

Received: May 2023 Accepted: June 2023
DOI: <https://doi.org/10.58262/ks.v11i02.036>

Mental Fitness and its Relationship to the Depth of Knowledge in Mathematics for Secondary School Students

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Abstract

The aim of the current research is to identify the nature of the correlation between mental fitness and the depth of knowledge in mathematics among intermediate school students, by answering the following question: What is the nature of the correlation relationship and its type, direct or inverse, between mental fitness and levels of depth of knowledge in mathematics for secondary school students, according to the gender variable? The two researchers adopted the descriptive research approach, the method of studying relationships and their connection, and to achieve that goal, a group of zero hypotheses, which are seven hypotheses, were developed. The number of students of the research community was (10210), with (4763) male students and (5447) female students, and the research sample consisted of (385) students, divided into (181) male students and (204) female students from the fourth scientific grade in secondary schools. And the secondary school affiliated to the General Directorate of Education of Baghdad / Al-Karkh First. For the purpose of collecting data for the research, a scale of mental fitness was built for fourth science students, which consisted (in its final form) of (30) test items, and a test of the depth of knowledge in mathematics for fourth scientific students. This included (37) items with (16) items of the essay type, and (21) items of the objective type (multiple choice), after analyzing the contents of the fourth grade book, first semester, thirteenth edition, for the academic year 2022-2023, according to the indicators of the depth of knowledge in mathematics that were prepared by the two researchers. The clarity of the scale items, the test items, the instructions, and the time required to conduct the scale and test were verified. Appropriate statistical analyzes were conducted for both the mental fitness scale and the test for the depth of knowledge in mathematics to find out (discrimination coefficient, coefficient of difficulty and ease of the test items of depth of knowledge in mathematics and the discriminatory power of items of the mental fitness scale), as well as verifying the psychometric characteristics of them. After the statistical tools were chosen to analyze the results of the application of the two tools, such as the T-test for one correlated sample, as well as the T-test for two independent uncorrelated samples, Pearson correlation coefficient, the alpha Cronbach equation, and the T- equation to measure the significance of the correlation, the results indicated that there is a strong positive correlation between fitness and the mentality and the depth of knowledge in mathematics among the students of the fourth scientific grade, which is a direct relationship. Finally, some recommendations and suggestions were made.

Keywords: Mental fitness, Depth of knowledge, Fourth scientific grade

Research Problem

By looking at the literature and previous studies in the field of teaching mathematics, such as the study of Hasan & Faris (2020) , the study of Hassan et al (2023) the study of Al-Aqabi

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& AL- Kadhimi (2023) and that of (Karim and Jassim (2013), it became clear that there is a failure in the academic achievement of students in the general education stages and in their abilities in some skills, including the skill of generating information, the skill of decision-making, the disciplined ability to solve familiar mathematics problems, and others, and to find the connection between its concepts and the cognitive depth, as indicated by the study of Hassan et al (2023) . (Huang & Chen, 2023; Alonso-Sanz & Ramon, 2022)

During the evaluation of mathematics teachers for their students, as in the study (Hassan & Hammadi, 2018; Almerri, 2023) in which the existence of this failure was indicated, and when trying to identify the characteristics of students who enjoy mental fitness, including the ability to think, make decisions and the ability to solve problems quickly and accurately, the researchers noted that there is an influential relationship of mathematics in the mental fitness of students, and vice versa is also possible. Therefore, we decided to conduct the following research, that aims to diagnose the mental fitness of fourth scientific branch students, and accordingly, the research problem is determined by focussing on that aspect. By examining the literature that dealt with the concept of mental fitness, the two researchers learned about the characteristics of students who enjoy mental fitness. Some of these characteristics indicated that they are able to think, make decisions, and determine the ability to solve problems quickly and accurately and in different and short ways that they can benefit from in their scientific and practical lives and are distinguished by their thinking. logical by supporting them with examples, arguments and proofs, and they have the ability to mentally calculate. Here, the two researchers realized that there might be a relationship between students' mental fitness and the depth of knowledge in mathematics, and that mathematics itself is a thinking approach that stimulates the mind and helps to develop mental fitness. The researcher decided to study the relationship between students' mental fitness with depth of knowledge in mathematics, therefore, the research problem was dedicated for answering the following question : (Humanes et al., 2023; Muhammad Awais & Bauirzhanovna, 2023)

What is the relationship of mental fitness to the depth of knowledge in mathematics among secondary school students? What is the type of this relationship, is it direct or inverse? (Mukongo et al., 2023; Seidu et al., 2022)

Research Importance

The importance of the research lies in two aspects, the theoretical side and the application side, as follows:

Theoretical side

- 1- This research seeks to contribute to the enrichment of an important aspect in the fields of educational studies, which is mental fitness and depth of knowledge in mathematics.
- 2- Secondary school students need to use their mental skills because this stage is the most active and energetic, and they need to have mental fitness to solve the mathematical problems they face

Application side

- 1) This research helps those responsible for mathematics curricula to take into account the results of the current research in order to develop mathematics curricula to the best and most appropriate level.
- 2) The research contains a scale of mental fitness and a test of the depth of knowledge in

mathematics for the fourth scientific grade, and whenever these variables are positively consistent with the students, they are in the right direction and the right situation.

Aims

The research aims to identify:

The correlation, its nature, and its direction between mental fitness and the depth of knowledge in mathematics for the fourth scientific grade students for both genders.

Research Hypothesis

1) There is no correlation at the level of significance (0.05) between the mental fitness and the depth of knowledge of mathematics for the fourth grade students.

Research Limits

Current research includes:

- 1- Students of the fourth grade in Al-Karkh Education - First in the first semester of the academic year 2022-2023.
- 2- The first, second, third, and fourth chapters of the mathematics book for the fourth scientific grade, the thirteenth edition, 2021 AD, to be taught by the Ministry of Education.

Terms definition

Mental fitness is defined by:

- 1- (Peter, 2003) as the students' mental ability that affects his way of thinking, his ability to remember, his mood, his compatibility with life, his sense of happiness and success, his ability to make sound decisions, solve problems, challenge risks and confront them with great flexibility and confidence (Peter, 2003 :13).
- 2- Wujec (2009) defines mental fitness as the ability to focus, think, visualize, imagine, make decisions, solve problems, and think clearly and creatively Wujec, (2009: 12)

The researchers define mental fitness theoretically as the ability of students to train their minds so that they are able to focus, think and quickly recall the stored information with flexibility and high confidence, as well as their ability to challenge and exchange information for decision-making to solve simple and complex problems that they face while learning away from failure to achieve success.

The two researchers define mental fitness procedurally as the degree obtained by the students of the fourth scientific grade in the mental fitness scale in its six areas (thinking, remembering, focusing, problem solving, decision-making, imagination and visualization) through their answers to the mental fitness scale that was used for this purpose (Vargas et al., 2023)

Depth of knowledge is defined by

- 1- Al-Feel (2019) as “ a tight logical organization of the knowledge and skills that students must master in any field of study according to the degree of their depth and strength, which are included in four levels starting with the least deep and powerful level, which is the level of remembering and reproduction, then the level of applying concepts and skills .Following that

is the level of strategic thinking and finally extended thinking, which is the deepest and most powerful level (Al-Feel, 2019: 240-239) .

2- Webb (2002) define the depth of knowledge is an educational process that requires teachers to explain the depth in which education takes place, and teachers must reflect this depth and define the purpose of their education for students, and thus evaluate students on the information that must be retained for lifelong learning (Webb, 2002: 8) .

The two researchers adopt the theoretical definition of (Webb, 2002) for this research, and the researchers relied on Webb's classification mentioned in Al-Feel (2019).

The two researchers define the depth of knowledge procedurally as the degree obtained by the students of the fourth scientific grade on testing the depth of knowledge in mathematics in its four levels (remembering and reproduction - applying concepts and skills - strategic thinking - extended thinking), which comes from their organization of knowledge and linking ideas together to solve a specific problem included in the book Mathematics fourth scientific grade through their answers to the test prepared for this purpose.

Section Two Mental fitness

Students who have mental fitness have the ability to solve problems by making sound decisions, and they feel happy and psychologically comfortable for that. Mental fitness affects psychological fitness as it enables students to deal with others well and makes them feel confident in themselves and their thinking is balanced. Also, mental fitness gives them flexibility in their thoughts (Suleiman, 2021: 489). Mental fitness helps students to face the problems they encounter and adapt to the environment (Eidan, 2013: 1). Mental fitness has a major role in students' lives, as it helps them acquire information, experiences, skills, and adaptation to the classroom environment (Alwan, 2009: 2).

Mental fitness goes through two roles

- 1- The role of formation: Mental fitness is formed step by step, as it is initially stumbling and not perfect, then the students continue to practice and train on it until they reach mastery.
- 2- The role of stability: It is the role of constancy and stability. The reasons for stability are due to the maturity that the students have reached. At first, their solution to issues is stumbling and slow, then it becomes stable and becomes fast and elaborate. The brain begins to receive signals, and with them, it goes to automatic mode, and how to deal with the matter and any behavior it takes. Then it begins to be repeated and preserved (Al-Abadi, 2019: 63).

Characteristics of students who enjoy mental fitness

- 1- The ability to think in decision-making and problem-solving.
- 2- Thinking in a logical manner, armed with various evidences, arguments, and proofs, and tends to enjoy them.
- 3- Solving mathematical problems quickly and accurately and saving effort at the same pace, while clinging to it and resisting changing it. (Al-Abadi, 2019: 59)
- 4- The student has the characteristic of a good thinker to solve mathematical problems in different and concise ways and benefits from them in his scientific and practical life.
- 5- Using the best mental behavioral patterns appropriate to the problem he is exposed to.
- 6- He has the characteristic of mental arithmetic and speed in performing mathematical operations and mastering them (Costa & Kallick, 2002: 1).
- 7- The ability to quickly comprehend and comprehend, which is based on a strong and

organized memory, an understanding in a permanent state of knowledge of the causes, events and situations.

- 8- The student has a degree of abstract thinking, which is increasing and complicated by the existence of multiple concepts, which leads to a diversity of the mental process in solving problems and complex thinking.
 - 9- He has the ability to infer, understand and comprehend relationships, as he sets laws and rules that require inferential thinking based on deduction, formulation of concepts, abstraction and linking of various elements and ideas.
- (Ibrahim, 2019: 76).
- 10- The student has a high mental ability, high innovation or creativity, and a strong commitment to tasks (Abu Hatab, 1996: 614).

Areas of mental fitness

There are several areas of mental fitness that have been extracted from definitions and previous studies, namely:

First: Thinking clearly and creatively

The concept of thinking: It is a willful ability possessed by students to evaluate ideas and beliefs, control them, and direct them in the right direction to obtain positive and successful results for solving problems, through logical mental systems that bear a positive character that seeks to reach a solution to the problem (Ibrahim, 2005).

Mathematics is an innovative activity of the human mind, and it has special advantages in the development of thinking, and thinking takes into account the rules through which unknown facts are reached from known facts, and it is described as the main pillar of mathematical thinking, so the relationship between mathematics and the knowledge society is a very close relationship of logic. It seeks to achieve an important goal of education, which is to provide students with the principles of sound thinking (Al-Kubaisi and Saleh, 2015: 40).

The researchers conclude that students who have mental fitness can solve their mathematical problem with sound logical thinking, resulting from sequential and consistent mental processes, that suit their mental abilities and the stage they are in.

Second: Remembering

It is a skill and a mental ability that characterizes a person related to recalling information, identifying it, and developing mental capabilities and skills (Abu Hatab, 2013: 130). For students to remember a rule or law, this is called retrieval, and retrieval depends on the students' mental fitness. Students who possess mental fitness have a great ability to remember and store information better and faster than others who do not possess mental fitness (Al-Qaisi, 2008:105). Remembering refers to a set of activities or strategies that students carry out with the aim of storing information in long-term memory.

The two researchers conclude here in this field that students who have mental fitness may have strong memory in preserving and retrieving knowledge because students' mental fitness helps them organize their ideas and abilities to solve problems and thus achieve their goals.

Third: focusing

It is directing the attention of students to specific stimuli from the environment without the other stimuli. Students focus when they feel that there is a problem facing them or the existence of a confusing issue, or there is a lack of some meanings for them, as it works to help them

collect small particles of the information available to them, and it is also used at the end of solving problems or during assimilation (Abu Jado, 2007: 78).

Also the ability to give orders to the mind and make it adhere to them, and it is also defined as the process of focus which means mental perseverance .It is defined as the system of caring for specific selected matters, and ignoring other matters that are not related to it, and it is known that focus is pouring attention to the event, and having the courage to impose your decision about what is important to time, people, and events around you (Horn, 2001: 20-24)

Focusing or concentration is the highest degree of attention, and it is the ability to ignore everything that distracts the mind and pursue important matters only.

Here, the researchers conclude that students who enjoy mental fitness must have the power of concentration and attention to a high degree.

Fourth: Solve problems related to life, routine , and creativity

Solving problems in daily life occupies a large part of human intellectual activity, and this skill is considered as one of the basic skills that public education should develop within the framework of its mission to provide students with the skills necessary to live in society. Mathematics is a product of the activity of the human mind, and thus mathematics has become a means and a tool that helps students solve real problems, which is the natural way to practice thinking in general. There is no mathematics without thinking, and there is no thinking without solving problems (Al-Kubaisi and Saleh, 2015: 48).

There are several definitions of problem solving presented by researchers. It is viewed as an organized and directed intellectual process in which students use their experiences and knowledge in order to get rid of an obstacle or an ambiguous situation, and it is also defined as an individual or collective effort aimed at achieving a specific goal (Al-Atoum, 2012, p. 266).

The researchers conclude that students who have mental fitness are able to solve the problems they face through creative solutions that are characterized by originality, flexibility, modernity and self-confidence.

Fifth: Decision making

The decision-making process is one of the very important issues in the life of students, and it is a human function that requires a measure of intellectual energy and mental fitness, and it is defined as a mental process to choose between two or more alternatives, as this process depends to a large extent on the skills of the decision-maker (Al-Atoum, 2012: 370).

There are many factors that influence decision making, including:

- 1- The personality factors or the personal formation of the decision-maker, as the psychological aspects, his motives, his abilities, and his capabilities are decisive in this process.
- 2- Social, cultural, civilizational and economic factors that represent the environment in which decisions are taken are of great importance in the type of decisions that can be taken.
- 3- The time available to the decision-maker is considered one of the factors influencing the decisions taken because the decision-making process is a complex mental process. Therefore, the necessary time must be available to analyze the problem, develop alternatives, and take the appropriate decision.
- 4- Teamwork and the involvement of others in decision-making is an important element in making wise decisions (Abu Jado, 2007: 382).

The researchers conclude that decision-making refers to selecting the best appropriate solution

among several ones, all of which are correct to solve a specific problem.

Sixth: Imagination and visualization

It is a human mental faculty that links the past, present and future in human understanding to follow things and developments. Students who have mental fitness see and imagine from existence. In other words, what students know about existence is basically their different perceptions, and to the extent that perception is correct, we will be correct in perception, knowledge and understanding and closeness to the facts. Thus the correctness of their behavior in life, is the depth of their understanding of reality that brings them closer to a good perception of facts, reality is the product of the interactions of facts, while thought is the product of the interactions of mental perceptions (Makrum, 1999,: 48). Imagination is the ability to create an idea, a mental image, or an emotional sense of something. In creative visualization, students use their imagination to create a clear image, idea, or feeling, then continue to focus on the idea or feeling repeatedly, giving it positive energy until it becomes an objective reality (Gawin, 2010, p. 24).

The two researchers conclude that one of the benefits of visualization is taking students to places that cannot be reached in any other way. As imagination is a valuable educational tool, it is a thinking skill that all students should possess.

The depth of knowledge

Types of knowledge

The types of knowledge can be identified due to the degree of work, explanation and interpretation:

- 1- Superficial knowledge: It is the knowledge that depends on questions that start with “who, what” and is also called explicit knowledge. This knowledge is the lowest level of understanding, and superficial learning is called the learning that takes place in schools whose focus is on superficial knowledge associated with indoctrination, memorization and storage of knowledge in the form of information found in books.
- 2- Shallow knowledge: It is the knowledge that students possess when they have some understanding and some information and formulating the meaning of the knowledge that they have. When formulating the meaning, students must be familiar with this information, and therefore we require this knowledge to be a level of understanding so that students can determine the logical relationships, integration and consistency between the information provided to them.
- 3- Deep knowledge: It is the knowledge that is concerned with developing information provided to students and developing their understanding and being aware of when and how effective action can be taken. (Bennet. D & Bennet. A ,2008: 4).

Levels of depth of knowledge

The first level: Remembering and reproducing

This level describes the basic tasks that require students to retrieve the knowledge and skills included in the elements of the curriculum (Hassan & Hammadi, 2018, 439). This level includes students' interactions with remembering and reproducing the principles and concepts they learned previously, as well as various facts. It also includes performing mathematical operations and simple formulas. It simply requires students to answer without calculating or solving (Wyse

The second level: Applying concepts and skills

It is possible to transfer the level of depth of knowledge from the first level to the second level by training students with activities and assignments such as: forming a puzzle or solving a mathematical problem with multiple steps, identifying more complex issues, identifying operations and concepts and how they work, and more complex arithmetic duties such as calculating the average as well as arithmetic values with categories, summarizing and organizing the collected data in the form of simple tables or graphs (Hess, 2013: 11; Rovira et al., 2022)

Within this level, there is a set of procedures for multiple steps, and it includes other activities such as explaining opportunities from experimental procedures, their use and application, and students in the second level must go beyond explanation and clarification of the information required (Abdul Malak, 2020: 469; Yan, 2023)

The third level: Strategic thinking

It is intended for students at this strategic level to be able to use higher thinking processes such as evaluation, analysis, anticipating, drawing and predicting results (Jawad , et al, 2021 : 196), and it is also intended to coordinate skills and knowledge in different fields, to implement the required operations and obtain a solution in Light project based framework (Mississippi State University, 2009: 11).

Fourth level: Extended thinking

This level is also called extended strategic thinking. As students participate in the use of the most advanced higher-order thinking processes, such as installation, evaluation, modification of plans, and meditation over time. They contribute to conducting investigations in solving problems from the real world, with unpredictable results (Webb, 2009:13). Employing and maintaining strategic thinking processes is an essential and important characteristic of the objectives of the curricula designated for this level, and the level of extended thinking includes a set of processes that indicate this level, including installation, development, innovation, and proposal) (Mississippi State University, 2009:13).

Chapter three: Research methodology and procedures

First: Research Methodology

In this study, the two researchers relied on the descriptive (relational) approach, as it is one of the most consistent research methods in studying the correlations between research variables (Majeed, 2018), which is mental fitness and depth of knowledge in mathematics.

Second: Research community

The current research community includes all students of the fourth scientific grade who study in the morning governmental preparatory and secondary schools affiliated to the General Directorate of Education of Baghdad / Karkh for the academic year (2022-2023) of both genders, and the total number of students was (10210), with (4763) male and (5447) female students.

Third: The research sample

The two researchers determined the size of their basic research sample based on the formula of Afaneh (1997), which consisted of (385), with (181) male students, and (204) female students from the total community of female students, as they were selected using the simple random sample method from the schools of the General Directorate of Education in Baghdad-The Karkh- First.

Fourth: Research tools

First: Building a mental fitness scale This includes

1- Determine the concept of mental fitness and its skills:

The concept of mental fitness used in the current research was determined based on the theoretical background of the current research, as mental fitness includes the six skills (thinking, remembering, focusing, problem-solving and decision-making, and imagination and perception) in proportion to the nature of the research.

2- Presenting the concept of mental fitness to a number of arbitrators

The questionnaire of the concept of mental fitness was presented after it was defined in its initial form to a number of arbitrators in the methods of teaching mathematics and educational psychology and taking into account their observations about the validity of these concepts and in light of their opinions and observations. The amendments they proposed were made, and they were approved by more than (80%) of the opinions of the arbitrators, with an amendment to the questionnaire.

3- Formulation of the items of the scale: The items of the scale were formulated based on the concept of mental fitness and reviewing the literature and previous local, Arab and foreign studies , in order to build a measure of mental fitness, as no scale or test was found that measures mental fitness in mathematics, and this scale may be the first in mathematics in Iraqi and Arab studies. The number of paragraphs of the scale (30) paragraphs according to the five-point Likert.

4- Instructions for answering the scale items:

Instructions for answering the paragraphs of the mental fitness scale have been developed, taking into account that they are clear, and students are informed that if they obtain the scale score, it is for scientific research purposes only.

5- Presenting the scale to a group of arbitrators:

The 30 items of the mental fitness scale were presented to a group of arbitrators and experts specializing in teaching methods of mathematics and psychology to find out their validity and whether they are suitable for measuring the mental fitness of students in the fourth scientific grade in mathematics.

Reconnaissance application

The scale was applied to a group of students in a random manner, and their number reached (100), with (50) male and (50) female students, and some statistical analyzes were conducted for the items, including honesty, discriminatory power, and stability. All items proved adequate for the final sample of the search.

Second: Testing the levels of depth of knowledge in mathematics:

The process of building a test of depth levels of knowledge in mathematics was carried out in a number of stages.

The two researchers analyzed the four chapters of the mathematics book for the fourth scientific grade, namely (the first chapter: mathematical logic, the second chapter: equations and inequalities, the third chapter: exponents and roots, and the fourth chapter: trigonometry) of the mathematics book for the fourth scientific grade, according to the levels of depth of knowledge in mathematics.

1- Determine the objective of testing the levels of depth of knowledge in mathematics:

The test aims to measure the levels of depth of knowledge of the students of the fourth scientific grade in the General Directorate of Education of Baghdad - Karkh First.

2- Determine the concept of depth of knowledge in mathematics:

The concept of depth of knowledge in mathematics was defined according to the theoretical background (chapter two) .

3- Determining levels of depth of knowledge in mathematics and its indicators:

The two researchers looked at a number of researches and previous studies that dealt with the concept and levels of depth of knowledge in mathematics. In determining this list, the researcher relied on Webb's classification(2002) in defining these levels, which are (remembering and reproduction, applying concepts and skills, strategic thinking, extended thinking) and in proportion to the nature of the research.

4- Presenting the levels and indicators of the depth of knowledge in mathematics to the arbitrators:

The levels of depth of knowledge were presented to a group of arbitrators, and the required adjustments were made to some indicators, after those levels had been approved by more than (80%) of their opinions.

5-Analyzing the content of the mathematics book for the fourth scientific grade .

6- Drafting items to test the levels of depth of knowledge in mathematics and answer instructions:

The two researchers prepared a test map showing the weight of each level according to the chapters of the book in the light of the analysis. As the total test consisted of (37) items, the two researchers also set special instructions for answering the test items in terms of their clarity and not leaving any item unanswered. Score on each item as appropriate, and the total score for the test is (113).

7- Statistical analysis of the test items:

The students' answer sheets were arranged in descending order from the highest degree to the lowest degree, which numbered (100) answer sheets that represented the students' grades. Statistical analyzes were performed as follows:

A - Difficulty coefficient for the test paragraphs:

The difficulty coefficients for the objective and essay items ranged between (0.07 -0.72) for the test items, and all were acceptable and within the specified range, except for two items whose difficulty was (0.07 and 0.19), so they are omitted from the test.

B- The discriminatory power of the test items:

It was found that the degree of discrimination for the paragraphs ranged between (0.05-0.59), and the paragraph is acceptable if the percentage of its discrimination coefficient is (20%) or more, so all paragraphs are considered distinct except for three paragraphs, as their distinction reached (0.05, 0.06, 0.11) respectively, so they are deleted paragraphs of the test.

C- The effectiveness of false alternatives to thematic paragraphs:

The effectiveness of the alternatives for the thematic items was calculated using its own equation, and all of them were negative, which indicates that they are effective.

8- Checking the psychometric characteristics, including:

8-1- Validity: The validity of the items of the Depth of Knowledge Test in Mathematics is verified in two ways:

8-1-1- Face Validity:

As the two researchers presented all the test items in their initial form to the arbitrators in the field of mathematics specialization, and the methods of teaching it, to verify that the items are suitable for the field to be measured, and after collecting the opinions of the arbitrators, their opinions and directives that were put forward for the test items were taken into account in terms of modifying some items.

8-1-2- The validity of the construction:

The validity of the construction has been verified as follows:

8-1-2-1- Correlation coefficient of the scores of each item with its level scores:

Pearson's correlation coefficients ranged between (0.104 - ** 0.893), and it is statistically significant, except for one paragraph.

8-1-2-2- Correlation coefficient of scores for each level of depth of knowledge and the score of the total test. The correlation coefficients ranged between (**0.479) to (**0.879), so all correlation coefficients indicate that it is statistically acceptable .

8-1-2-1- Correlation coefficient between the scores of each item and the total test score:

All correlation coefficients ranged between (0.016 - 0.640 **), so they are all statistically significant except for one item, as its correlation coefficient reached (0.016), which is not significant, so it is deleted from the final test.

8-2- Stability:

The stability coefficient was (748%), which is a good indicator of the stability of the test, so the test is ready for final application.

Fifth: The final application on the research sample:

The test was applied to the research sample, which was chosen at random and included (385) students, during the period from 26/2/2023 to 21/3/2023, as the environmental conditions were appropriate when the test was applied, and to ensure that there was no exam before or after applying the test and the scale, and thus it was appropriate to extract the search results.

Sixth: Statistical means:

Appropriate statistical methods were used for the research, including arithmetic means, standard deviation, alpha Cronbach equation, Pearson's correlation coefficient, and T-test for one and two samples, in addition to the coefficients of difficulty, ease, discrimination, and the effectiveness of false alternatives.

Section Four

The following null hypothesis was tested:

There is no correlation at the level of significance (0.05) between the mental fitness and the depth of knowledge in mathematics for the fourth grade students.

The two researchers extracted the Pearson correlation coefficient (Pearson cor.) between the students' scores on the mental fitness scale and their scores on the test designed to measure their levels of depth of knowledge in mathematics, as shown in the following table:

Table (1) The correlation coefficient between the levels of mental fitness and the depth of knowledge of mathematics and the significance of the correlation among the research sample

variables	Number of individuals	Statistical mean	standard deviation	standard error	Correlation coefficient value	The T value of the correlation
Mental fitness	385	119.382	12.395	0.632	0.360**	7.552
depth of knowledge		57.964	23.276	1.186		

Note that 1.98 is the tabular T-value at the level of significance (0.05).

It is noted from the table that the correlation coefficient calculated between the degrees of mental fitness and the depth of knowledge in mathematics for students of the fourth scientific grade was (0.360**). This is considered statistically significant at the level of significance (0.05) and a degree of freedom (383) because the T-value of the significance of the correlation coefficient was (7.552), which is greater than the tabular T-value of (1.98), which indicates the rejection of the previous zero hypothesis and the acceptance of the alternative hypothesis.

Therefore, the two researchers concluded that there is a strong correlation between the two variables, and the direction of the relationship is positive, meaning that the more students have mental fitness, the higher the levels of depth of knowledge in mathematics as well.

Interpretation of the results of the correlation:

The results clearly showed the existence of a strong positive correlation, as it is close to (+1) and positive, between the two variables (mental fitness and depth of knowledge in mathematics). That is, the greater the variable, the greater this increase will be reflected on the other variable and vice versa. The reason may be due to the fact that mental abilities work together, but we separate them for the purposes of scientific research. Since mathematics is a method of thinking because of its topics that need to be understood, in addition to knowledge of previous information and the development of mathematical ideas, so it works to develop the mental fitness of students, and this

is what we have seen, as there are students who have a depth of knowledge in mathematics with a high percentage, they tend to be mentally fit at the same time.

In light of the research results, the following points are recommended:

- 1- It is hoped that mathematics teachers, especially in the fourth scientific grade, will pay attention to focusing on examples and enriching exercises that include thinking skills, focus, problem-solving and decision-making in a way that develops students' imagination while keeping pace with the needs of society.
- 2- It is also hoped that the developers of the curricula will provide the mathematics teacher for the fourth scientific grade in particular with a work guide and an instructional-learning design that focuses on developing the mental fitness of students through deepening knowledge by raising its levels to higher levels of thinking, particularly strategic and extended thinking.

In order to satisfy and develop the goals behind this research, the following suggestions are proposed by the researchers:

- 1- Conducting similar studies that measure the relationship between students' mental fitness during tests in mathematics and other variables that do not interfere in their sub-skills with the fields of the mental fitness variable.
- 2- Preparing an instructional-learning design according to the fields of mental fitness and its impact on student achievement in mathematics and at different stages.
- 3- Conducting a study to find out the relationship between mental fitness and other types of thinking, whether for teachers or students.

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