dealing with problems, having a good level at mathematics, reasoning, logic, problem solving, computer programming, the possibility of learning through classification, tabulation, abstract patterns and relationships, making complex calculations, love of drawing and leaning towards it, the desire to isolate and construct objects in various forms, the great pleasure in solving visual puzzles, good perception for details and relationships of the whole to the part, remembering places by description or through images, learning through drawing, visual perception, colors and images, ability to explain maps, cooperation, discussion, communication, ability to observe all relevant points of view, good level of performance in group projects, showing compassion to others, associating with peers and adults, sensitivity to others' feelings, role playing, team work, admiring others, showing good ability to lead, guiding and directing others, learning through participation, stories, interviewing and cooperation (Mohamed Abdel Hadi Hussein, 2008, p. 230-239).

Thinking Patterns

Thinking Patterns are defined as "a series of mental activities carried out by the individual's brain to discuss a specific topic or to judge the reality of something or to solve a particular problem. This behaviour has certain characteristics, the most important of which are: the existence of the fact of connecting information to reality, the ability to look and choose and reorganize (Hani Fathi Abdel Karim Najm, 2007, p. 7) (Ryan and Attieh, 2013). There are several types of thinking, including visual, creative, critical, inference, analytical, and convergent thinking. The current research is limited to some of these patterns, one of which is considered the most important type of thinking in mathematics, "visual thinking." Campbel (1995) defined it as thinking based on the shapes, drawings and images presented in the situation and the real relationships contained therein where such drawings and images lie in the hands of the learner, who tries to find meaning in the contents in front of them. Visual thinking is based on two processes identified by Obaid and Afaneh (2003): **vision**, meaning the use of the sense of sight to identify, locate and understand objects and guide the individual in the surrounding world, and **imagination,** which is the process of creating a new image by recycling and reusing past experiences and mental fantasies, with the absence of visual stimuli relying on their preservation in the mind's eye. Vision and imagination are the basis of cognitive processes using special memory-based skills drawing on previous experiences, where the device of perception (the brain) and mind transforms signals from the eye to the three components of imagination: modelling, colour and movement (Obaid & Afaneh, 2003, p. 43) (Saif Mohammed Rashad Al-Muzaffar, 2012).

Inference thinking is defined as "a process of thinking that involves the establishment of facts or information in an organized manner that leads to a conclusion, decision or resolution of a problem" (Fathi Abdel Rahman Jarwan, 1999, p. 337). Inference usually involves three elements: an introduction or introductions, a subsequent logical relationship between the introductions, and the result (Mahmoud, 2006, p. 150). The basic skills of inference thinking are set out by Fathi Abdel Rahman Jarwan, 1999 in "Inductive Inference," in which the thinking takes place from the private to the general, and "Inductive" here is a language that follows the molecules in order to reach a total result, and Inductive Reasoning in which the thinking takes place from the general to the private. Inductive reasoning means the ability to reach a result by processing information or facts available according to specific logical rules and procedures (Fathi Abdel Rahman Jarwan, 1999 p. 31-34).

Critical Thinking is defined as "the adoption of decisions and judgments based on objective grounds, consistent with the observed facts, which are discussed in a scientific manner away from prejudice or external influences that spoil these facts or avoid accuracy or exposure to possible interference from internal factors" (Obaid and Afana, 2003, p. 54). There are several

critical thinking skills specified by Watson & Glasser (1991): conclusion, deduction, assumptions, evaluation, and explanation.

Creative Thinking is defined as "open-minded thinking in which production is characterized by a unique characteristic or variety of productive answers that are not determined by the given information" (Gilford, 1967, p. 122) (Nabil Rafiq Mohammed Ibrahim, 2008). It is also defined by Fathi Abdel Rahman Jarwan (1999) as "a combined mental activity which is purposefully guided by a strong will to search for solutions or to reach original results that were not known or presented previously." There are five main skills for Creative Thinking: fluency, flexibility, originality, details, and sensitivity (Fathi Abdel Rahman Jarwan, 1999, p. 82-85).

Relationship of Mathematics to Thinking and Intelligence

Mathematics is one of the most important subjects in all stages of education. Early mathematical development and the role of mathematics knowledge in the success of a late school career have been covered by many studies. Mathematics is an integral part of large international comparative studies such as PISA (International Student Assessment Program, OECD, 2013), TIMSS (Trends in Mathematics and International Science, Mullis & Martin, 2013) and national assessment systems. Based on the results of these studies, the features of educational systems that better promote the development of mathematical knowledge and skills are well known. Thus, if we intend to make an online assessment of creativity in an educational context and choose one school to which its tests relate, mathematics is a clear choice (Pasztor & Csapo & Moha, 2015, p. 3) (Watson، G. B. and Glasser. E. H. 2016), which contribute to the development of thinking of its various types. In addition to being one of the basic pillars of scientific and technical development, the nature of its construction, content and method of dealing with subjects, makes it a fertile ground for training in sound thinking. It has long been associated with mental processes and logical thinking in particular. There are those who believe that the purpose of teaching mathematics is not to give the learners some concepts, principles and laws, but to accustom them to the different ways of thinking. The components of mathematical knowledge are not just facts, concepts, skills and problems, but also methods of thinking. Therefore, Al-Sadiq (2001) considered it as an expression of the human mind which reflects the practical ability, the ability to reflect and reason and the desire to reach perfection in aesthetics. Its study helps in the development and growth of many of the mental attributes such as the strength of thinking and inference and proofing, induction, deduction, creativity and originality of thinking, generalization and discovery, and so on. Each mathematical question contains an intellectual determination, which is a good exercise of the mind (Al-Sadiq, 2001, p. 163-167). It is important to organize, consolidate and develop the capacities of thinking and to draw conclusions from facts and introductions to the results in addition to possessing real value that develops and evolves the strengths of thinking and inference (Ahmed Suleiman Auda, 1999).

Al-Khatib pointed to a relationship between mathematics and thinking, as the study of mathematics must focus on proper reason and thinking so that the student can: reach sound logical conclusions, use models, facts, characteristics, and mathematical relationships to explain discussions and conclusions, and manage responses and solutions, use patterns and relationships to analyse mathematical attitudes (Khatib, 2009, p. 116). Due to the difficulties faced by students in learning mathematics, it is necessary to identify the level of mathematical intelligence and their thinking patterns in order to employ them in the learning of mathematics in an effort to reduce these difficulties and raise their rates of achievement. Ahmed (2001) pointed out that there is a strong connection between excellence in achievement and development of intelligence, with a difference in the findings of the researchers in the relationship between thinking and achievement (Ahmed, 2001, p. 140). The study of Mohammed Baidaa Ahmed (2017) indicated that there is a correlation between patterns of thinking and achievement in mathematics. In the absence of these relationships, and the discrepancy between the results of studies and literature related to the subjects of intelligence and thinking, and achievement in mathematics, the researchers decided to conduct this study to identify the relationship between these three variables.

Research Problem

The problem of the current research is to reveal the correlation between mathematical intelligence and patterns of thinking and achievement in mathematics among students in the intermediate stage. The two researchers noted, through their knowledge of the results of previous studies related to the subject of their research, a number of problems, including the problem of low achievement rates in mathematics, especially in the intermediate stage (which is characterized by the stages of the educational ladder as the link between the primary and secondary stages) in which the learner moves from concrete experiences to abstract experiences, and has the basic concepts and skills that constitute a base from which to start his future study, and choose the specialization that fits with his/ her mental abilities and intelligence). (Hani Fathi Abdel Karim Najm, 2007) pointed out that the application of the theory of multiple intelligence within the classroom had a positive effect on the increased responsibility, self-direction and independence of students, and a decrease in system problems and the increase in their thinking, which may be due to low level of thinking and intelligence. (Hani Fathi Abdel Karim Najm, 2007 p4).

The search problem can be presented by answering the following questions:
1- What is the degree of mathematical intelligence among intermediate school students in Baghdad?
2- What is the level of thinking patterns of students of the intermediate stage in Baghdad?
3- Is there a correlation between mathematical intelligence and thinking patterns and academic achievement in the mathematics of intermediate third grade students in Baghdad?

Research Importance

1- Measuring the degree of mathematical intelligence among students in the intermediate stage because of its importance in their academic achievement in mathematics.
2 - Measuring the level of possession of students of the intermediate stage of some types of thinking in mathematics because of its importance in their academic achievement in mathematics.
3- To reveal the nature of the relationship between mathematical intelligence among intermediate school students and their achievement in mathematics.
4- To reveal the nature of the relationship between thinking patterns in mathematics among intermediate school students and their achievement in mathematics.
5- To reveal the nature of the relationship between mathematical intelligence and thinking patterns in mathematics among intermediate school students.
6- To draw the attention of those involved in teaching mathematics to the importance of mathematical intelligence and thinking patterns in mathematics and their role in learning and teaching mathematics.
7- The importance of the intermediate stage in which the ages of students are in the transition from the stage of sensory processes to the stage of abstract processes, which requires knowledge of their multiple intelligences.
8- Introducing the teachers with the importance of mathematical intelligence and thinking patterns in mathematics, and mental skills for their students to benefit from the process of learning mathematics.
9- The scarcity of research and studies in Iraq which dealt with measuring the level of mathematical intelligence and study its relationship with some types of thinking and academic achievement in mathematics among students in the intermediate third grade, according to gender variable (to the knowledge of both researchers).

Research Objectives

1- The level of mathematical intelligence among intermediate school students.
2- The level of acquiring thinking patterns in mathematics of intermediate school students in Baghdad.
3- The relation of statistical significance between mathematical intelligence and academic achievement in mathematics among intermediate school students.
4- The relationship of statistical significance between the thinking patterns in mathematics and the academic achievement of the students in intermediate school.
5. The statistical significance relationship between mathematical intelligence and thinking patterns in mathematics among intermediate school students.

Research Hypotheses

1- There is no statistically significant difference between hypothetical average of the mathematical intelligence score and the arithmetic average of the research sample students' scores on the test.
2- There is no statistically significant difference between the scores averages of research sample students of the research on the mathematical intelligence test which is due to the gender variable.
3- There is no statistically significant difference between the hypothetical average of the test score of thinking patterns in mathematics and the arithmetic average of the scores of the research sample students on the test.
4- There is no significant statistical difference between the hypothetical average of the research sample students on the test of thinking patterns in mathematics which due to the gender variable.
5- There is no significant correlation between the scores of the research sample students on the test of mathematical intelligence and their scores on the academic achievement test.
6- There is no correlation relationship of statistical significance between the scores of the research sample students on the test of thinking patterns in mathematics and their scores on the test of academic achievement.
7- There is no correlation relationship of statistical significance between the scores of the research sample students on the test of mathematical intelligence and their scores to the test of thinking patterns in mathematics
.1-8- Research limits:
1-Sample of students in the intermediate third grade in two schools belonging to Baghdad/ Al-Karkh Directorate General of Education for the academic year 2016-2017.
2- Mathematical intelligence represented by (linguistic, logical, visual, and social) intelligence.
3- Thinking patterns in mathematics (visual, inference, critical, and creative).

Research Methodology and Procedures

2-1- Research Methodology: The two researchers used the descriptive analytical approach because it suits the nature of the research objectives.

2-2- Research Community: The current research community consisted of the intermediate third grade students in intermediate schools of Baghdad/ Al-Karkh Directorate General of Education for the academic year 2016 - 2017, the second semester.

2-3-A- The Research Sample: It consisted of intermediate third grade students of (Buratha Intermediate School for Boys) for boys and (Zarqa' Al-Yamama Intermediate School for Girls). These two schools were chosen intentionally, table (1):

Table 1: Distribution of research sample individuals

Name of School	Before Exclusion	Failure and Absence	No. after Exclusion
Buratha Intermediate School for Boys	115	8	107
Zarqa' Al-Yamama Intermediate School for Girls	108	6	102
TOTAL	223	14	209

2-3-B- Survey Sample: It consisted of (150) students (males and females) from the intermediate third grade students and were chosen from schools of the research community.

2-4- Research Tools:

2-4-A- Mathematical Intelligence Test: It was used to measure the level of four types of multiple intelligences in mathematics which are (linguistic, mathematical logical, visual, and social intelligences) after studying the tests of multiple intelligences dealt with literatures and previous studies. It consisted of (24) sections distributed as follows: (5 sections to measure the level of visual intelligence, 5 sections to measure the level of logical mathematical intelligence, 8 sections to measure the level of linguistic intelligence, 6 sections to measure the level of social intelligence). Based on the opinion of most arbitrators, the two researchers put an assumed average of students' answers to the test of (50%) of the total score of the test of (24) degrees.

2-4-B- Thinking Patterns Test: The researchers adopted the test patterns of thinking in mathematics, prepared by (Mohammed Baidaa Ahmed, 2017) to identify the extent of possession of students of the sample research patterns of thinking. It consists of (21) sections (15 sections of multiple choice type and 6 sections) to measure patterns of thinking (visual, inference, critical, creative) in mathematics. The distribution of the sections was as follows: Visual thinking (4) sections, inference thinking (6) sections, critical thinking (5) sections, creative thinking (5) sections).

2-4-C- Test of Academic Achievement in Mathematics: It was used to measure the academic achievement of the research sample students. It consists of (30) of the type of multiple choice with three alternatives.

Application Procedures

2-5-A- Survey Application: It appeared after the survey application, that the sections and instructions of the test were clear to the students. The application of the mathematical

intelligence and thinking patterns took 50 minutes for each test. The test of achievement took 45 minutes.

The three tests were marked by giving one score for each correct answer and 0 for the wrong answer. The greatest scores for the tests were: (24 for mathematical intelligence, 21 for thinking patterns, 30 for test and achievement).

2-5-B- Validation of the Tools: To verify the validity of the three tests, the two researchers used two types of validation: the apparent validation by presenting them to a group of arbitrators specialized in education, psychology and methods of teaching mathematics, and the internal consistency validation which calculates the correlation coefficient between each section and the total score. The value was (32.0 - 76.0) for the mathematical intelligence test, and between (56.0 and 892.0) for the test of thinking patterns. And by calculating the correlation coefficient between each section and the overall score of the test, the value ranged between (55.0 and 73.0) for the mathematical intelligence test and between (75.0 and 893.0) for the thinking patterns test. And the calculation of the correlation coefficient between each section and the total score of the achievement test. The values ranged from (45.0 to 87.0), all of which have an acceptable indicator of the internal consistency of the test component sections.

2-5-C- Stability: To determine the stability of the tests, the two researchers used the Kuder–Richardson equation (KR - 20) to calculate the stability coefficient which was 89% for the mathematical intelligence test, 93% for the test of thinking patterns, and 91% for academic achievement test.

All of which are good stability coefficients in educational and social sciences. The test is good if the coefficient of stability is more than 85% (Audi, 1999 p396).

2-5-D- Statistical Analysis of the Three Test Sections:

After extracting the difficulty and discrimination coefficients using the equations, it was found that the values of the difficulty and discrimination coefficients for the mathematical intelligence and thinking patterns ranged from (0,23- 0,78) except for one section in the mathematical intelligence test was (0,16) so it was deleted. As for their values for the academic achievement test, it ranged between (0,42 - 073). These values are acceptable as the sources indicated that any section within the range (0,20 – 0,80) could be accepted and advised to be retained (Audi, 1999 p297).

The use of the equation of the effectiveness of the wrong alternatives between the two terminal groups in each section with each wrong alternative, it turns out that all of them were negative, so they are acceptable and effective.

Statistical Methods

The following statistical methods were used: (coefficient of difficulty and discrimination of sections, equation of the effectiveness of false substitutions, Pearson correlation coefficient, Kuder– Richardson equation (KR-20), Spearman-Brown equation, percentage weight, (Z - Test) for one sample and two independent samples, (Z - Test) to denote differences between correlation coefficients.

Results

3-1- Results of the first hypothesis: There is no statistically significant difference between the hypothetical average of the score of mathematical intelligence test and the arithmetic average of the scores of the research sample students on the test.

To evaluate the validity of the hypothesis and to determine the level of mathematical intelligence among the students in the research sample, the mathematical averages and standard deviations of their scores were extracted on the mathematical intelligence test. To find out the significance of the differences between the hypothetical averages and the arithmetic averages of the scores of the research sample students , the Z Test was used for one sample, table (2).

Table 2: Significance of the differences between the scores averages of the research sample students on the mathematical intelligence test

Type of Intelligence	Sample Size	Hypothetical Average	Arithmetic average	Standard deviation	Calculated Z value	Tabular Z Value	Level of significance	Percent weights
Males	107	11,5	10,88	3,005	2,14 -	1,98	Significant	47%
Females	102	11,5	12,06	2,771	1,74	1,98	Not Significant	52%
All Students	209	11,5	11,35	2,940	0,67 -	1,96	Not Significant	49%

The results of Table (2) showed the following:

- The tabular z-value is greater than calculated, i.e., the difference is statistically insignificant between the accepted mean of the mathematical intelligence score and the arithmetic mean of the scores of (all the students, and female students) on the test, although the arithmetic mean of the female students is higher than the hypothetical average, and statistically significant for male students as the calculated z value is greater than the tabular.
- The percentages of the students' scores were as follows: Students in general is (49%) and male students is (47%), which is low. That is, they have mathematical intelligence but at a lower level than acceptable performance level. As for the percentage weight of the female

sample, it was (52%). This means that they have mathematic intelligence at a level slightly higher level than acceptable performance level.

3-2- The results of the second hypothesis There is no statistically significant difference between the scores averages of research sample students of the research on the mathematical intelligence test which is due to the gender variable.

To test the hypothesis, and to know the significance of the difference between the averages of scores of the research sample students in the in the mathematical intelligence test by gender variable, the z test was used for two independent samples, Table (3)>

Table 3: Significance of the differences between the average scores of the research sample students on the mathematical intelligence test by gender variable

Variable	Gender	Sample Size	Hypothetical Average	Arithmetic average	Standard deviation	Calculated Z value	Tabular Z Value	Level of significance
Mathematical Intelligence	Males	107	11,5	10,88	3,005	3,241 -	1,96	Statistically significant
	Females	102		12,06	2,711			

The results of Table (3) show that the calculated z value is higher than the tabular. This means that the difference is statistically significant at the level of significance (0.05) between the average scores of the research sample students and for female students.

3-3- Results of the third hypothesis: There is no statistically significant difference between the hypothetical average of the test score of thinking patterns in mathematics and the arithmetic average of the scores of the research sample students on the test.

To test the hypothesis, the arithmetical averages and standard deviations of the scores of the research sample students were extracted on the test of thinking patterns in mathematics. To find out the significance of the differences between the mean and arithmetic mean of the students' scores, the z test was used for one sample, table (4).

Table 4: Significance of the differences between the mean scores of the research sample students on the test of patterns thinking

Type of Intelligence	Sample Size	Hypothetical Average	Arithmetic Average	standard deviation	Calculated Z value	Tabular Z Value	Level of significance	Percent weights
Males	107	10,5	10,7	2,072	0,677	1,98	Not Significant	51%
Females	102	10,5	12,13	2,258	6,108	1,98	Significant	58%
All Students	209	10,5	11,274	2,854	3,628	1,96	Significant	54%

The results of Table (4) shows the following:

- The calculated z value is greater than the tabular, i.e., the difference is statistically significant between the hypothetical average of the thinking patterns test score and the arithmetical average of the scores of (all male and female students) on the test and not statistically significant for male students as the calculated z value is smaller than the tabular although the arithmetic average of their scores is higher than the hypothetical average.
- The percentage weights of the research sample students' scores were as follows: students in general (54%), male students (51%) and female students (57%) which higher than the acceptable level of performance. Therefore, They have thinking patterns and a slightly higher level of acceptable performance.

3-4- Results of the fourth hypothesis: There is no significant statistical difference between the hypothetical average of the research sample students on the test of thinking patterns in mathematics which due to the gender variable.

To test the hypothesis, and to know the significance of the difference between the average scores of the students in the research sample in the test of mathematics thinking patterns by gender variable, the z test was used for two independent samples, Table (5).

Table 5: Significance of the differences between the average scores of the research sample students on the test of thinking patterns according to gender variable

Variable	Gender	Sample Size	Hypothetical Average	Arithmetic average	Standard deviation	Calculated Z value	Tabular Z Value	Level of significance
Thinking Patterns in Mathematics	Males	107	10,5	10,7	3,072	3,37 -	1,96	Statistically significant
	females	102		12,13	2,258			

The results of Table (5) show that the calculated z value is higher than the scale. This means that the difference is statistically significant at the level of significance (0.05) between the

average scores of the research sample students and favouring the female students. Therefore, the fourth hypothesis is rejected.

3-5- Results of the fifth hypothesis: There is no significant correlation between the scores of the research sample students on the test of mathematical intelligence and their scores on the academic achievement test.

To test the hypothesis, and to find out if there is a correlation between the scores of the research sample students on the mathematical intelligence tests and academic achievement, Pearson correlation coefficient was extracted between the students' scores on the two tests, table (6).

Table 6: The correlation coefficient values between the scores of the research sample students based on the mathematical intelligence and the academic achievement tests

	Mathematical Intelligence		
Males	0,103 * 0,291 107	Pearson Correlation Significance Level Sample	Academic Achievement
Females	0.463 ** 0.000 102	Pearson Correlation Significance Level Sample	Academic Achievement
All Students	0.279 ** 0.000 209	Pearson Correlation Significance Level Sample	Academic Achievement

*Significance at significance level (0,05). ** Significance at significance level (0,01).

The results of Table (6) that there is a statistically significant relation between the scores of the research sample students (generally and female students) on the mathematical intelligence and the academic achievement of the study at the level of significance (01.0) only, and the existence of a positive relationship, but very weak and not statistically significant between the scores of male students on both tests.

3-6- The results of the sixth hypothesis: There is no correlation relationship of statistical significance between the scores of the research sample students on the test of thinking patterns in mathematics and their scores on the test of academic achievement.

To test the hypothesis, and to find out if there is a statistically significant correlation between the scores of the research sample students on the tests of the thinking patterns in mathematics and the educational achievement, Pearson correlation coefficient was extracted between the students' scores on the two tests, Table (7).

Table 7: The values of correlation coefficient between the scores of the research sample students which are based on the tests of the thinking patterns in mathematics and the academic achievement

	Thinking Patterns		
Males	0.099 0.311 107	Pearson Correlation Significance Level Sample	Academic Achievement
Females	- 0.092 0.443 102	Pearson Correlation Significance Level Sample	Academic Achievement
All Students	0.109 0.147 209	Pearson Correlation Significance Level Sample	Academic Achievement

The results of Table (7) show that there is a very weak but statistically significant relationship between the scores of the students in the research sample (generally males and females) on the tests of the thinking patterns in mathematics and the academic achievement. This means that the seventh hypothesis is accepted.

3-7- Results of the seventh hypothesis: There is no correlation relationship of statistical significance between the scores of the research sample students on the test of mathematical intelligence and their scores to the test of thinking patterns in mathematics.

To test the hypothesis, and to find out if there is a statistically significant correlation between the scores of the students in the research sample on the tests of mathematic intelligence and thinking patterns in mathematics, Pearson correlation coefficient was extracted between the scores of the students on the two tests, table (8).

Table 8: The correlation coefficient between the scores of the research sample students on the tests of mathematical intelligence and thinking patterns

	Thinking Patterns		
Males	0.988 ** 0.08 107	Pearson Correlation Significance Level Sample	mathematical intelligence
Females	0.195 0.100 102	Pearson Correlation Significance Level Sample	mathematical intelligence
All Students	0.798 ** 0.000 209	Pearson Correlation Significance Level Sample	mathematical intelligence

Table (8) shows that there is a statistically significant relationship between the scores of the students in the research sample (generally and the male students) on the mathematical intelligence and thinking patterns in mathematics at the level of significance of (01.0) only. There is a positive relationship, but it is very weak and is not statistically significant between female students' scores on both tests (Mohammed Baidaa Ahmed and Hind Abdul Razzaq Naji 2017).

Discussion and conclusion

Discussion

A- The Level of Mathematical Intelligence

The results of Table (2) show that the research sample have mathematical intelligence but at a lower level than of acceptable performance. The results of this study were agreed in part with the results of the study of Wardah Abdul Qader Yahya Yamin (2013) in Palestine, and differed with the results of the study of Ezzo Ismail Afaneh and Nawelah Najib Al-Khazandar (2004) in Palestine. Their results showed that the study sample has multiple intelligences at different degrees for the basic education stage, and Najim (2007) study in the possession of sample study of some of the multiple intelligences.

The two researchers believe that this may be due to:

- The mathematics curriculum for the intermediate third grade does not include mathematical positions that raise and develop the mathematical intelligence of students, but focuses on the collection of mathematical information only.
- Teachers do not use teaching methods that stimulate and develop students' mathematical intelligence.
- The method of assessment depends on tests that focus on getting students to move to higher grades without focusing on intelligence.
- The low level of mathematical intelligence may be due to the fact that students were not used to the type of questions that were included in the test because they are used to the tests used in schools.

B- The Level of Mathematical Intelligence

The results of Table (3) showed that there was a difference between the average scores of the intermediate third grade students (the research sample) in the level of mathematical intelligence according to the gender variable and for the female students, and differed with the results of the

study of Ezzo Ismail Afaneh and Nawelah Najib Al-Khazandar (2004) in part, and Najim (2207), whose results showed that there were no differences due to the gender variable.
This result might be attributed to the nature of the activities carried out by female students, represented by the following:

- "That females are better than males to remember a certain letter, and remember the features in the way."
  - "Females are better than males in verbal fluency, including recalling a particular letter, and remembering the features on the road" (Kimura D. Amice, 1987: p133-147).
- Verbal activities by interacting with their family members for long periods of time with them, unlike male students who are engaged in various activities outside the home.

C- *The Level of Thinking Patterns*

The results of Table (4) show that the average third grade students (the research sample) have the thinking patterns in mathematics at a level slightly higher than the acceptable performance level. This result was agreed with Hamash (2010) and Mohammed Baidaa Ahmed (2017). The results differed with the results of Najim (2007) and Wardah Abdul Qader Yahya Yamin (2013) studies, which showed a decrease in the level of thinking as it was (26%) and (40%) respectively.

The two researchers believe that this may be due to:

- Non-observance of the curricula for thinking patterns in mathematics, and focusing only on the collection of mathematical information only.
- Teachers do not use teaching methods that stimulate and develop students' thinking patterns.
- The assessment method depends on tests that focus on getting students to move to higher grades without focusing on thinking patterns.
- This may be due to the fact that students were not used to the type of questions that came in the test because they are used to the tests used in schools.

D- The Level of Thinking Patterns According To the Gender Variable

The results of Table (5) show that there is a difference between the average scores of the intermediate third grade students (the research sample) at the level of thinking patterns in mathematics according to the gender variable and favoring female students. This result was agreed with the results of the Hamash study (2010) which its results showed a difference in thinking patterns favoring the females. It disagreed with Najim (2007) study which its results showed that there are differences in mathematical thinking patterns favoring the males.

This result might be due to the different nature of mathematical thinking patterns among them. The test questions were divided into four types of thinking: visual, critical, inference, and creative. Each type requires mental abilities that differ from those needed by other types, Visual thinking is connected to the right side of the brain, and reasoning is related to the left side of the brain, while both critical thinking and creative thinking are linked to both sides. (Afana and Al-Jaish, 2008, p. 26). Therefore, this difference may be a reason for female superiority over males as females tend to use both sides of the brain and men tend to use the right side of the brain. This is affirmed by study of (Annet, 1985 p76).

E- The Relationship between Mathematical Intelligence and the Academic Achievement

The results of Table (6) showed a weak positive relationship between the mathematical intelligence and the academic achievement of the intermediate third grade students (the research sample). This result is in part consistent with the results of the study of Ezzo Ismail Afaneh and Nawelah Najib Al-Khazandar (2004), and Najim (2007) and Wardah Abdul Qader Yahya Yamin (2013) in Palestine.

This is due to the nature of the two tests. The mathematical intelligence test measures the level of the intelligences that grow and develop with the stimulation of educational stimuli. This is not directly dependent on the abstract information. As for the academic achievement test, it measures the level of knowledge and mathematical information obtained by the students through studying the school's curricula, and this is confirmed by (Al-Dosari, 2008). Or it may be due to the close correlation between academic achievement and intelligence level among students, which is confirmed by (Ahmed, 2001) as he pointed out that there is a close correlation between excellence in academic achievement and development of intelligence, with a difference in the findings of researchers in the relationship between thinking and academic achievement (Mohammed Baidaa Ahmed, 2015).

F- The Relationship between Thinking Patterns and the Academic Achievement

The results of Table (7) showed a very weak and statistically insignificant relationship between the scores of the intermediate third grade students (the research sample) on the tests of thinking patterns in mathematics and the academic achievement. This result is in part consistent with the results of the studies of Hani Fathi Abdel Karim Najm (2007), Nasreen Mohammed Hamsh (2010), Wardah Abdul Qader Yahya Yamin (2013) in Palestine, and Mohammed Baidaa Ahmed (2017) in Iraq.

This might be due to the nature of the two tests. The test of thinking patterns measures the thinking capacities that are developed and refined by stimulating pedagogical stimuli and by this, it is not directly dependent on abstract information. The academic achievement test

measures the level of mathematical knowledge and information obtained by students studying curricula in schools, and this is confirmed by (Al-Dosari, 2008). Or this may be attributed to the close correlation between the academic achievement and the level of thinking among students, which is confirmed by (Ahmed, 2001) as he pointed out that there is a close connection between excellence in academic achievement and development of thinking pattern, with a difference in the findings of researchers in the relationship between thinking and academic achievement (Mohammed Baidaa Ahmed 2014).

G- The Relationship between Mathematical Intelligence and the Thinking Patterns

The results of Table (8) showed a statistically significant relationship between the scores of the intermediate third grade students (the research sample) on the mathematical intelligence tests and the thinking patterns in mathematics. This result is in part consistent with the results of both Najim (2007) and Wardah Abdul Qader Yahya Yamin (2013) in Palestine.

This is due to the similar nature of the two tests. The test of mathematical intelligence measures the level of intelligences that are developed and refined by stimulating pedagogical stimuli, as well as for the testing of thinking patterns in mathematics as it measures students' mental abilities, or may be due to the close association between intelligence and thinking patterns.

Conclusions

A- Conclusions

1- Decline in the level of mathematical intelligence and thinking patterns among the students of the research sample.
2- The superiority of females on males in both mathematical intelligence and thinking patterns.
3- Mathematical intelligence was associated with a weak positive relationship with academic achievement, and a strong positive relationship with thinking patterns, and the association of thinking patterns with a very weak and not significant relationship with the academic achievement of the research sample students.

B- Recommendations

1- The need to continue to measure the level of mathematical intelligence and thinking patterns of students, to employ them in directing students to academic practices that correspond to their intelligence and patterns of thinking and encourage them to invest effectively in the process of education.
2- Introducing the field of mathematical intelligence and thinking patterns in the mathematics curricula to contribute to the development of intelligence and thinking of students.

3- Enrich the mathematics curricula at different levels of appropriate educational activities to contribute to the detection of mathematical intelligence and thinking patterns of students and the opportunity for them to express themselves.
4- Increase teachers' knowledge of the theory of multiple intelligences and patterns of thinking and applying it within the classrooms, and training them to use educational inputs and teaching methods that help and contribute to the development of intelligence and thinking of their students.

C- Suggestions

1- Measure the level of mathematical intelligence and thinking patterns for different educational stages and study their relationship to academic achievement in mathematics and the extent of their impact on it.
2- Study the effectiveness of some strategies that would help in the development of mathematical intelligence among students.

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