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# Mathematical Culture and Its Relationship to Sound Thinking in Fifth Grade Primary Students

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The aim of this research is to identify the level of mathematical culture among fifth-grade students in Baghdad, their level of sound thinking, and the nature of the correlation between mathematical culture and sound thinking in mathematics. The current research sample consisted of 210 pupils. The number of male pupils was 150 and the female sample was 160. The sample was selected randomly for both sexes so that the researchers can distribute them evenly according to the sex variable. In order to achieve the objectives of the research, the researchers prepared a tool to measure thinking. Saberbara built a measure of thinking consisting of four areas, namely: understanding the concept, interpreting information, reaching inferences, and applying principles. The apparent validity of the instrument was verified by presenting it to a group of experts composed of professors specialising in teaching methods and in the educational and psychological sciences. The reliability of the instrument was verified in two ways, using the Alpha-Kronbach equation. The correlation coefficient (0.82) was a test for mathematical culture consisting of 21 three-choice multiple-choice clauses; the data were treated statistically using arithmetic averages, the Pearson correlation coefficient and T-test for one sample and two independent samples. The researchers reached the following results: The level of mathematical culture and the thinking of the pupils (the sample of the research) was low, with the percentage of their weight respectively 49% and 54%, and there were statistically significant differences in the level of each culture. The results also showed that there is a statistically significant correlation between the mathematical culture and each of the types of thinking in mathematics. The researchers reached a number of conclusions, recommendations and proposals for the purpose of conducting subsequent research and studies.

**Key words:** *Mathematical Culture, Thinking, Fifth Grade.*

**Introduction**

Human minds have become the first and strongest investment, and the most advanced countries are the ones that improve the investment of their children's mental energies and their cognitive abilities. The more advanced countries are investing energy, material capabilities and methods of their growth and development, and most of the people's goals can only be achieved by relying on mental capabilities and sound thinking. The expansion of cognitive and educational sciences research stems from the importance of knowing the individual differences between learners. Studying them helps to explain the difference between individuals. Successful education is the process that teaches students how to think, rather than what to think. In this sense, the teacher must use a type of question that raises students' thinking and reveals their true understanding of the educational situation, meaning that the student is given the appropriate opportunity to clarify what has been learned and interpreted through their answer to the question addressed to them, and thus be able to create or produce a logical answer and make generalisations appropriately (Naifeh Qattami, 2004, p. 184).

Sounding questions are one of the types of questions that can be relied upon in directing students' thinking and bringing them to the correct answer, relying on their knowledge from the knowledge base and the sequencing of the questions according to their responses and interactions. Both the behavioural and the cognitive schools agree that where they directed a clear interest in the questions. Skinner confirms their importance as stimuli for learning. Whenever they are organized and sequenced, and they develop correct answers, this leads to new learning (Bruner, Piaget, and Zebel). This also sees their contribution to the students' arousal of discussion and access to good ideas themselves (Katame, 1989, p. 85).

Research importance:

Mathematics and its applications in daily life are the cornerstones of any scientific or technical progress, as mathematics is not seen today as an independent science. Instead, it is present in all aspects of knowledge, and in everything we can think of; it is one of the most prominent indicators of the use of mathematics in our lives. We find it in everything, such as roads, buildings, bridges, and tunnels; mathematical operations are the second language that are frequently used in all dimensions of life (Al-Mughirah, 1989, p. 25; Saja Jalil Alwan, 2018). Mathematics is highlighted as one of the most important aspects of cultural development.

Mathematics is a major part of human civilisation, and is a major component in the culture of societies throughout the ages, and without providing an individual with mathematical culture, they will be excluded from the mainstream of civilisation.

1. Drawing attention to the dimensions of mathematical culture, by defining its various dimensions necessary for the mathematics teacher, and thus taking it into account when designing courses, teaching methods, activities, and assessment methods in the mathematics teacher preparation program.
2. Providing mathematics curriculum planners with the dimensions of the necessary mathematical culture for primary school pupils in order to review, develop and improve their current curricula over the coming years.
3. Directing the efforts of those responsible for preparing mathematics teachers towards developing preparation programs, by understanding the level of mathematical culture among teachers, identifying strengths and weaknesses in them, and making decisions to develop the mathematics teacher preparation program.
4. Providing pupils with new methods that help them to increase their achievement and stimulate the development of thinking in other fields.
5. Providing those in charge of preparing and developing mathematics curricula in the formulation and preparation of activities with guidelines and proposals to formulate the content while taking into account the relationship between the use of questions in teaching and the level of mathematical culture.

**Research Goals**

The current research aims to identify:

1. The level of mathematical culture for the fifth elementary grade students.
2. The level of elementary fifth grade students' acquisition of mathematics thinking skills.
3. The statistically significant relationship between mathematical culture and sound thinking in mathematics among fifth-grade primary students.

**Research Assumptions**

To verify the research objectives, the following hypotheses were formulated:

1. There is no statistically significant difference at the level of significance (05.0) between the hypothesis of the degree of mathematical culture test and the mean of students' scores (research sample) on the test.
2. There is no statistically significant difference at the level of significance (05.0) between the mean scores of students in the research sample on the mathematical culture test attributed to the gender variable.

3. There is no statistically significant difference at the level of significance (05.0) between the hypothetical mean for the degree of probing thinking in mathematics and the arithmetic mean for the scores of students (research sample) on the test.
4. There is no difference with statistical significance at the level of significance (0.05) between the mean scores of students appointed by the research on the test of sound thinking in mathematics due to the gender variable.
5. There is no statistically significant correlation at the level of significance (05.0) between the grades of students appointed by the research on the mathematical culture test and their scores on the test of thinking in mathematics.

Research parameters:

1. Fifth-grade primary school students in the Algeria Mixed Primary School and Al Wathba Mixed Primary School of the General Directorate of Education in Baghdad / Al-Karkh for the academic year 2018-2019.
2. Mathematical Culture Test: Nature of Mathematics, History of Mathematics, Basic Concepts, Mathematical Operations, Applications of Mathematics in Other Years, Applications of Life Mathematics.
3. A deep-thinking test: understanding the concept, interpreting data, applying principles.

**Defining Terms**

***First: Mathematical Culture***

- Defined by Mufti (1991): "A set of concepts, principles, basic mathematical skills, and methods of thinking necessary for understanding mathematics and understanding its nature and historical development." (Mufti and others, 1991, p. 171)
- Liana Jaber (2004): "The ability of the learner to read, write, discuss, speak, dialogue and solve mathematical problems and problems with a high degree of mastery: that enables him to achieve his goals and raise the level of his knowledge and his cognitive ability." (Liana Jaber, 2004, p. 53; Yahya Muhammed Nabhan, 2008).
- Procedural definition: "The student possesses an appropriate amount of mathematical knowledge that should remain rooted in his cognitive structure and use it to solve daily problems and is measured to the degree the student gets in the test prepared for this purpose."

***Second: Sound Thinking***

- Jihad Mustafa and Abdul-Hadi Darwish (2004) defined it as: "The process of arriving at inferences started from careful observation, then perceptual and related to previous experiences in memory, then he puts proposals, conclusions and imposes principles. (Mustafa and Darwish, 2004, p. 228)
- Al-Khalili (2005) defined it as "one of the patterns of thinking that has been linked to the cognitive direction, and it is thinking that depends on the concepts of cognitive structure and mathematical representations." (Al-Khalili, 2005, p. 209; Muhammad Amin Al-Mufti, 2017).

**Procedural Definition:** "It is the total score obtained by the student through his response to the test items thinking that is prepared for this purpose."

**Chapter Two: Theoretical Background and Previous Studies**

The concept of mathematical culture is relatively recent and has been dealt with from several angles. There are those who see it as a combination of three components: a symbolic component, a societal component, and a cultural component; complementing each other and these three components contribute to the process of sports education. The symbolic component develops mathematical cognitive abilities and skills, while the social component produces the daily applied value of mathematics, and the cultural component searches for finding techniques and alternatives to understand (Vijayalakshmi, 2004).

Culture requires the necessity of adapting the individual to his community in all his dealings, that is, he must acquire the necessary capabilities, the basic concepts and skills that help him in solving problems daily life (Amira and Fathi, 1989, p. 20; Nael Muhammad Qurqaz, 2004). Mathematical culture does not stop at mere concepts and mathematical skills, but it requires that students have practical applications that benefit the learner and take into account the needs of society; mathematics is designed to serve the learner, not the learner to serve mathematics, so we must work to provide the learner with mathematical concepts and skills and link their acquisition to practical applications for them to complete the components of mathematical culture (Southi, 1992, p. 27).

**Methodology:**

1. Mathematical culture associated with the natural language

Language represents a means of social interaction and communication between individuals, as it is a tool for social progress in all its fields. Since ancient times, societies were distinguished by their languages, and similarities between Arab peoples in their traditions, customs and thinking systems, even though these peoples were separated by long distances. Mathematics is a language that is read and written so the teacher must do their best to speak mathematically with their students to develop good speech. The language of mathematics includes at least two languages: the language of physical objects and the abstract language (variable), the language of mathematics is more accurate, clear, and short. (Muhammad Al-Taiti, 2013, p. 185).

The language of mathematics is represented as an active tool in forming mathematical concepts and bringing them closer to the minds of pupils, such as the analogy of equation to balance, as well as the communicative role that it plays through dialogue and discussion between the teacher and his students, or between students themselves. This mathematical communication plays an important role in the development of mathematical culture and building the student's mathematical meaning (Jaber, 2006, p. 17; Wafaa Qais Kareem, 2008).

2. Understanding associated with real life

As some mathematicians see that their studies of mathematics are of great benefit in their applications in daily life, and that others believe that their study of mathematics should be linked in mathematics itself (Bell, 1987, p. 24). When mathematics focuses on daily life activities and skills related to the lives of learners, this helps them to rely on themselves to solve the problems facing them, because the mathematics curriculum has become a functional curriculum based on daily life skills (Al-Hadidi and Jamal, 2005, p. 29).

On the other hand, the teacher prepares the responsibility of life contexts for mathematical topics so that learning of mathematics is meaningful, so that students seek their benefit. Providing life situations to learn knowledge and concepts is not essential in helping students to expand their mathematical culture and to build meaning for the knowledge and concepts that they learn only so as to help them understand reality and the culture of society, and therefore helps him to increase their sports culture. The student is better able to build new knowledge and use it in other contexts (Liana Jaber and Kishk Wael, 2007, pp. 19-20; Hana Hussein Al-Nuaimi, 2006).

Third: Mathematical culture related to other sciences

Mathematics in some different fields of science is an important language and a basic rule, as it represents the pure flood from which the various fields of science are spilled without taking anything from them as mathematics is like a bridge for crossing to other subjects. In other words, it is a tool to understand and absorb many of the subjects that the learner needs to have a certain amount of mathematics (Abbas Naji Al-Mashhadani, 2011, p. 44)

There are those who see the necessity of integrating mathematics with natural sciences or human sciences to make students realise the usefulness and importance of mathematics, which increases their knowledge and culture in other fields. When mathematical subjects are presented in contexts related to other fields of study, this pushes students to explore, research, and learn. It leads to an increase in their sports culture, and in return, the benefit is twofold, represented in learning mathematical knowledge, concepts and skills on the one hand, and enriching students' sports culture on the other hand. (Liana Jaber and Kishk Wael, 2007, pp. 17-21).

***Mathematical Culture as a Goal of Teaching Mathematics***

One of the goals of teaching mathematics is "to provide students with a suitable mathematical culture that enables them to continue their studies in educational stages subsequent to their educational stages" (Khudair, 1987, p. 56; Friedrich H. Bell, 2018). Through examination of the literature and studies that dealt with the general objectives of teaching mathematics, it is clear that the concept of mathematical culture was not directly mentioned, but the aspects that make up mathematical culture as a concept have been mentioned in these goals. One of the general goals of mathematics teaching is to understand mathematical concepts and the interrelationships between them, knowing the importance of the language of daily life in expressing mathematical ideas, and gaining skills in understanding mathematics, relationships and applications (Ali Nasr El-Sayed Al-Wakeel, 2018).

Mathematics in life helps to give students a comprehensive mathematical culture, as well as not only to highlight the role of mathematics in the natural sciences, but also in the humanities, economics and other life activities (Abdel Samie, 1985, p. 12; Bahaa Al-Din Abdullah Khudair, 2015). He explains that one of the general goals of mathematics is to prepare individuals as users of mathematics to solve the problems of daily life facing them, and this is done by providing learners with mathematical knowledge, skills, and forming positive attitudes towards the study of mathematics as well as developing methods of thinking in them (Fatima Abdel Salam Abu Al-Hadid, 2013, p. 38 - 39).

Attributes of the scientifically educated learner:

1. Possesses an understanding of the nature of mathematics, basic mathematical operations and the ability to solve everyday problems and culture in the use of mathematics and the realisation of scientific relationships.
2. Possesses an understanding of the nature of technology and its most important advantages and using tools and devices that help students understand their practical applications.

3. Realising the basic means and relationships in which science, mathematics, and technology depend on one another, and knowing this is increasingly important in a student's life.
4. Understanding science, mathematics, and technology within a historical conceptual framework, rather than dealing with it in a repulsive and dispersed manner.
5. Having a solid base of mathematical knowledge that qualifies them to face life situations efficiently and use them in their lives and daily activities.
6. Flexible thinking as the best way to solve a mathematical problem, especially when they look at the numbers mentioned in the problem.
7. The ability to form an interconnection between the existing ideas and concepts in all areas of mathematics. When they learn a mathematical subject in one field of mathematics, they use it in other areas of mathematics related (Ramadan Saeed Badawi, 2007, p. 87-89).

Thinking:

The organisation of information and ideas has a role in activating and forming sound thinking, and trying to think through the foresight that leads to reaching solutions, and emphasising accurate solutions and then generalizing them, that training students to practice thinking correctly, taking into account all the variables that would help in Forming the basic structure of thinking, by raising issues or concepts that require in-depth thinking, and the multiplicity of responses and reactions according to the nature of the problem at hand and modification of stimulus leads to the activation of sound thinking. (Nabil Abdel Hadi and Bani Mustafa Nadia, 2001: 24)

Saber thinking does not exist by human instinct, its skills are learned and acquired and need training. It is not related to a specific age stage, so each individual is able to perform according to his mental, sensory and abstract levels of thinking, which comes using other thinking skills: logical, inferential, analytical and difficult to occupy the mind in the process of sound thinking without support from other thinking processes (Karim, 2008, p. 15).

Requirements for deep thinking

**Attention:** It is a skill that is used for controlling, managing, or controlling different levels of attention. Foresight provides an opportunity to think, as it gives students the opportunity to give open answers, develop a sense of strength, and provide evidence.

**Perception:** It is the ability to distinguish things by identifying similarities and differences between them.

**Organizing:** It is the skill that is used to create a mental or intellectual framework through which individuals can organize information.

**Recalling stored experiences:** Individuals vary in their abilities to store and recall information, and there is a positive relationship between the power of memory and the level of intelligence. There is a difference in the power of memory between one field and another in the individual himself, as he may have a strong memory in linguistic or mathematical experiences, and a weak memory in other experiences.

**Connecting new experiences:** The teacher encourages students to link or apply the skills, knowledge or concepts, that they have learned or acquired in a specific subject, through class interaction, and to transfer them to other courses or subjects of study is a basic educational goal. The linking process helps students to preserve and activate knowledge, and the teacher whenever he encourages students to do it and apply it during their handling of school topics and issues raised, leads to the depth of their understanding of them, which requires the use of thinking skills to link new experiences with previous experiences. The information is stored in the memory in the form of knowledge structures and represents a sentence of the individual knows about a topic or something

**Encoding of experience:** The translation of information entered into a mental representation that can be stored in memory.

**Experience recording**: A skill that is used to record important information in a brief and written form. Collecting data and information by one or more of the five senses is a thinking process that includes: viewing, observing, and perceiving, usually associated with a strong cause or goal and calls for focus attention and accuracy of observation.

**Understanding experience:** The ability of the learner to receive, understand, and benefit from the information contained in a particular subject.

**Smoothing experience:** adding personalisation to it.

**Merging experience with the knowledge structure:** it becomes one of the experiences stored in it.

**Storing and recalling it:** The individual is able to retrieve this experience when needed in certain situations or transfer it when facing a new experience.

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*Styles of Saber Thinking*

**Remindable Thinking:** It is the learner's mistake in answering the teacher's question or his lack of the correct answer, so the teacher raises a question to the learner that reminds him of the correct answer or gives a hint of the answer.

**Explanatory Saber Thinking:** It is represented in the ambiguity of the learner's answer that may result from the ambiguity of the question. If the dialogue between the teacher and the learner ends, the teacher returns to the group discussion to clarify the question.

**Saber Thinking by Refocusing**: Occurs by the learner linking his answer to another idea or other subject, and this requires the learner to look at the problem from different points of view according to its correct relationship or linking two unrelated elements.

**Conscious, Sound Thinking:** It is the teacher enriching the learner's understanding of the subject matter of the discussion, that is, helping him discover and analyse the complex thing in the subject of the discussion.

**Encouragement Saber Thinking:** It is used when the learner's answer is wrong or weak and this type of thinking requires moving the learner step by step towards the correct answer with hints about it.

**Transformed Saber Thinking:** It is used to identify other views on the topic being discussed, and not to be satisfied with one point of view, meaning that it is used to expand the learner's desire, which increases classroom interaction. Saber justification thinking: It is used to increase awareness and awareness of the learner, by better highlighting Responses intellectually and logically to produce the best image of them, which makes the learner a decision-maker, where the learner can build a model in which he implements the deep thinking skills included in the model, and the retrospective tables to be built and used during periods of thinking training (Abu Libdeh et al., 1996, p. 43).

**Chapter Three: Research Methodology and Procedures**

This chapter includes the most important procedures used in the current research and capable of achieving its goals of defining the research community, its sample and the method of its selection, defining its tools and measures of measurement and the most important statistical means in it, and the presentation of the most important means used comes.

**First: Research Society**

The research community means the group of individuals who carry data on the phenomenon within the scope of the research. It is also said that he represents the group of research units that the researcher wants to obtain data and generalise the results related to the studied problem (Dawood and Anwar, 1990, p. 66).

The community used in the current research has been determined from the primary school students in fifth grade for the academic year 2018/2019 and their number (6427).

The research sample: The current research sample included 210 fifth primary class students who number 110 male and 100 female students, who were randomly chosen from the students distributed according to the gender variable in the mentioned schools themselves (the research sample). Table 1 shows the sample.

**Table 1: The exploratory sample**

| School Name | Before Exclusion | Failure and Absence | Number After Recovery |
|---|---|---|---|
| **Algeria Elementary Mixed School** | **115** | **8** | **108** |
| **Al Wathba Elementary Mixed School** | **109** | **6** | **102** |
| **Total** | **224** | **14** | **210** |

The exploratory sample: It consisted of 70 male and female students from the fifth elementary grade students, who were chosen from the research community schools.

**Search Tools**

Al-Saber Research Objective To identify the level of mathematical culture for fifth-grade students and its relationship to thinking in mathematics, and to achieve the research goals and test the validity of its hypotheses, the two researchers prepared the following:

Mathematical culture test used to measure the level of six types of mathematical culture are: the nature of mathematics, the history of mathematics, basic concepts, mathematical operations, mathematics applications in other areas, applications of life mathematics, after examining them on mathematical culture tests that were covered in the literature and previous studies. It consisted of 21 paragraphs distributed as follows:

4 paragraphs to measure the level of the nature of mathematics,
3 paragraphs to measure the level of mathematics history,
4 paragraphs to measure the level of basic concepts,
4 paragraphs to measure the level of mathematics operations,
3 paragraph to measure mathematics applications,
3 paragraphs to measure t Aziat life).
According to the opinion of most of the arbitrators, the two researchers put a hypothetical medium for students' answers to the test, which is 50% of the total test score of 21 points.

The Saber Thinking Test: The two researchers adopted the Saber Thinking Test in Mathematics prepared by Walther Johann from twelve tests that include tests for language, remembering, observation, spatial perception, and linking relationships. The test for this age group consists of 12 paragraphs, and the test is corrected by giving the student (0.1.2) and the highest score obtained by the student is 24 and the lowest score obtained 0.

**Application Procedures**

Exploratory application: After the exploratory application, it was found that the paragraphs of the tests and their instructions were clear to the students, and it took 50 minutes for each test to apply the mathematical culture and sound thinking tests.

The two tests were corrected by giving one score for each correct answer and zero for the wrong answer, so the maximum scores for the tests were as follows: 21 for the mathematical culture test, 12 for the sound thinking test.
Validity of the tools: To verify the validity of the two tests, the researchers used two types of honesty: the apparent honesty by presenting them to a group of arbitrators specialized in education and psychology and the methods of teaching mathematics, and the validity of the internal consistency by calculating the correlation coefficient between each paragraph and the overall score of the test, the value of which ranged between (33, 0 - 0,74) for the mathematical culture test, and between (54, 0 - 0,88) for the test of deep thinking. And between the degree of each type or pattern and the total score of the test, and its values ranged between (52, 0 - 0,78) for the mathematical culture test, and between (75, 0 - 0, 91) for the test of deep thinking), all of which are coefficients, an acceptable indication of the internal consistency of the two component paragraphs.

* Persistence: To confirm the consistency of the tests, the two researchers used the Koodrichard equation (KR-20) to calculate the stability factor, and its value was 88% for the mathematical culture test, and 91% for the probe thinking test.

All of them are good stability coefficients in educational and social sciences, as the test is considered good if its coefficient of stability is more than 85% (Return, 1999, p. 396).

Statistical analysis of the passages of the two tests:

After extracting the difficulty and discrimination coefficients using the relevant equations, it became clear that the values of the coefficients of difficulty and discrimination for the mathematical culture experiments and sound thinking ranged between (23, 0,76) except for one paragraph in the mathematics culture test, the difficulty coefficient reached (16,0), so it removed. These values are considered acceptable as the sources indicated that any paragraph within the range 0.08 - 20.0 could be acceptable and it is advised to keep them. (Return, 1999, p. 297).

The use of the formula for the effectiveness of the wrong alternatives between the two extremist groups in each paragraph with every wrong alternative in it shows that all of them were negative, so they are considered acceptable and effective.

**The Final Two Tests**

After taking the opinions of the arbitrators and statistical analysis of the paragraphs of the tests, and verifying their sincerity and consistency, the mathematical culture test will be in its final form of 21 paragraphs as shown in Table 2. As for the test of thinking in mathematics, the test may be in its final form of 12 Paragraph as shown in Table 3.

**Table 2:** Distribution of the test items to the six dimensions of mathematical culture.

| Dimensions Of Mathematical Culture | Paragraphs | Total |
|---|---|---|
| The Nature Of Mathematics | 1,2,3,4 | 4 |
| History Of Mathematics | 5,6,7 | 3 |
| Basic Concepts | 8,9,10,11 | 4 |
| The Nature Of Mathematics | 12,13,14 | 3 |
| Applications of mathematics with other sciences | 15,16,17,18 | 4 |
| Applications of life mathematics | 19,20,21 | 3 |
| Total | ------------- | 21 |

**Table 3:** Distribution of test items on sound thinking

| **Thinking** | **Paragraphs** | **Total** |
|---|---|---|
| **Gain concept** | **1,2,3** | **3** |
| **Interpretation of information** | **4,5,6** | **3** |
| **Access to inferences** | **7,8,9** | **3** |
| **Apply the principles** | **10,11,12** | **3** |
| **Total** | **-----------** | **12** |

The final application of the two tests:

The two researchers applied the two experiments to the basic research sample on Tuesday and Wednesday corresponding to 26-27 March 2018 in the schools of the research sample.

The mathematical culture test was applied on Tuesday and the sounding level test on Wednesday; the two researchers supervised the application process and with the help of teachers and teachers who contributed to the supervision of students in the classroom.

Statistical means:
The following statistical methods were used: coefficient of difficulty and discrimination of the vertebrae, equation of efficacy of wrong alternatives, Pearson correlation coefficient, Kudrichard's equation (KR-20), Spearman-Brown equation, percentage weight, test - z) for one and two independent samples, z test - test) to indicate the differences between correlation coefficients.

**Chapter Four: Presentation and Interpretation of Results**

The results of the first hypothesis which states: There is no statistically significant difference at the level of significance (05,0) between the hypothesis mean for the degree of mathematics culture test and the arithmetic mean for the grades of the fifth grade students (research sample) on the test.

To test the validity of the hypothesis and know the level of mathematical culture among students (the research sample), mathematical averages and standard deviations for their grades on the mathematical culture test were extracted, and to find out the significance of the differences between the hypothesis and mathematical averages of the pupils' scores (research sample) use the test (For one sample, as shown in Table 4 (z-test).

**Table 4:** An indication of the differences between the mean scores of students in the research sample on the mathematical culture test

| Kind and intelligent | Sample size | Its calculated value | Hypothetical mean | Standard deviation | Calculated value Z | Crosstab value Z | Significance level | Percent weights |
|---|---|---|---|---|---|---|---|---|
| Males | 108 | 11 | 11.555 | 2.836 | 2.036 | 1.98 | Function | 47% |
| Females | 102 | 11 | 10.725 | 2.560 | -1.083 | 1.98 | Is a function | 52% |
| All pupils | 210 | 11 | 11.152 | 2.713 | 0.808 | 1.98 | Is a function | 49% |

The results of Table 4 showed the following:

The tabular value (z) is greater than calculated, i.e. the difference is statistically significant at the level of significance (0.05) between the hypothetical mean of the degree of mathematical culture test and the arithmetic mean of scores (general pupils, and female pupils) over the test, although the arithmetic mean of degrees female pupils are above the hypothetical mean, and statistically significant for male pupils as the calculated value of (z) is greater than tabular.

The percentage weights of the pupils' degrees (the research sample) came as follows: pupils in general: 49%, and male pupils: 47%, which are low percentages compared to the acceptable level of performance (50%) as determined by the arbitrators, as the total severance score = (5, (X 21 = 10.5). That is, they have mathematical culture but with a lower level of performance. As for the percentage weight of female students' sample scores (52%), this means that they possess mathematical culture at a level slightly higher than the degree proposed by the judges.

The results of the second hypothesis, which states: There is no statistically significant difference at the level of significance (05.0) between the mean scores of students of the research sample on the mathematical culture test attributed to the gender variable. To test the correctness of the hypothesis, and to know the significance of the difference between the mean scores of students in the research sample in the culture test for two independent samples, Table 5 (z- test) Mathematical by gender variable.

**Table 5:** Significance of differences between the mean scores of students in the research sample on the mathematical culture test according to the gender variable

| **variable** | **Sex** | **Sample size** | **Hypothetical mean** | **standard deviation** | **standard deviation** | **Calculated value Z** | **Crosstab value Z** | **Significance level** |
|---|---|---|---|---|---|---|---|---|
| Sports culture | Males | 108 | 11 | 11.555 | 2.836 | 2.228 | 1.98 | Statistical function |
| | Female | 102 | | 10.725 | 2.560 | | | |

The results of Table 5 showed that the calculated value of (Z) is higher than tabular, and this means that the difference is statistically significant at the level of significance (05.0) between the average levels of students (research sample) and for the benefit of female students, and the second hypothesis is rejected.

The results of the third hypothesis, which states: There is no statistically significant difference at the level of significance (05,0) between the hypothetical mean for the degree of probing thinking in mathematics and the mean for the scores of students (the research sample) on the test.

For the hypothesis validity test, arithmetic averages and standard deviations for students' sample scores were extracted to search for a test of sound thinking in mathematics.

**Table 6:** The significance of the differences between the mean scores of the students in the research sample on the probing test in mathematics

| Kind and intelligent | Sample size | Its calculated value | Hypothetical mean | standard deviation | Calculated value Z | Crosstab value Z | Significance level | Percent weights |
|---|---|---|---|---|---|---|---|---|
| Males | 108 | 11 | 11.870 | 2.935 | 3.081 | 1.98 | Is a function | 51% |
| Females | 102 | 11 | 12.117 | 2.895 | 3.899 | 1.98 | Function | 58% |
| All pupils | 210 | 11 | 11.990 | 2.911 | 4.929 | 1.98 | Function | 54% |

Table 6 shows the following:

The calculated value of (z) is greater than the tabular, meaning that the difference is statistically at the level of significance (05.0) between the hypothetical mean for the degree of the math thinking test and the arithmetic mean for the scores (general pupils, female pupils) on the test, and is statistically significant for male pupils as the calculated value of (z) is smaller than tabular even though the mean of their scores is higher than the hypothetical mean.

The percentage weights of the students' scores for the research sample came as follows: pupils in general (54%), male pupils (51%), and female pupils (57%), which is a higher percentage of the acceptable level of performance (50%) as determined by the arbitrators, as the degree was The total score = (5.0 x 21 = 5,10), and therefore the fifth elementary grade students (the research sample) possess a sound thinking in mathematics and a level slightly higher than the acceptable level of performance.

The results of the fourth hypothesis, which states: There is no difference with statistical significance at the level of significance (0.05) between the mean scores of his specific request. The research on the test of thinking in mathematics is attributed to the gender variable.

To test the validity of the hypothesis, and to determine the significance of the difference between the mean scores of students in the research sample in testing patterns of thinking in mathematics according to gender variable, I use the test (z) for two independent samples, shown in Table 7.

**Table 7:** Evidence of differences between the mean scores of students assigned to them. Research on a test of sound thinking in mathematics according to the gender variable.

| variable | Sex | Sample size | Hypothetical mean | standard deviation | standard deviation | Calculated value Z | Crosstab value Z | Significance level |
|---|---|---|---|---|---|---|---|---|
| Sports culture | Males | 108 | 11 | 11.870 | 2.935 | -0.614 | 1.98 | Statistical function |
| | Female | 102 | | 12.117 | 2.895 | | | |

It is clear from the results of Table 7 that the calculated value of z is higher than tabular, and this means that the difference D statistically at the level of significance (05.0) between the mean scores of the students appointed by the research and for the benefit of female students, and therefore rejects the fourth hypothesis.

The results of the fifth hypothesis, which states: There is no statistically significant correlation at the level of significance (05,0) between the grades of pupils appointed by the research on the mathematical culture test and their scores on the probe thinking test in mathematics.

To test the validity of the hypothesis, and to determine whether there is a correlation between the scores of students in the research sample on the mathematical culture tests and deep thinking, a Pearson correlation coefficient was extracted between the scores of the students on the two tests, shown in Table 8.

**Table 8:** The correlation coefficients were evaluated between the students' scores for the sample of the research on mathematical culture experiments and sound thinking

| The pupils | Mathematical culture | Correlation coefficient |
|---|---|---|
| Males | <br>1.69<br>0.081<br>108 | Pearson Link<br>Thinking<br>Significance level<br>the sample |
| Females | <br>0.022**<br>0.000<br>102 | Pearson Link<br>Thinking<br>Significance level<br>the sample |
| All pupils | <br>0.087**<br>0.000<br>210 | Pearson Link<br>Thinking<br>Significance level<br>the sample |

A function at the significance level (05,0). ** A function at the significance level (01.0).
It is clear from Table 8 that there is a statistically significant relationship between the pupils' degrees of the research sample (in general, and for female pupils) on the mathematical culture and deep thinking tests at the level of significance (0,001) only, and the presence of a positive, but very weak and statistically significant relationship between the degrees of male pupils on the two tests.

**Discussion of the Results**

The findings of this research can be interpreted as follows.

*The level of mathematical culture among the students of the sample*

The results of Table 4 showed that students of the fifth primary class (the research sample) possess mathematical culture, but at a level lower than the degree of criterion proposed by the arbitrators. The result of this study partially agreed with the result of both Soutouhi's (1992) study in Egypt, and the secret study (2005) in Palestine and differed with the results of the study of each of the shrouds (2018) in Iraq, as its results showed that the study sample possesses mathematical culture in different degrees for the basic education stage.

The researchers believe that this may be due to the following reasons:

1. Mathematics curricula for the fifth grade of primary school do not include mathematical situations that enrich and develop mathematical culture among students, but rather focus on obtaining mathematical information only.
2. The teachers do not employ teaching methods that stimulate and develop mathematical culture.
3. The evaluation is based on the tests that focus on students obtaining their transfer grades to higher grades without promoting thinking.
4. Students are not accustomed to the type of questions that came in the test because they are used to the tests used in schools.

*The level of sound thinking among students of the sample*

The results of Table 6 showed that fifth-grade primary students (the research sample) possess sound thinking in mathematics at a slightly higher level than the acceptable level of performance. This result was consistent with the study of Abdullah Ali Mohamed Ibrahim (2005) and Jones (1995) and differed from the results of the studies of both Al-Naimi (2006) and Wafa (2008), whose results showed a decrease in the level of patterns of thinking, which was attributed 26% and 40% respectively.

The two researchers believe that this may be due to three reasons:

1. Curricula fail to observe sound thinking in mathematics and focus only on the collection of mathematical information.
2. Teachers do not use teaching methods that stimulate and develop sound thinking among students. The evaluation is based on tests that focus on students getting their grades to move up to higher grades without focusing on sound thinking.
3. Students are not used to the type of questions presented in the test because they are more accustomed to the tests used in schools.

*The level of mathematical culture and its relationship to deep thinking among students of the research sample as a whole*

The reason for this is due to the nature of the two tests. The mathematical culture test measures the level of cultures that grow and develop by refining it with educational stimuli, and in this it is not directly dependent on abstract information. The test of sound thinking measures the level of mathematical knowledge and information obtained by students through his study of academic courses in school, and this was confirmed by each of the previous studies, with a difference in the results of the researchers in the field of the relationship between deep thinking and mathematical culture.

Recommendations:

The two researchers reached a number of recommendations and proposals to complement and develop the current research. Among the most important recommendations are:

1. Work to exchange experiences with educational institutions that have a long history in developing sound thinking skills
2. Develop curricula that would conduct and develop the personal qualities acceptable to students to help them benefit from these experiences.
3. Encourage students to discover, innovate and search for knowledge from all fields and train them to solve problems and problems facing them in several ways through educational situations intended by the new curriculum.

**Suggestions**

1. Study the level of mathematical culture of students who are scientifically superior to understand the level of their culture and compare them to the level of intelligence of students in other basic stages.

2. Build training programs to measure sound thinking and its relationship to other variables, including decision-making skills, patterns of thinking related to the two hemispheres, cognitive curiosity and personality traits.
3. Study the cultural level in other fields for students of the basic stages, such as scientific culture, linguistic culture and technical culture.
4. Undertake an analytical, investigative study of school mathematics curricula to identify the availability of elements of mathematical culture in them and the extent of their contribution to the development of their thinking.

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