

The Relationship Between Visuospatial Memory and Difficulties in Learning Mathematics Among Fourth-Grade Primary School Pupils

علاقة الذاكرة البصرية الفضائية بصعوبات تعلم الرياضيات لدى تلاميذ السنة الرابعة ابتدائي

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Abstract:

The present study examined the relationship between visuospatial memory and difficulties in learning mathematics within the Algerian school context among fourth-grade primary education pupils. The study sample consisted of 40 male and female pupils drawn from three primary schools. Participants were administered a series of assessments, including the Peanut Test for visuospatial memory and the Zareki-R Battery for the Assessment of Number Processing and Calculation in Children. To address the research questions, a descriptive methodological approach was adopted as appropriate to the objectives of the study. Statistical analysis was conducted using SPSS (version 22). The findings revealed a statistically significant correlational relationship between visuospatial memory and difficulties in learning mathematics.

Keywords: visuospatial memory; difficulties in learning mathematics; primary education; SPSS statistical package.

ملخص:

تناولت الدراسة الحالية العلاقة بين الذاكرة البصرية الفضائية وصعوبات تعلم الرياضيات في الوسط المدرسي الجزائري لتلاميذ السنة الرابعة من التعليم الابتدائي حيث تكونت عينة الدراسة من 40 تلميذ وتلميذة موزعين على ثلاث مدارس ابتدائية تم إخضاعهم لمجموعة من الاختبارات منها اختبار Peanut للذاكرة البصرية الفضائية وبطارية تقييم معالجة الأعداد والحساب لدى الأطفال Zareki-r وللإجابة على تساؤلات الدراسة اعتمدنا على المنهج الوصفي الذي يلائم

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الدراسة وتم استعمال المعالجة الإحصائية عن طريق الحزمة الإحصائية SPSS 22 وخلصت نتائج الدراسة الى وجود علاقة ارتباطية ذات دلالة إحصائية بين الذاكرة البصرية الفضائية وصعوبات تعلم الرياضيات.

الكلمات المفتاحية: الذاكرة البصرية الفضائية؛ صعوبات تعلم الرياضيات؛ التعليم الابتدائي؛ الحزمة الإحصائية (SPSS).

Introduction

Learning disabilities are a relatively recent phenomenon and constitute a pervasive issue observed among learners of diverse genders, cultures, and linguistic backgrounds. Empirical studies conducted on these children have confirmed that they do not exhibit intellectual impairments; rather, they experience significant difficulties in language acquisition, particularly in reading and writing, while others encounter challenges in mastering arithmetic operations. Among the various categories of learning disabilities that have increasingly attracted scholarly attention are difficulties in learning mathematics. Mathematics is considered one of the academic subjects in which learners—especially at the primary level—experience substantial challenges, often resulting in apprehension toward the subject and avoidance of its study. According to (Ben Ali, 2012), learning difficulties represent a widespread phenomenon, particularly in recent years, with mathematics being the subject most prominently affected. It has been observed that a number of pupils struggle to acquire fundamental mathematical concepts.

“Mathematics constitutes a universal symbolic language encompassing all cultures and civilizations, regardless of their diversity or differing levels of advancement and development. It serves as a foundational language for numerous forms of human interaction and coexistence, particularly in relation to mathematical reasoning and inference, the comprehension of quantitative, logical, and mathematical relationships, as well as the cognitive and mental processes and activities it entails. Moreover, it underpins many other academic pursuits. The significance of mathematics derives from its status as one of the most essential instructional domains provided to all learners, enabling them to reason and solve problems, and equipping them to apply mathematical knowledge, principles, laws, and modes of reasoning across various aspects of everyday life.” (Ibrahim & Wahed, 2010, p. 326).

Scholars have differed in defining children with learning disabilities, owing to the difficulty of identifying these pupils despite their substantial presence in many schools. These children constitute a genuinely perplexing group of

students, as they do not exhibit a marked discrepancy between their actual academic performance and the level that is expected or aspired to. Who, then, is the child with learning disabilities? Such a child does not suffer from an intellectual disability, sensory impairment (auditory or visual), cultural or environmental deprivation, or emotional disturbance. Rather, the child experiences a disorder in the fundamental cognitive or psychological processes—including attention, perception, concept formation, memory, and problem-solving—the repercussions of which are manifested in an inability to acquire reading, writing, and arithmetic skills. This, in turn, leads to subsequent deficiencies, whether at the primary school level or later, in learning various academic subjects. Consequently, parents and teachers observe that this child fails to attain the same educational level as peers of the same age, despite possessing average or above-average intellectual abilities and intelligence quotient (Abdelsalam, 2009, p. 11).

Among the learning difficulties prevalent in school settings are difficulties in learning mathematics, which have not received the same degree of attention from researchers in psychology and educational sciences as reading difficulties and other learning disabilities. Arab and international studies indicate that the prevalence of mathematics learning difficulties among primary school pupils is approximately 6%, meaning that 6% of children of primary school age exhibit significant difficulties in arithmetic (mathematics). Moreover, arithmetic difficulties are as widespread as reading difficulties; however, this does not imply that every child with reading difficulties necessarily experiences difficulties in learning arithmetic (mathematics). Mathematics learning difficulties have become an important topic that has increasingly engaged researchers and specialists in the field of learning disabilities in recent years. This growing interest may be attributed to the intrinsic importance of mathematics itself. Mathematics constitutes an intellectual activity that contributes, on the one hand, to the development of pupils' cognitive capacities and, on the other, to the expansion of their knowledge and arithmetic and geometric skills, which extend into their social and cultural environments. Accordingly, mathematics is regarded as one of the essential and fundamental disciplines taught across all levels of education. "Piaget's studies indicate that children learn primarily through interacting with and manipulating objects, and this continues until approximately twelve years of age. If children's minds are not cognitively stimulated in mathematics through both concrete and abstract experiences during the stages of concrete and formal operations between the

ages of eleven and twelve, their capacity to acquire mathematical knowledge becomes disrupted, processes of discovery diminish, and ultimately decline to their lowest level” (El Zayat, 2008, pp. 340-342).

The manifestations of difficulty among children with mathematics learning disabilities are evident in their performance of mathematical tasks and in their impaired comprehension of mathematical concepts, such as understanding symbols and terminology. These difficulties also include deficits in perceptual skills, such as reading mathematical signs, and weaknesses in attentional skills, manifested in errors when printing or copying numbers. Hummel and Humes (1984) further noted that children and adults with mathematics learning disabilities exhibit difficulties in number comprehension, understanding spatial concepts, and performing arithmetic operations (addition, multiplication, subtraction, and division), as well as an inability to recall mathematical facts and difficulty solving word problems presented in sentence form (Ziada, 2006, pp. 40-45).

Research findings accumulated over two decades likewise indicate an association between memory dysfunction and the core problems experienced by children and adults with learning disabilities. Subfield research on learning disabilities has demonstrated that deficits in working memory underlie the difficulties encountered by students with reading and mathematics disabilities (Swanson & Siegel, 2001, p. 13).

Studies have also shown that short-term memory deficits generate multiple difficulties due to their substantial impact on how students process numerical information, an effect that becomes more pronounced in the presence of long-term memory weaknesses. A student with impaired short-term memory, for example, cannot mentally solve the arithmetic problem $(78 + 47)$ without the aid of paper and pencil, as the task requires tracking a sequential set of steps, and the omission of any step leads to an incorrect solution. Weak memory also results in students forgetting some or all of the instructions provided by the teacher. Working memory difficulties include problems with sequencing, losing track while counting or constructing tables, difficulty moving backward or forward in a sequence, difficulty remembering steps in multi-stage operations, and difficulty recalling basic arithmetic facts (numbers). Students may also be unable to remember the meanings of different symbols, forget previously learned procedures rapidly, recite the entire multiplication table to determine, for instance, the result of (3×9) , and forget the question before beginning to formulate an answer (Abu AL Diyar, 2015, pp. 47-48).

Mayring and Wimmer (2000) indicated that children with general learning difficulties in reading, writing, and mathematics exhibit deficits across all domains of working memory performance, whereas children with behavioral or emotional problems demonstrate typical performance on memory-related tasks. Visuospatial memory is also associated with mathematical abilities. It has been noted that the functions of visuospatial memory may be conceptualized as a mental blackboard upon which numbers, place value, numerical order, and column alignment in counting and calculation are represented. Children with weakened visuospatial memory skills lack sufficient capacity on this mental blackboard to retain relevant numerical information (Abu Al Diyar, 2012, p. 71/82).

Clark and Campbell (1991) found that impairments in visuospatial memory and verbal memory exert a strong influence on mathematical performance. Similarly, Fletcher (1985) reported that when children with mathematics learning difficulties were administered two tasks—one assessing verbal memory and the other assessing nonverbal memory—they demonstrated poorer performance on nonverbal tasks compared to verbal tasks. Memory, in its various forms, may be defined in its simplest sense as the capacity to store and retrieve information (Ziada, 2006, pp. 162-163).

Metz-Lutz et al. (2004) conducted a standardization study of the Working Memory Test Battery for Children (WMTB-C), originally developed by Pickering and Gathercole (2001). This standardization was carried out on a sample of 730 children, including 98 children with learning difficulties requiring specialized educational support. These difficulties encompassed fine motor impairments and arithmetic difficulties. The findings indicated that children with fine motor and arithmetic difficulties demonstrated the lowest capacities at the level of the visuospatial sketchpad in comparison with the other two components of working memory (the central executive and the phonological loop) (El Zayat, 2008, p. 342).

In light of the preceding studies and theoretical literature, the following general research question was formulated:

Is there a statistically significant correlational relationship between visuospatial memory and difficulties in learning mathematics among fourth-grade primary school pupils?

General Hypothesis:

There exists a statistically significant correlational relationship between visuospatial memory and difficulties in learning mathematics among fourth-grade primary school pupils.

Study Significance:

The significance of this study lies in identifying the relationship between visuospatial memory and difficulties in learning mathematics among fourth-grade primary school pupils within the Algerian school context. It seeks to highlight this population and to draw upon the findings obtained in order to achieve a deeper understanding of the role of complex cognitive processes—such as visuospatial memory—in the learning process.

1. Definition of Study Terms:

- **Visuospatial Memory:** According to Alan Baddeley (2002), visuospatial memory is a component of working memory and constitutes a specialized system responsible for the temporary active processing and storage of visuospatial information in accordance with task demands. Visuospatial memory receives information either through sensory input or from long-term memory (Baddeley, 2002, p. 85).
- **Operational Definition:** It refers to the scores obtained by the study participants through the administration of the Peanut (Clown) Visuospatial Memory Test.
- **Mathematics Learning Difficulties:** According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), dyscalculia (mathematics learning difficulties) is defined as difficulties in processing numerical information, learning mathematical facts, and performing accurate or fluent calculations (American Psychiatric Association, 2013, p. 36).
- **Operational Definition:** It refers to the scores obtained through the administration of the Algerian-adapted version of the ZAREKI-R Battery for the Assessment of Number Processing and Calculation in Children.

1.1 Field Study:

1.1.1 Study Methodology:

This study adopted the descriptive method, which is consistent with the nature and problem of the research. The descriptive method is defined as a scientific research strategy based on identifying the relationship between two or more variables—whether positive or negative, direct or inverse—primarily concerned with describing relationships without determining their underlying causes.

1.1.2 Study Sample:

- The study sample comprised 151 male and female fourth-grade primary school pupils, distributed across three schools and six classes. The researcher selected the sample according to a set of criteria, namely:
- Age: Between 9 years (108 months) and 11 years and 3 months (135 months).
- Intelligence: Pupils were required to demonstrate average or above-average intelligence, operationalized as obtaining a score of 90 or higher on the Draw-a-Man Test, in order to exclude intellectual disability.
- Low achievement in mathematics: Determined based on teachers' observations and pupils' academic results in the first and second terms of the 2022/2023 academic year.
- Sensory impairments: The researcher excluded children presenting hearing impairments or uncorrected visual impairments, as the diagnosis of mathematics learning difficulties presupposes the absence of such conditions.

Table 01: Percentage distribution of the study sample following the application of the selection criteria.

Educational Institution	Total Number of Pupils (N = 151)	Number of Selected Pupils and Percentage After Applying Sampling Criteria	Study Sample Size
Mahmoudi Al-Madani School	15	16 pupils, representing 31.37%	40 pupils (26.49%)
Rachidi Moulay Ahmed School	53	13 pupils, representing 24.52%	
Bakri Ahmed School	47	11 pupils, representing 23.40%	

Source: The Authors.

Based on the criteria established for sample selection, the researcher obtained a sample of 40 pupils, representing 26.49% of the total number of pupils enrolled in the three educational institutions, which comprised 151 pupils. It should be noted that this sample (40 pupils) ultimately constituted the study sample upon which the Draw-a-Man Test, the ZAREKI-R Battery for the Assessment of Number Processing and Calculation in Children, and the Peanut Visuospatial Memory Test were administered.

1.2 Study Instruments:

- ZAREKI-R Battery for the Assessment of Number Processing and Calculation in Children

The battery was adapted and standardized for the Algerian context by the researcher Lamia Hassan (2011). It targets children aged between 6 and 11 years.

The primary objective of the battery is to identify the specific difficulties experienced by each child, which may vary and differ in nature, even though they all may culminate in the manifestation of dyscalculia. This detailed analysis of calculation and/or number-processing difficulties, combined with a psychological and neuropsychological assessment, and taking into account the socio-cultural and educational environment, allows for the selection of appropriate intervention strategies tailored to each child.

The battery comprises the following subtests:

- Dot Counting.
- Backward Oral Counting.
- Number Dictation.
- Oral Mental Calculation.
- Number Reading.
- Number Positioning on a Vertical Scale.
- Digit Span.
- Oral Comparison of Two Presented Numbers.
- Visual Estimation of Quantities.
- Qualitative Estimation of Quantities in Context.
- Orally Presented Arithmetic Word Problems.
- Comparison of Two Written Numbers.

2. Peanut Visuospatial Memory Test (Clown Test)

This instrument consists of a clown figure drawn on an A4 sheet, bearing a set of colored discs distributed across various parts of its body. The examinee is presented with the model image containing the required number of discs, which is displayed on the table for a few seconds, with a maximum exposure time of five (05) seconds. The image is then immediately covered and, throughout all test items from beginning to end, replaced with a single blank image placed before the examinee. The examinee is required to recall the number of discs, their colors, and their positions, and to affix them onto the blank clown drawing accordingly.

This measure relies on the storage and processing of information and requires the use of simultaneous processing contexts. It assesses perceptual organization, immediate visual memory, spatial ability, and organizational skills.

It also aims to measure visuospatial memory and is distinguished by its capacity to differentiate between the internal scribe that retains spatial stimuli and spatial orientation, on the one hand, and the visual store that preserves visual information (color, shape, brightness), on the other. Furthermore, the test reveals the developmental progression of memory in accordance with the evolution of analytical strategies and storage capacities.

2.1 Presentation of Results:

2.2 Results of the ZAREKI-R Battery for the Assessment of Number Processing and Calculation in Children:

Table (02): Presents the results of the sample participants on the ZAREKI-R test

Case	Dot Counting	Backward Oral Counting	Number Dictation	Oral Mental Calculation	Number Reading	Number Placement on Vertical Scale
1	4	0	3	2	4	6
2	6	1	4	2	5	3
3	6	1	6	8	11	7,5
4	5	4	5	10	13	9
5	4	1	4	2	2	3
6	4	4	3	2	2	4
7	6	1	6	6	4	6
8	4	2	4	9	4	8
9	4	0	2	0	0	3
10	4	0	5	4	4	6
11	6	2	13	7	4	10
12	6	3	11	15	16	10
13	3	3	2	4	4	3
14	5	3	15	25	14	10
15	5	1	6	12	6	9
16	3	0	2	0	0	3
17	6	0	6	10	5	6
18	5	0	5	8	6	4,5
19	6	2	11	20	14	16,5
20	6	3	16	28	16	14,5
21	6	1	10	9	6	10
22	4	1	5	8	4	9

23	4	0	3	4	2	4
24	5	2	6	10	6	8
25	5	3	16	14	10	12
26	4	3	6	14	6	7,5
27	3	0	4	7	6	6
28	4	1	2	0	3	4,5
29	5	0	3	6	4	6
30	3	1	2	0	2	4,5
31	6	2	5	8	6	18
32	5	3	11	15	6	11
33	4	0	3	4	0	3
34	6	2	4	6	4	6
35	4	0	3	4	2	3
36	3	1	3	6	4	6
37	4	0	2	0	2	3
38	4	2	5	6	4	6
39	3	1	2	4	2	3
40	4	1	3	6	6	4,5
Digit Reordering	Comparison of Two Numbers (Oral)	Visual Estimation of Quantities	Qualitative Estimation in Context	Orally Presented Arithmetic Problems	Comparison of Two Written Numbers	Total Raw Score
9	7	2	4	0	7	39
7	8	4	4	0	5	42
11	10	4	7	1	7	68,5
11	9	5	5	0	6	71
8	0	0	4	0	1	21
5	9	5	7	0	4	44
8	8	3	4	0	4	48
10	10	4	4	0	10	59
5	7	4	2	0	4	26
8	7	2	2	2	6	42
12	11	4	6	2	9	74
13	12	4	4	2	7	90
7	0	2	2	0	0	23
18	8	5	4	2	4	95
11	10	4	5	1	10	69
6	7	3	5	0	6	29
8	9	3	5	0	6	56
6	8	2	2	0	6	46,5
12	7	4	5	5	7	97,5
18	8	3	4	4	10	112,5
8	10	4	6	2	5	69
11	7	2	1	0	4	45

6	7	1	4	0	4	33
7	9	2	1	0	5	54
12	8	2	2	0	7	79
10	8	3	5	1	4	61,5
9	7	2	4	0	4	43
7	7	1	4	0	4	30,5
7	8	3	5	0	4	44
6	7	0	1	0	1	21,5
14	14	5	6	5	10	85
16	14	4	6	4	7	86
7	7	0	1	0	1	23
9	8	3	6	0	7	52
6	7	3	1	0	1	28
9	7	4	4	0	4	42
6	0	3	1	0	1	16
9	8	4	5	0	1	45
6	0	3	1	0	1	20
7	7	4	6	2	4	47,5

Source: The Authors.

Note: The results of the Digit Span Test are not included in the total composite score of the battery.

From the preceding Table (2), it is observed that the scores of the study sample ranged between (3–6) on the Dot Counting subtest; (0–4) on the Backward Oral Counting subtest; and (2–16) on the Number Dictation subtest. On the Oral Mental Calculation subtest, scores ranged between (0–28), while on the Number Reading subtest they ranged between (0–16). Scores on the Vertical Number Placement subtest ranged between (3–18), and on the Digit Span subtest between (5–18). On the Oral Comparison of Two Numbers subtest, scores ranged between (0–14); on the Visual Estimation of Quantities subtest between (0–5); on the Qualitative Estimation of Quantities in Verbal Context between (2–7); on the Orally Presented Arithmetic Problems subtest between (0–5); and on the Written Comparison of Two Numbers subtest between (0–10).

Following the administration of the ZAREKI-R battery for the assessment of number processing and calculation in children (6–11 years), Algerian adapted version, it was observed that the majority of the study participants failed the Backward Oral Counting subtest and the Orally Presented Arithmetic Problems subtest. It is also noteworthy that most participants required extended time to respond to the test items and experienced difficulties in performing arithmetic operations and in identifying the correct and optimal procedures for solving them. They further demonstrated difficulties in solving orally presented

problems, as well as in visual estimation of quantities and qualitative estimation of quantities within verbal contexts. These findings are reflected in the generally low performance of the study sample across the various subtests.

Table (03): Descriptive Analysis of the ZAREKI-R Test

Test	N	Mean	Sd	Highest Score	Lowest Score
ZAREKI-R Test	40	49.75	28.34	112.5	16

Source: The authors.

As shown in Table (03), the mean score of fourth-grade primary school pupils on the ZAREKI-R test was 49.75, which is lower than both the normative sample mean and the theoretical mean of the test. The standard deviation of the scores was 28.34. The highest score recorded was 112.5, while the lowest score was 16.

2.3 Results of the Peanut Visuospatial Memory Test:

Table (4): Results of the Sample Participants on the Peanut Visuospatial Memory Test

Case	25 / Score	Percentage
1	9	%36
2	7	%28
3	11	%44
4	11	%44
5	6	%24
6	10	%40
7	8	%32
8	7	%28
9	6	%24
10	9	%36
11	10	%40
12	11	%44
13	6	%24
14	10	%40
15	10	%40
16	6	%24
17	9	%36
18	8	%32
19	9	%36
20	11	%44
21	8	%32
22	8	%32
23	7	%28
24	9	%36
25	10	%40

26	7	%28
27	9	%36
28	6	%24
29	10	%40
30	6	%24
31	10	%40
32	9	%36
33	6	%24
34	7	%28
35	6	%24
36	7	%28
37	8	%32
38	8	%32
39	6	%24
40	10	%40

Source: The Authors.

Table (4) indicates that the results of the administration of the Peanut (Clown) Visuospatial Memory Test revealed weakness in visuospatial memory, as the success rates for the various members of the sample did not exceed 50%. The percentages ranged between 24% and 44%, which reflects the presence of difficulties among the sample participants at the level of visuospatial memory.

Table (05): Descriptive analysis of the Peanut Visuospatial Memory Test

Test	N	Mean	Sd	Highest Score	Lowest Score
Visuospatial Memory Test	40	8.27	1.7	11	6

Source: The Authors.

Table (5) indicates that the arithmetic mean of the research sample on the Peanut Visuospatial Memory Test was 8.27, with a standard deviation of 1.70. The highest score obtained was 11, representing 44%, whereas the lowest score was 06, representing 24%.

3. Study of the Relationship between Visuospatial Memory and Mathematics Learning Difficulties:

To verify the hypothesis positing the existence of a statistically significant correlational relationship between visuospatial memory and mathematics learning difficulties, statistical analysis was conducted using the SPSS22 software package. Pearson's correlation coefficient was calculated between the study variables, as it provides information regarding both the magnitude and the direction of the relationship.

Table 06: Illustrates the relationship between visuospatial memory and mathematics learning difficulties

Variables	r	DF	Sig Level	Decision
Visuospatial Memory and Mathematics Learning Difficulties	**0.74	38	0.01	Statistically Significant
Sample Size	40			

Source: The Authors.

Table (6) indicates that the correlation coefficient between visuospatial memory and mathematics learning disabilities was estimated at 0.74, with a significance level of $p = 0.01$. This reflects a statistically significant and strong relationship, thereby permitting acceptance of the hypothesis positing the existence of a statistically significant correlational relationship between visuospatial memory and mathematics learning disabilities.

4. Analysis of the Results:

The field results of the study, following administration of the ZAREKI-R battery for the assessment of number processing and calculation in children (Algerian adapted version) and the PEANUT test for measuring visuospatial memory, were analyzed using SPSS version 22 to test the study hypothesis. This was conducted through calculation of Pearson's correlation coefficient between the two study variables, which yielded a value of 0.74, statistically significant at the level of $p = 0.01$. This value indicates a strong positive relationship between visuospatial memory and mathematics learning disabilities. Accordingly, the hypothesis asserting the existence of a statistically significant correlational relationship has been confirmed.

These findings are supported by the study conducted by Swanson (2004), which demonstrated a strong relationship between working memory and mathematics learning disabilities. Individuals with mathematics learning disabilities lack the capacity to utilize memory efficiently and appropriately and exhibit an inability to solve mathematical problems, attributable to deficits at the level of working memory, particularly visuospatial memory (Lee Swanson & Frankenberger, 2004, p. 490).

The results obtained in the present study are also consistent with the findings of Ben Ali (2012), which revealed a relationship between mathematics test performance and working memory in general, and visuospatial memory and spatial orientation in particular, with correlation coefficients estimated at 0.99, 0.96, and 0.85 respectively, all statistically significant at $p = 0.01$ (Ben Ali, 2012, pp. 211, 214).

Similarly, the study conducted by Makki (2020) concluded that statistically significant differences exist between typically developing students and intellectually gifted students with arithmetic learning disabilities in visuospatial working memory and its subcomponents (pattern recall and visuospatial sequencing), with differences favoring the group with higher mean ranks (typically developing students), and no differences attributable to gender (male–female) (Makki, 2020, pp. 86-87).

Likewise, the study by Al-Mutlaq (2024) found a high correlation between difficulties in learning arithmetic, difficulties in learning reading, and developmental learning difficulties. It further demonstrated that verbal developmental difficulties are more critical in relation to reading and academic difficulties, whereas nonverbal developmental difficulties are more salient in arithmetic. For both grade levels examined, visuospatial processing emerged as the most important variable in arithmetic, while verbal working memory was identified as the most important factor in reading.

In mathematics for the second and third grades, verbal–visual processing is more significant than nonverbal memory. In reading, however, nonverbal memory is more important than verbal–visual processing in the second grade, whereas in the third-grade verbal–visual processing emerges as the most salient factor. It may therefore be concluded that these capacities constitute robust predictors of achievement in reading and mathematics and contribute to academic difficulties (Mutlaq, 2024, pp. 130-131).

The findings of the present study are inconsistent with those reported by Dib (2011), whose results indicated an inverse relationship between visuospatial memory and performance on the subtraction test, estimated at 0.23 and statistically non-significant. The researcher attributed these results to students' difficulties in comprehending the terminology employed, interpreting the instructions and data presented to them, and applying them effectively to arrive at a solution to the mathematical problem, in the absence of any impairment or disorder in working memory and its components (Dib, 2011, pp. 95-96).

Undoubtedly, based on the results obtained, working memory in all its components constitutes a fundamental psychological process characterized by deficits among students with mathematical learning difficulties. This is clearly demonstrated by the findings of the present study, which revealed impairments in the visuospatial memory component, given that visuospatial memory represents a core developmental difficulty and one of the essential psychological processes underlying the learning of mathematics.

5. Conclusion:

The findings obtained in this study, which demonstrate a statistically significant correlational relationship between visuospatial memory and mathematics learning difficulties among fourth-grade primary school pupils, underscore the substantial role of working memory—and visuospatial memory in particular—in the learning process in general and in mathematics learning specifically. Any impairment at the level of visuospatial memory is associated with difficulties in the comprehension, storage, and effective processing of information. In order for a child to solve mathematical problems fluently and straightforwardly, without unnecessary complexity, a robust memory capacity is essential. This calls upon specialists in the field of learning disabilities to design individualized and group-based remedial programs that place greater emphasis on memory in general, and on working memory in particular, across its various components, given the pivotal role memory plays in the learning process.

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