SCIENTIFIC CULTURE
www.sci-cult.com

SCIENTIFIC CULTURE, Vol. 12, No. 1.1, (2026), pp. 4126-4143
Open Access. Online & Print

DOI: 10.5281/zenodo.19259411

STUDYING WORKING MEMORY AMONG A SAMPLE OF CHILDREN SUFFERING FROM DYSCALCULIA IN PRIMARY EDUCATION

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Received: 01/12/2025
Accepted: 02/01/2026

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ABSTRACT

The current study is a review article that aimed to evaluate the working memory of dyscalculic children in the primary education stage. The hypothesis was that the working memory of students who suffer from dyscalculia is characterized by a weak level. The researchers relied on the descriptive method based on a case study. The study sample consisted of 7 cases that were diagnosed using the ZAREKI-R2005 test. Their ages ranged from 8 to 11 years. This was done through an exploratory study at the level of the state of Blida in four primary schools. To achieve the study objectives, the researchers applied Farah Yahia's working memory test to the diagnosed sample, and after analyzing the results quantitatively. The researchers concluded that children with dyscalculia have deficiencies at the level of working memory. The fulfillment of the hypotheses indicates the validity of the theoretical concept on which it is based.

KEYWORDS: Working Memory, Mathematics Learning, a child suffering from dyscalculia.

1. INTRODUCTION AND RESEARCH PROBLEM

Dyscalculia is one of the topics that has attracted the attention of researchers and scholars recently due to its widespread among students, especially in the primary stage, where this dyscalculia is an obstacle that prevents them from acquiring mathematical skills and abilities appropriate for their age, as learning Mathematics is considered one of the most important skills that must be acquired. A person can acquire it since most of the daily life skills depend on it, and Mathematics represents the ability to correctly apply the skill of counting and grouping, whether for integers, fractions, and decimal numbers, and the operations of addition, subtraction, multiplication, and division, and the ability to use these rules effectively in every way life situation.

Dyscalculia disorder represents difficulty in performing these simple mathematical problems and operations, although the child with dyscalculia does not suffer from any problems or disorders that cause this disorder, as he does not have any problems with his auditory and visual abilities, and he does not have any mental or psychological problems.

Therefore, the researchers studied the cognitive processes that interfere in the process of learning Mathematics, and memory was the most important of these processes, as it forms the focus of other cognitive processes, and any defect in this function leads to an imbalance in the learning process.

Working memory is considered one of the most important types of memory due to its important role which lies in the ability to store and retrieve all received information. Working memory is characterized by the multiplicity and complexity of its components, and it is the storehouse that processes the sensory information it receives and transfers it to long-term memory. Therefore, some researchers have linked dyscalculia to deficiencies in working memory.

From this standpoint, the researchers have chosen the subject of this study which aims to evaluate working memory among children with dyscalculia. The researchers will attempt to determine the level of working memory among a group of children with dyscalculia.

Arithmetic represents an abstract intellectual activity that deals with numerical symbols that the individual needs in his quest to comprehend the quantitative existence that surrounds him, as it is one of the important and necessary sciences for any individual, regardless of his culture. It is essential in making decisions related to matters of daily life, such as monetary and accounting transactions. These skills that students need in daily life vary and require the use of the four operations: addition, subtraction, multiplication, and division (Ait Yahya, 2009, 170).

Some students may confront difficulties and problems in dealing with these arithmetic operations and quantities, even though the fact that these students do not have any mental, psychological, or social problems, and they receive an appropriate education like their peers, as these children are called dyscalculia children.

Dyscalculia is considered one of the most important problems that appear at this primary stage, as it stands as an obstacle between the learner and his acquisition and learning of the arithmetic skill. This problem usually appears more clearly during the fourth and fifth school years, as the child at this age has reached a fair stage of cognitive maturity.

Difficulty in arithmetic is considered one of the most widespread difficulties, and this difficulty is defined as a term that expresses difficulty or difficulties in using and understanding mathematical concepts and facts and performing mathematical operations (Al-Zayat, 2007, 41).

Researchers have tried to find out the mental and cognitive processes involved in this disorder to help these children who face difficulty in receiving an appropriate education for them. Understanding, perception, concentration, and memory are involved in the process of learning arithmetic, as each cognitive process has a role in acquiring arithmetic. Memory of all types has important roles that help learning, and working memory, according to Baddeley and Hitch, is like a warehouse in which information is stored and processed simultaneously, and it depends on the interaction between its two components, which are the ability to store and the ability to process. (Abu Al-Diyar, 2012, 25).

Through this research, the researchers will try to evaluate the working memory of children with arithmetic disabilities. Several previous studies have touched on this topic, with similar titles (Boras-Hina, 2017) entitled: Working Memory and its Relationship to the Difficulty of Learning Mathematics among Fourth and fifth-grade Students of Primary Education, where the researcher concluded, after applying several tests, that there is no relationship between working memory and mathematical learning difficulty.

There is also another study on dyscalculia by Maryam Moaziz (2015), entitled Semantic Memory among the child with dyscalculia. This study concluded that the child who suffers from dyscalculia does not suffer from any disturbance in semantic memory in acquiring arithmetic skills.

(Zardoumi& Omrani, 2013) is entitled Cognitive Treatment of dyscalculia according to the model of processing information in working memory." In this study, the researcher tried to clarify the correlation between both intelligence and working memory with dyscalculia. The study concluded that working

memory has a statistically significant effect on dyscalculia.

(Bin Safia, 2004) entitled: Working memory among people with dyslexia (a cognitive self-addressing through the Baddeley model of working memory) concluded that children who suffer from dyslexia have difficulties at the level of working memory.

Also, (Hitch& McCauley, 1991) aimed to identify the nature of working memory among students with arithmetic learning disorders. They finally concluded that there are differences between normal students and students with dyscalculia, as they suffer from clear deficiencies in working memory, especially during storage and processing. Numerical information.

1.1. Research Questions

Relying on these studies and several references, the researchers will attempt to evaluate working memory among children with arithmetic disabilities. They will try to answer the following questions:

What is the working memory level among a sample of children with dyscalculia?

The following sub-questions emerge from this question:

1. What is the verbal component level among children with dyscalculia?
2. What is the visual-spatial component level among children with dyscalculia?
3. What is the central access level among children with dyscalculia?
4. What is the source of events level among children with dyscalculia?

1.2. Research Hypotheses

1.2.1. General hypothesis:

The working memory of students with difficulty counting is characterized by a weak level.

1.2.2. Partial hypotheses:

1. Students with difficulty counting are characterized by weakness in the performance of the verbal component.
2. Students with difficulty counting are characterized by weakness in the performance of the visual-spatial component.
3. Students with difficulty counting are characterized by weakness in the performance of the central port.
4. Students with difficulty counting are characterized by weakness in the source of events performance.

1.3. Research objectives:

1. The level of working memory performance among children with dyscalculia.
2. The performance level of the verbal component among children with dyscalculia.
3. The performance level of the visual-spatial component among children with dyscalculia.
4. The performance level of the central port among children with dyscalculia.
5. The performance level of the events source among children with dyscalculia.

1.4. Research Importance:

1. Opening the way for new research and studies related to working memory among people with learning disorders.
2. Drawing the attention of parents and teachers to the importance of memory for the good academic achievement of students.
3. Drawing the attention of professors and guardian bodies to some disorders that they do not give importance to, but which are of great importance (arithmetic - reading - writing - handwriting - dictation).
4. Identifying the most important disorders that hinder the process of learning arithmetic.

2. LITERATURE REVIEW

2.1. Research Concepts

2.1.1. Working Memory:

Bordin (1994) defined it as a system with multiple components to understand how information is stored and processed for use in performing various complex cognitive activities. (Abu Al-Diyar, 2012, p. 25)

Raja Mahmoud (2012) defined it as the element of memory in which information is processed. It is recognized in the sensory register, retains the information for a longer period, and then processes it after that. (Boras, 2017, p. 39)

Baddeley (1992) defined it as a system with limited capacity that allows for the temporary storage and processing of information necessary to perform complex cognitive tasks such as understanding, learning, and thinking. (Kosma, 2007, p. 23)

Working memory is defined procedurally as the memory that receives information from sensory memory, as it is a temporary storage system for the material that comes from immediate memory and processes it, such as performing a mathematical operation and also entering the information into long-term memory, which is the sign by which we confirm that the information is processed correctly. It is measured through the Farah Yahya working memory test.

2.1.2. Dyscalculia:

Kosc (1970) defined it as a functional disorder in arithmetic abilities whose origins are due to genetic or innate problems that appear in some parts of the brain and whose basic basis is psych-anatomical and

in which arithmetic abilities have not reached the required level of maturity, without these manifestations being concurrent with difficulties in general mental functions. (Rakza, and Saleh Al- Ahmadi, 2021, page 81)

Inserm (2007) defined it as a specific learning disorder to be diagnosed with dyscalculia, the patient must not suffer from any impairment, whether sensory, motor, mental, trauma or a widespread developmental disorder. Psychological, economic, or even educational deficiencies will also be excluded. (Roncier, 2013, p. 29)

Corsini (1999) defined it as difficulty performing simple mathematical problems and operations such as 2+2=4, and it appears among children who suffer from disorders in the parietal lobe. (Alsayed Mohamed Ziadeh, 2006)

Dyscalculia is defined procedurally as difficulties in dealing with mathematical operations and problems, which appear in the form of distortions in quantitative thinking. It is a permanent disorder that affects all ages and those who do not suffer from a mental disability, that is, they are of average or above average intelligence. It is measured in this study through the Zareki test - R2005.

Since dyscalculia has become a widespread phenomenon among school students; Therefore, many researchers have been interested in studying it. Among the studies that focused on studying dyscalculia in general and mathematics in particular, they proved that the prevalence of these difficulties is high, including:

(Mazzoco, 2001) concluded that there is a significant and positive correlation between inherited comorbidities, like Turner, and that difficulties in learning mathematics are inherited difficulties to some extent (Shalev R.et al., 2001). (Moaziz, 2015) concluded that the child with dyscalculia does not suffer from a disorder in semantic memory in acquiring arithmetic skills (and a lack of good understanding of them). The reason for this disorder can be attributed to the cases' lack of some arithmetic concepts and their lack of good understanding of them. (Haddoun, 2017) concluded that the person with dyscalculia suffers from impairment in visual- spatial reasoning and selective attention.

(Jarad Abdel Khaleq, 2018) concluded that the hypothesis states that there is a statistically significant correlation between the ability to learn arithmetic and verbal working and short-term memory among people with difficulty, and (El- Sayed, Rakza, 2019) concluded that there is a significant relationship between working memory and difficulties in learning arithmetic among a sample of fifth-grade primary school students. (Bin Daoud, 2019) found that there is no significant relationship between the results of arithmetic-disabled children in the working memory test and the arithmetic test. There is also a significant relationship between the results of arithmetic-disabled students in working memory item - numbers and linear arithmetic operations item, and (El-Sayed, Rakza, 2020) revealed that children with mathematics learning disabilities are characterized by low visual memory.

From the previous studies that the researchers presented, it can be seen that they differ slightly from the subject of this research and are not similar to it, except that they dealt with an aspect of our current study in terms of the study variables.

It can be noted that the results of these studies differ from one to another, despite the great similarity in the titles. It can be noted that the studies that study the relationship between working memory and dyscalculia have different results. We find one that highlights the existence of a verified hypothesis that proves the existence of a statistically significant relationship, and others deny the existence of a statistically significant relationship between working memory and dyscalculia.

From this standpoint, the researchers will evaluate the working memory among a group of children who suffer from dyscalculia. These previous studies have benefited us by reviewing their results in helping us formulate the problem and the theoretical framing of the study. They have also helped to form an idea about the applied aspect of the current research.

3. METHODOLOGY

This Review article will use the descriptive approach based on a case study.

3.1. Survey Study

3.1.1. Objectives of the exploratory study:

Before any field study, the researchers must conduct a reconnaissance study of the place where the study will be conducted

After taking this step, its objectives can be determined as follows:

1. Getting closer to the field and controlling the study variables.
2. Knowing the availability of the study group.
3. Taking a look at the locations of the study group's cases and identifying their characteristics.
4. Knowing the psychometric properties of the study tool and developing a plan for its application.
5. Knowing the application difficulties that would determine the value of scientific research and its scientific standing to reduce them in the basic study or try to avoid them.
6. Inquiring about methods for building a relationship with sample cases to facilitate application and reach the best possible results.

3.1.2. Survey study methodology:

In this exploratory study, the researchers relied on the clinical method based on a case study, as it is more appropriate for diagnosing the study group.

Because diagnosis is a complex process, it is necessary to take each case and analyze it in a detailed and accurate manner. Hence, we decided that the clinical method is the best way to ensure the correct diagnosis.

3.1.3. Spatial and temporal determinants:

1. Spatial determinants: After obtaining the license to conduct a field study within the framework of preparing the graduation thesis by the Directorate of Education of Blida Province, the researchers went on to conduct our exploratory study in the "Ben Merah" and "Omar Khaidari" schools, Bab Sabt, Blida. and also, a license from the director of the "Asry Mohamed" school in the municipality of Beni Tamo and the director of the "Zawawi Ben Issa" school in Oued Al-Alaik.
2. Temporal determinants: The exploratory study lasted from 16/10/2025 to 23/10/2025.

3.1.4. Survey study group:

The number of cases in the exploratory study group was 26 and consisted of:

1. Four sections for the third year of primary school (3 from Asry Mohamed School, 2 from Omar Khaidari School, 2 from Ben Merah School, and 1 from Zawawi Ibn Issa School).
2. Three sections from the 4th year of primary school (4 students from Omar Khaidari School, 4 from Ben Merah School, and 4 from Zawawi Ben Issa School).
3. Two sections from the fifth year of primary school (4 from Zawawi Ben Issa School, 2 from Ben Merah School).

They were chosen intentionally by consulting the professors of each department and reviewing the students' results in all subjects. The researchers chose those who were weak in mathematics without having any weaknesses in other subjects. They were between the ages of 8 and 11 years, males and females.

We also interviewed the students' parents to collect information and verify the psychological and social health of the study group.

3.1.5. Survey study tools:

1. The interview:

The researchers interviewed professors to determine the initial population for the survey group. They also interview students to apply diagnostic tests. They used standardized and subjective tests for the exploratory study group and were as follows:

2. **Illustrated intelligence test by Ahmed Zaki Saleh** to eliminate the factor of mental retardation in the study group.
3. **ZAREKI-R battery** for evaluating number processing among children to diagnose dyscalculia and identify students who are arithmetic, and this is the sample we need in the basic study.
4. **Self-tests to ensure the integrity of audio-visual capabilities.**

3.1.6. Providing exploratory study tests:

First: The Illustrated Intelligence Test by Ahmed Zaki Saleh:

This test is considered one of the non-verbal collective tests, that measures the ability to perceive similarities and differences between subjects and things. The use of this test also indicates its great benefit in the first diagnostic cases, as it measures the general ability of individuals.

Second: ZAREKI-R battery for evaluating number processing and arithmetic among children

The French ZAREKI-R battery is a modified version of the original German battery, which was prepared and developed in German in 2001, by Von Aster in cooperation with Monika Weinhold Zulauf, to evaluate number processing and arithmetic among children.

This battery allows for the evaluation of the various elements that make up number processing and arithmetic among children in the primary stage from the first year of primary school to the fifth year of primary school. The selection of the twelve tests for the battery was based on recent research and work in neuropsychology, indicating the complex and diverse nature of children's ability to use numbers and perform basic calculations:

1 Knowing the verbal series of numbers.
2 The ability to count.
3 Correct transition from one system of representing numbers to another (numbers in Arabic writing, numbers presented orally, numbers written literally).
4 Knowledge of arithmetic facts (for example: the multiplication table).
5 The ability to estimate and compare numbers and quantities.
6 Understanding the meaning of numbers.

Therefore, the modified ZAREKI-R battery was designed as an analytical tool to identify and recognize the difficulties facing every child in the field of arithmetic and number processing. These difficulties can be diverse and determined at the level of:

1 Knowledge of numerical symbols and the transition from one symbol to another, the correct transition from one system of representing numbers to another.
2 Working memory. - Attention. - Perception of

space.

3 The ability to estimate and estimate quantities. - The ability to compare numbers and quantities.

4 Understanding the principles of counting, i.e. the ability to count. - Knowing the verbal series of numbers. - Understanding the meaning of numbers.

5 Knowledge of arithmetic facts and basic calculation procedures such as the multiplication table.

This battery aims to reveal the difficulties specific to each child, and they can be different and varied, even if they all lead to the emergence of dyscalculia.

3.2. Results of the survey:

1. Through a field survey, the sample was found and adjusted to suit the variables and the research objectives.
2. The problem and hypotheses were identified and controlled.
3. Through the field survey, we were directed to the importance of applying the intelligence test, and we chose the pictorial intelligence test by Ahmed Zaki Saleh, to eliminate the presence of the factor of mental delay.

Through the results represented in the table, we notice that the students obtained scores ranging between 2 and 32 out of the total score of 60, that is, ranging between 85 and 135, that is, from low intelligence to very high intelligence, compared to what was stated in the test's triple standard list, most of which were between average and good except for two cases, one received a score of 2 out of 60, meaning a score of 82, and the other received a score of 4, which is the weakest, meaning a score of 78 on the standard.

The ZAREKI-R arithmetic test was applied to diagnose the study group.

3.3. The Basic study:

3.3.1. Basic study method:

The first basis for conducting any scientific study is to choose a method that is compatible with the objectives of the research to be conducted, since the primary objective of this study is to evaluate working memory among children with arithmetic disabilities. The researchers used the descriptive method represented by a case study method because it is compatible with this objective.

The case study technique aims to identify the characteristics and content of a single case or phenomenon in a detailed and accurate manner, and it can be defined as an in-depth investigation of a specific case to find the results that can be generalized to other similar cases. (Obaidat et al., 1999, p. 44)

3.3.2. Spatial and temporal determinants:

1. Spatial determinants: Our field study was conducted in several primary schools at the Blida state level, where we conducted it in Isri Ahmed School, located in the municipality of Beni Tamu, Zawaoui Ben Issa School in the municipality of Ouled Al-Alaik, and Ben Merah School and Omar Khediri School, located in the municipality of Bab Sabt.
2. Temporal determinants: The exploratory study lasted from 16/10/2025 to 23/10/2025.

3.3.3. Basic study group:

Choosing the appropriate sample is one of the most important steps that the researcher goes through in his study. After calculating and analyzing the results of the students in the pictorial intelligence test and the Zareki-R test and comparing them to the standard score for ordinary students, and after reviewing the student's academic results, we were able to identify the members of the basic study sample that had the ability to with 7 cases suffering from dyscalculia, they were selected intentionally according to the following conditions:

1. I Q ranges between average and excellent.
2. Their ages range from 8 to 11 years.
3. Their achievement results in mathematics are weak, despite their obtaining good results in other subjects.
4. They do not have neurological or sensory damage or psychological disorders.
5. They do not have visual or hearing disorders.

Table 1: Characteristics of the basic study sample

Case no.	Name and surname	Birth date	Age	Gender	IQ
1	M.F.	21/7/2014	9	Male	32
2	M.B.	20/11/2012	11	Male	22
3	R.F.	12/3/2014	9	Female	30
4	M.Q.	12/4/2012	11	Male	34
5	D.E.	31/7/2015	10	Female	22
6	M.W.	24/12/2015	8	Female	26
7	L.Y.	13/2/2015	8	Female	12

3.3.4. Basic study tools:

Working memory test, by Farah Yahya: The researcher divided the scale into four dimensions, each dimension of which includes a group of subtests, which we mention below:

1. The verbal component: It includes a test of sequential retrieval, reverse retrieval, retrieval of the last word of the sentences read, the truth and error of the sentences, and retrieval of the last word of the sentences heard verbally.
2. The visual-spatial component: includes a test of sequential clicking, reverse clicking, shape transfer, and shape completion.
3. The central section: consists of the word completion test, the even numbers test, and the linking test.
4. The source of events: includes the test word and its location, the numbers of the small space, and the location of the stimuli in the table.

The working memory test is applied individually, as the average duration of application on the standardization sample was 15 minutes, noting that working memory tasks require performing the task or retrieving the material immediately after hearing it.

Characteristics of the subjects: This test is used to detect the level of working memory among students enrolled in the second and third grades of primary school, in addition to students who suffer from learning difficulties.

Answer method: The working memory test consists of 15 subtests in which the instructions and method of performing the task differ, including the method of correcting the test items.

Table 2: Shows the test dimensions with subtests and correction methods

Dimension	Item	Respond	Score
Verbal component	Sequential retrieval	The student is asked to retrieve a series of numbers from numbers sequentially in four stages, starting from 3 units to 7 units in the last series.	Each string retrieved correctly is given a score, and the final total is 4 marks.
	Reverse loopback	The same task as the previous one, but retrieving the units is in reverse.	Each series retrieved correctly inversely will be given one score and the total will be 4 marks.
	Retrieve the last word	The subject reads three sentences and then is asked to recall the last word of each sentence.	One point for each correct word, so the total is 3 marks
	True and false of sentences	The subject listens to three sentences and must answer whether each sentence is true or false.	Each sentence has one mark, and the total is 3 marks at the end
	Retrieve the last word	After answering true or false, he is asked to recall the last word of each sentence.	A score for each word retrieved correctly, finally 3 marks
The total score for the verbal component dimension is: 17 degrees			
Component Visual Spatial	Sequential clicking	The subject clicks on the red squares on the card sequentially at four levels, starting from 3 units to 6 at the last level or series.	Each series retrieved correctly is given a score, and the total in the final is four scores.
	Reverse clicking	The same task as the previous one, but clicking on the squares is done in reverse.	One mark is awarded for each correctly retrieved sequence, and the final total is 4 marks.
	Move shape	The subject looks at the proposed shape within five seconds and is then asked to copy it again on a white sheet of paper.	Each part is drawn in the appropriate place and is awarded one mark, and the total is 8.
	Complete the shape	The subject is presented with three missing shapes and is asked to choose the correct missing part.	Choose the correct missing part for each shape, for which a grade is given, and the total is 3 grades.
The total score for the visual-spatial component dimension is: 19 degrees			
Central port	Finish the word	The subject is presented with three incomplete words in sequential form and is asked to choose the appropriate letter or letters from those he listens to.	Each correct word is awarded a mark, and the total is 3 marks.
	Even numbers	The subject is presented with two sets of numbers simultaneously, one in audio form and the other visually, at three levels, and he is asked to extract the even numbers.	Extracting the correct even numbers from each level is awarded one mark, and thus the total is 3 marks.
	Connectivity	The subject is asked to link shapes that are similar in color.	For each correct response, a point is given, and the total is 3 marks.
Total score for the central port dimension is: 9 degrees			
Events source	The word and its location	The subject is presented sequentially, each with a word in a specific location, and he was asked to retrieve the words that came at the top right of the paper.	Each word recalled correctly is awarded one point, and the total is two marks.
	The small space	The subject is presented with two spaces, each with a set of numbers, and is asked to retrieve the numbers of the small or inner space.	Each number retrieved correctly is awarded one point, and the final score is 3 marks.
	Location of stimuli in the table	The subject is presented with a table divided into 9 boxes, each with a specific stimulus, and he is asked to remember the location of the clock, the number 10, and the word well.	A point is given for each correct answer, and the total is 3 marks.
The total score for the source of events dimension is: 8 degrees			
Maximum working memory test score: 53			

Interpretation of test scores: The score obtained by the subject indicates five levels: poor between (0-10), below average between (11-21), average between (22-32), above average between (33-43), and high between (44 - 53) degrees.

3.4. Psychometric properties of the scale:

Standardization sample: To verify the validity and reliability of the test, it was applied to a sample of students in the second and third grades of primary school, with a sample of 90 male and female students, with an average age of approximately nine years, at a rate of 8.73 years.

3.5. Validity of the test:

Internal consistency validity: The researcher calculated the correlation coefficient in the first dimension of each item and the total score of the dimension to which it belongs. The correlation scores in the first dimension of the verbal component ranged between 0.73 and 0.88 at a significance level of 0.01.

The degree of correlation of the items in the second dimension of the visual-spatial loop ranged between 0.72 and 0.90 at a significance level of 0.01, and the degree of correlation coefficient of the items in the third dimension and the total degree of the dimension of the central port ranged between 0.53 and 0.83, which is significant at the level of 0.01.

Regarding the last dimension of the event buffer, the degree of correlation of its items with the total score ranged between 0.82 and 0.87 at a significance level of 0.01.

As for the degree of correlation coefficient between the dimensions and the scale as a whole, it ranged between 0.67 and 0.94, and they are all at a significance level of 0.01.

Discriminant validity: To calculate the discriminant validity coefficient, the researcher applied the T-test to two independent samples to test the differences between the upper and lower groups on each item of the scale, as the statistical treatment revealed the presence of significant differences between the upper and lower groups in all items.

The test in its general form also showed its ability to distinguish between the upper and lower groups in terms of the level of working memory, which is another indicator of the validity of the test.

3.6. Test stability:

Calculating stability using the Alpha Cronbach coefficient: Calculating the stability coefficient using the Alpha Cronbach coefficient method between each dimension of the test and the test as a whole, where the value of the reliability coefficient for the scale as a whole was 0.93, while the reliability of the test dimensions was acceptable, ranging between 0.48 and 0.82.

Validity and stability were re-measured by the two students, Anfal Bin Sheikh and the student, Darwish Zainab Wassal, in the master's study "The relationship of working memory to the ability to solve problems in children who benefit from cochlear implants" in the year 2023, and the results expressed the following:

Validity: Validity was calculated using the internal consistency method using the Alpha Cronbach coefficient, with a value of 0.88, which is a high value indicating that the test has validity.

Stability (Alpha Cronbach): In calculating the stability of the working memory test, we relied on internal consistency, by calculating the total score of the test.

Table 3: Alpha Cronbach for the working memory test

Working memory test	Alpha Cronbach
	0.885

It is clear from the table that the value of Alpha Cronbach is high, and it can be said that the test has a high degree of stability.

4. FINDINGS AND DISCUSSION

4.1. Presentation and analysis of the results of the first case:

Table 4: represents the results of the first case in the working memory test

Item	Points	Percentage
Verbal component	6	35.29%
Visual-spatial component	6	31.57%
Central port	4	44.44%
Source of events	3	37.5%
Total	19	37.18%

4.1.1. Quantitative analysis:

The table shows us that the case obtained 6 points out of 17 points in the verbal component dimension with a percentage of 35.29%, and obtained 6 points out of 19 in the visual-spatial component dimension with a percentage of 31.57%, and 4 points out of 9 in the central port dimension with a percentage 44.44%, and finally, he got 3 points out of 8 in the source of events dimension, which was estimated at 37.5%. The total score for the test as a whole was 19 points out of 53 points, which means a percentage estimated at 37.18%.

4.1.2. Qualitative analysis:

Qualitative analysis of the first case shows that it obtained average results in the working memory test, as it obtained a low percentage in the first dimension, such that the case couldn't perform sequential retrieval of numbers correctly for long groups. As for reverse retrieval, the case encountered greater difficulty in it, and in retrieving the last word, his performance was also poor. Then, in the correctness and error of the sentences, the answer to the condition was good, but he couldn't remember and retrieve the last word of the sentence.

Then, in the dimension of the visual-spatial component, the case's answer was also weak concerning the total score. The case's performance was poor in the first task, then concerning transferring the shape, his performance was good in the other tasks, as his answer in the shape completion task was wrong.

In the third dimension, the condition showed improvement, but he also received a score below average, as the word completion task was easy for him, while the task of extracting even numbers from groups was difficult for him and the performance was poor, as for the linking task it was easy for him and the answer was correct. This is what Rourke (1993) showed when he confirmed that students with dyscalculia suffer from a clear deficit in the processes of forming concepts and weak verbal and non-verbal memory and that their degree of verbal intelligence is better than the degree of practical intelligence.

In the last dimension, the word location task was difficult for the case, as he couldn't answer. As for the small space task, the subject could find some correct answers, but his performance was still considered weak. In the last task, the subject had to find the location of the stimuli in the table, where he could get one correct answer out of three.

As a sum of its results in these dimensions, the case obtained a score of 19, which is considered a below-average result, as it represents a percentage of 37.18%, which is a weak score as a result of the working memory test.

4.2. Presentation and analysis of the results of the second case

Table 5: represents the results of the second case in the working memory test

Item	Points	Percentage
Verbal component	2	11.76%
Visual-spatial component	5	26.31%
Central port	3	33.33%
Source of events	0	0%
Total	10	17.85%

4.2.1. Quantitative analysis:

The table shows us that the case obtained 2 points out of 17 points in the verbal component dimension with a percentage of 11.76%, and obtained 5 points out of 19 in the visual-spatial component dimension with a percentage of 26.31%, and 3 points out of 9 in the central port dimension with a percentage 33.33, and finally, he got 0 points out of 8 in the source of events dimension, which was estimated at 0%. The total score for the case in the test as a whole was 10 points out of 53 points which means that percentage estimated at 17.85%.

4.2.2. Qualitative analysis:

The results of the qualitative analysis show that the second case obtained a very low score in the verbal component item, as it performed the correct retrieval of the series of short numbers only, and couldn't perform the reverse retrieval, and in retrieving the last word of the sentences, he couldn't do so either, and in the task of correctness and error of the sentences. He could answer correctly only one sentence, and couldn't retrieve the last word in all the sentences.

As for the visual component, his performance was slightly better, but it did not exceed average, as he obtained 5 marks out of 19 marks. This dimension contains the task of sequential clicking and reverse clicking. He could not remember the correct order, especially for long chains. Then the task of transferring the shape was easier for him, as he got a

good mark on it, but his results were bad in completing the form.

In the central port item, his performance was slightly better, reaching 33.33%, as he obtained 3 correct answers out of 9.

The task of completing the word was not easy for him as his answers were wrong, and the task of finding even numbers from a series of numbers was also difficult for him.

In the last dimension, all his answers were wrong, so he received a score of 0 in all tasks.

This case obtained a score of 10 on the working memory test, which represents 17.85%, which is a very weak percentage of the total score. The emergence of this result is due to a defect in the process of processing and storing information, as Hitch and McCauley believe in their study that there are differences between normal students and students with learning disorders, including a clear deficiency in working memory, especially during the storage and processing of numerical information.

4.3. Presentation and analysis of the results of the third case:

Table 6: represents the results of the third case in the working memory test

Item	Points	Percentage
Verbal component	7	41.17%
Visual-spatial component	7	36.84%
Central port	5	55.55%
Source of events	0	0%
Total	19	33.39%

4.3.1. Quantitative analysis:

The table shows us that the case obtained 7 points out of 17 points in the verbal component dimension, a rate of 41.17%, and obtained 7 points out of 19 in the visual-spatial component dimension, a rate of 36.84%, and 4 points out of 9 in the central port dimension, a rate of 55.55%, and finally, he got 0 points out of 8 in the source of events dimension, which is estimated at 0%. The total score for the test as a whole was 19 points out of 53 points which means that percentage estimated at 33.39%.

4.3.2. Qualitative analysis:

The third case obtained a score of 7 out of 17 in the verbal component dimension, where in sequential retrieval of numbers he could answer short strings only, and likewise for reverse retrieval N, as for retrieving the last word of sentences he could answer only one, as (Blount and Izaki, 1997) see that the verbal working memory is one of the difficulties facing people with learning disorders. concerning the accuracy of the sentences, he could answer them correctly, but he couldn't retrieve the last word of each sentence.

Concerning the second dimension, his results were weak, as he got a score of 7 out of 19 marks. The sequential and reverse clicking task was difficult for him, as his score was bad in it. Concerning transferring the shape, drawing it was good, but in the shape completion task, he did not get the full mark because it was difficult to draw or identify some of the correct answers.

His answer was good in the central port dimension, as he obtained a score of 5 out of 9. Thus, his results were above average, and he could answer correctly. His performance was poor in the source of events dimension, as he received a score of 0, and all his answers were wrong.

Thus, his total results in the working memory test were 19, and this result is considered below average. These results are consistent with the results of (El-Sayed& Rakza, 2019) who found in their research that children with dyscalculia suffer from a disorder at the level of the visual diary

4.4. Presentation and analysis of the results of the fourth case:

Table 7: represents the results of the fourth case in the working memory test

Item	Points	Percentage
Verbal component	5	29.41%
Visual-spatial component	5	26.31%
Central port	3	33.33%
Source of events	3	37.5%
Total	16	31.63%

4.4.1. Quantitative analysis:

The table shows us that the case obtained 5 points out of 17 points in the verbal component dimension with a percentage of 29.41%, and obtained 5 points

out of 19 in the visual-spatial component dimension with a percentage of 26.31%, and 3 points out of 9 in the central port dimension with a percentage of 33.33%. Finally, he got 3 points out of 8 in the source of events dimension, which was estimated at 37.5%. The total score for the test as a whole was 16 points out of 53 points, which means that percentage estimated at 31.63%.

4.4.2. Qualitative analysis:

The results of the fourth case were close in all dimensions of the test, as in the first dimension he obtained a score of 5 out of 17 marks, and thus it is considered a weak mark, as he could retrieve only short numerical strings, and he couldn't retrieve any string in reverse retrieval, and as for retrieving the last word in the sentence He could not remember them all, and in the task of correctness and error of sentences, he could answer them, but he could not remember the last word in those sentences.

In the dimension of the visual-spatial component, the case obtained a score of 5 out of 19, which is also a weak score, as he couldn't remember the correct sequence of sequential and reverse clicking. As for the shape transfer task, he could do it despite the presence of some shortcomings, in the last task he could answer some of them.

In the central port dimension, he got a mark out of 9. It is a weak mark, as he couldn't correctly answer the word completion task and the even numbers task, but he could correctly connect shapes that are similar in terms of color.

In the source of events item, he got a score out of 8, which is a score below the average. He couldn't answer the first task correctly, but he could answer the small space task. The answer was not completely correct, but he could remember some numbers, and in the last task, which was the location of the stimuli in the table. only one hottie could.

Thus, you may get a score of 16 as an overall result of the test, and this score means that the level of working memory in this case is below average. These results are consistent with the results of (Kenza Haddoun, 2017) who found that children with dyscalculia suffer from a disorder at the level of the visual-spatial diary.

4.5. Presentation and analysis of the results of the fifth case:

Table 8: represents the results of the fifth case in the working memory test

Item	Points	Percentage
Verbal component	7	41.17%
Visual-spatial component	8	42.10%
Central port	6	66.66%
Source of events	1	12.5%
Total	22	40.60%

4.5.1. Quantitative analysis:

The table shows us that the case obtained 7 points out of 17 points in the verbal component dimension with a percentage of 41.17%, and obtained 8 points out of 19 in the visual-spatial component dimension with a percentage of 42.10%, and 6 points out of 9 in the central port dimension with a percentage of 66.66%. Finally, he got 1 point out of 8 in the source of events dimension, which was estimated at 12.5%. The total score for the test as a whole was 22 points out of 53 points, i.e. a percentage estimated at 40.60%.

4.5.2. Qualitative analysis:

In the fifth case, after applying the working memory test, obtained a score close to the average in the verbal component dimension. He could retrieve the numbers in each sequence and reverse for the short sequences. He could correctly recall the last word of the sentences even though he made a mistake concerning the validity and correctness of the sentences. He could also retrieve the last word (a word in one sentence).

In the second dimension, he could perform the sequential clicking task, but he made a mistake in the reverse clicking. He could also move the shape in a good way, but he did not answer correctly in the shape completion task.

In the central port dimension, her answer was good, as he could complete the words correctly. He made a mistake in the even numbers task, as he couldn't identify them, but he connected the shapes correctly.

In the source of events, he couldn't find the location of the words, so all of her answers were wrong. The same applies to the small space task, and he could find one exciting location inside the table.

Thus, her final score on the working memory test was 22, which is interpreted as an average score.

This is explained by the fact that the child is subject to follow-up with the psychologist and artophonists according to the information provided by the parents. These results are consistent with the results of (Kenza Haddoun, 2017; and El-Sayed& Rakza, 2019), where they found in their research that children with

dyscalculia suffer from a disorder at the level of the visual diary.

4.6. Presentation and analysis of the results of the sixth case:

Table 9: represents the results of the sixth case in the working memory test

Item	Points	Percentage
Verbal component	1	5.26%
Visual-spatial component	7	36.82%
Central port	4	44.44%
Source of events	2	25%
Total	14	27.88%

4.6.1. Quantitative analysis:

The table shows us that the case obtained 1 point out of 17 points in the verbal component dimension, with a percentage of 5.26%, and obtained 7 points out of 19 in the visual-spatial component dimension, with a percentage of 36.82%, and 4 points out of 9 in the central port dimension, with a percentage of 44.44%. Finally, he got 2 points out of 8 in the source of events dimension, which was estimated at 25%. The total score for the test as a whole was 14 points out of 53 points, i.e. a percentage estimated at 27.88%.

4.6.2. Qualitative analysis:

The case in the first dimension obtained a very low score, as the serial retrieval task was difficult for him, so he only retrieved the first short series, and couldn't correctly answer the reverse retrieval. As for the last tasks in this dimension, his performance was so weak that he couldn't answer any of them.

Concerning the second dimension, his performance was slightly better than the first dimension, but it did not exceed the average. The case could do the sequential clicking task for the first short series only, but he couldn't complete the rest of the series, even in the reverse clicking. In the shape transfer task, he was correct in moving two shapes and then made a mistake in drawing the rest of the shapes.

In the next item, the case could do the word completion task well, even though he made a mistake at the end. As for the task of finding even numbers, it was difficult for him and he couldn't answer it correctly. In the last task in this dimension, all of the case's answers were correct.

In the last dimension, his performance was below average. He couldn't do the word location task correctly, and the same was true for the small space task. In the last task, which was the location of stimuli in the table, the case could find the location of 2 stimuli out of 3 stimuli in the table.

Hence, after collecting the results in these dimensions, we concluded that its working memory is characterized by a below-average level. These results are consistent with the results of (Kenza Haddoun 2017; and El-Sayed& Rakza, 2019). They found in their research that children with dyscalculia suffer from a disorder at the level of the visual-spatial diary.

4.7. Presentation and analysis of the results of the seventh case:

Table 10: represents the results of the seventh case in the working memory test

Item	Points	Percentage
Verbal component	3	17.64%
Visual-spatial component	8	42.1%
Central port	4	44.44%
Source of events	2	25%
Total	17	32.29%

4.7.1. Quantitative analysis:

The table shows us that the case obtained 3 points out of 17 points in the verbal component dimension with a percentage of 17.64%, and obtained 8 points out of 19 in the visual-spatial component dimension with a percentage of 42.1%, and 4 points out of 9 in the central port dimension with a percentage of 44.44%, and finally, he got 2 points out of 8 in the source of events dimension, which is estimated at 25%. The total score for the test as a whole was 17 points out of 53 points, i.e. a percentage estimated at 32.29%.

4.7.2. Qualitative analysis:

The case obtained varying results in the dimensions of the test, as its performance in the first dimension was poor, and the case couldn't perform the process of sequential and reverse retrieval of numbers. The case couldn't perform the task of retrieving the last word, but it could determine the truth and error of the sentences without retrieving the last word of these sentences.

In the visual-spatial component dimension, her performance was better, as it approached the average.

The case could perform the task of clicking in short numerical strings and had difficulty in the rest, and perform the reverse clicking.

But for the task of transferring the shape, it was easy for her, as the transfer was correct, and in the task of completing the shapes, she could complete the first two shapes, but she made a mistake in the third.

Concerning the dimension of the central port, the case's performance was also close to average, as the case could perform the word completion task easily, but couldn't perform the task of finding even numbers. In the last task, it connected the shapes according to color easily.

In the last dimension, the case's performance was poor such that it couldn't do the first and second tasks, while in the last task, it obtained two correct answers and one wrong answer.

5. DISCUSSING HYPOTHESES

5.1. Presentation and analysis of the results of the first hypothesis:

Students with difficulty counting are characterized by weakness in the performance of the verbal component.

Table 11: Results of the cases in the verbal component dimension.

The case	Points
Case 1	6
Case 2	2
Case 3	7
Case 4	5
Case 5	7
Case 6	1
Case 7	3
The Arithmetic Mean	4.42
Percentage	26%

After displaying the results in the table and analyzing them using percentages, the researchers found that the arithmetic mean value for the verbal component dimension is 26%, and the arithmetic mean value for the total scores of the verbal component dimension in the test is 4.42, and through our recording of a set of observations when summing data, the researchers noticed that the results were variable between cases, and there was a weakness in the ability to retrieve long strings, and greater difficulty in backward retrieval.

From this, the researchers conclude that students who suffer from dyscalculia have weaknesses in the performance of the verbal component.

5.2. Presentation and analysis of the results of the second hypothesis:

Students with difficulty counting are characterized by weakness in the performance of the visual-spatial component.

Table 12: Results of the cases in the visual-spatial component dimension

The case	Points
Case 1	6
Case 2	5
Case 3	7
Case 4	5
Case 5	8
Case 6	7
Case 7	8
The Arithmetic Mean	6.57
Percentage	34.57%

After displaying the results in the table and analyzing them using percentages, the researchers found that the arithmetic average value for the visual- spatial component dimension is 34.57%, and the arithmetic average value for the total scores in the visual-spatial component dimension in the test is 6.57. Through their recording of a set of observations when collecting data during our application of the working memory test, the researchers noticed that the results were similar between the cases, that there was difficulty in sequential clicking, especially in long and reverse sequences, and that there were varying difficulties in transferring the shape and completing the shape. Through this, they conclude that students who suffer from dyscalculia have a weakness in the performance of the visual-spatial component.

5.3. Presentation and analysis of the results of the third hypothesis:

Students with difficulty in numeracy are characterized by weakness in the performance of the central port.

Table 13: Case results in the central port dimension

The case	Points
Case 1	4
Case 2	3
Case 3	5
Case 4	3
Case 5	6
Case 6	4
Case 7	4
The Arithmetic Mean	4.14
Percentage	46%

After displaying the results in the table and analyzing them using percentages, the researchers found that the arithmetic average value for the central port dimension is 46%, and the arithmetic average value of the total scores in the central port dimension in the test is 4.14. By recording a set of observations when collecting data during our application of the working memory test, they noticed that the results were close between the cases and that there was a weakness in the word completion task and difficulty in extracting the even number from the strings. As for the tying task, it was a little easier for them. Through this, we conclude that students who suffer from dyscalculia have weaknesses in the performance of the central port.

5.4. Presentation and analysis of the results of the fourth hypothesis:

Difficulty students are characterized by weakness in the performance of the source of events.

Table 14: Case results in the source of events dimension.

The case	Points
Case 1	3
Case 2	0
Case 3	0
Case 4	3
Case 5	1
Case 6	2
Case 7	2
The Arithmetic Mean	1.57
Percentage	19.62%

After displaying the results in the table and analyzing them using percentages, the researchers found that the value of the arithmetic average for the source of events dimension is 19.62%, and the value of the arithmetic average of the total marks in the source of events dimension in the test is 1.57%, and through their recording of a group from observations when collecting data during our application of the working memory test, they noticed that the results were close between the cases, as all the cases faced great difficulty in this dimension, as none of them could answer the task of the word, its location, and the small space, and they obtained bad marks in it. Through this, the researchers conclude that students who suffer from dyscalculia have a weakness in the performance of the source of events.

5.5. Presentation and analysis of the results of the basic hypothesis:

The working memory of students with difficulty counting is characterized by a weak level.

Table 15: Case results on the working memory test.

The case	Points
Case 1	19
Case 2	10
Case 3	19
Case 4	16
Case 5	22
Case 6	14
Case 7	17
The Arithmetic Mean	16.71
Percentage	31.52%

After displaying the results in the table and analyzing them using percentages, it became clear to the researchers that the arithmetic mean value of the results of the memory test and the working memory test was 16.71, with a percentage of 31.52%. Through their application of the test, some observations were recorded, including the presence of difficulty among students with arithmetic impairment in performing the test, especially in retrieval. Whether sequential or reverse retrieval, retrieval of words, or location of stimuli, and concerning the percentage of the arithmetic mean of the overall results expressed, the students with poor arithmetic obtained a weak level in the working memory test. This is consistent with (El-Sayed& Rakza, 2019; and Marie-Pascale Noel), where the result of their study was that children with dyscalculia had lower working memory values than those of normal children.

Therefore, this study allows the researchers to accept the basic hypothesis, from which the researchers can say that children with arithmetic impairment are characterized by a weakness in the level of working memory.

6. GENERAL RESULTS

After applying the working memory test to the study group and obtaining the results, the researchers analyzed them quantitatively and qualitatively and discussed them in light of the partial hypotheses of their study and in light of previous studies that dealt with topics similar to the subject of this research. They concluded that children with arithmetic impairment suffer from a weakness in working memory, and this weakness includes all dimensions of working memory from the verbal component, the visual- spatial component, the central port, and the source of events.

Through the results, the researchers have found that children with arithmetic disabilities suffer from clear difficulties in the ability to perform sequential retrieval, especially in long sequences, and greater difficulty in reverse retrieval. This does not include only some tasks, but even the clicking tasks found in the test. They also concluded that the results were very low, especially in the last dimension, which is the source of events.

As for the level of the study group in the working memory test in all its four dimensions combined, it was below average with a score estimated at 16.71 points out of 53, equivalent to a percentage estimated at 31.5%, as the study group's performance was poor in most working memory tasks.

The results are similar to (Jarad Abdel Khaleq) who concluded that there is a statistically significant correlation between the ability to learn arithmetic and the working memory of people with arithmetic disabilities, and (Blount and Izaki) which concluded that verbal working memory is one of the difficulties facing people with learning difficulties compared to ordinary people. (El-Sayed, Rakza, 2019).

Through the results of this study and the results of previous studies on this subject, the researchers conclude that the basic hypothesis of their study, which states that children with arithmetic impairment have a weak level of working memory, has been achieved.

7. CONCLUSION

This study dealt with one of the important cognitive processes, which is memory. The researchers choose working memory due to its basic role in processing and storing information. This cognitive skill was and still is one of the most important topics researched by many scientists, researchers, and specialists in the field of cognitive sciences, and this is shown by attempt researchers to study memory from several aspects, and among these aspects is its effect on various other cognitive skills of humans in general and children in particular.

This study was a result of several previous studies that dealt with one or both of the variables of the current study to know the level of working memory in one of the most important learning disorders common in the school environment, "dyscalculia."

In the current study, the researchers allocated a specific group of children, namely students studying in the third, fourth, and fifth grades of primary school, due to the prevalence of these disorders among them. They decided to study it in-depth with a small group of the study population, selected through diagnostic tests, which resulted in the extraction of 7 students out of 26 students, and this is to shed light. On working memory and its role in learning arithmetic, and evaluating its level among students with arithmetic disabilities, and this is through this study of the nature of these disorders and their cognitive characteristics that directly affect the arithmetic process in this group.

After the theoretical information the researchers collected, the field study they conducted, the analysis of the results obtained, and the discussion of the hypotheses presented, we concluded that there is a deficiency in working memory in children with dyscalculia (8-11 years). It has become clear to us through the results of the working memory test that the group The study has difficulty in many cognitive tasks, such as retrieval, whether it is retrieving numbers, letters, words, or shapes, and also a defect

in the visual space diary, and the most affected task was the source of events.

However, the results of this study remain related to the time, place, and size of the study group, and are not generalizable.

All of this directs us to the need for researchers to go deeper into such studies from all aspects to learn more about them, understand them, try to develop and improve them in the average child, and prepare therapeutic training programs for children who suffer from their deficiencies.

In summary, the researchers recommended that learning arithmetic can be improved by improving working memory capacity.

As suggestions for this study, the researchers offer the following:

1. Conducting courses for teachers to detect various disorders that the student child may suffer from.
2. Holding awareness meetings for parents within institutions to identify the disorders that students may suffer from while studying.
3. Paying more attention to diagnosing and treating students in institutions, by providing psychologists and psychologists at the level of all educational institutions, due to the presence of many cases of various undetected disorders in schools.
4. Conducting other studies on the topic at hand.
5. Preparing special programs to develop the cognitive abilities of students, especially those with learning disorders.
6. Preparing therapeutic programs and development activities in the field of memory.
7. Preparing teaching programs adapted to children with learning disorders.

ACKNOWLEDGMENTS

The authors extend their appreciation to Prince Sattam bin Abdulaziz University for funding this research work through project number (PSAU/2025/02/37518).

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